PART (RULE NO.) 32
relating to
SKI TOWS AND OTHER PASSENGER TRAMWAYS
(Statutory Authority: Labor Law Sections 21, 27, 200, 202-c)
Title 12 State of New York Official Compilation of Codes, Rules and Regulations
(12 NYCRR PART 32)

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Part 32 of Title 12 of the New York Official Compilation of Codes, Rules and Regulations is amended to read as follows:

A Rule Relating To
SKI TOWS AND OTHER PASSENGER TRAMWAYS
(Statutory Authority: Labor Law Sections 21, 27, 200, 202-c)
Title 12 State of New York Official Compilation of Codes, Rules and Regulations (12 NYCRR PART 32)

SUBPART 32-1
GENERAL PROVISIONS

Section 32-1.1 Title and citation. Within and for the purposes of the Department of Labor this Part (rule) may be known as Industrial Code Rule No. 32 relating to ski tows and other passenger tramways and may be cited as Rule 32 as an alternative and without prejudice to its designation and citation established by the Secretary of State.

32-1.2 Application. Except as otherwise specifically provided, this Part (rule) applies to all ski tows and other passenger tramways to which section 202-c of the Labor Law applies and to the owners and operators of such equipment and to their employees. It does not apply to cog railways, or to material handling equipment.

32-1.3 Purpose and intent of part (rule).

(a) It is the purpose and intent of this Part (rule) to require reasonable and proper guarding against personal injuries to employees and the public in the use and operation of ski tows and other passenger tramways. It is recognized that certain dangers and risks are inherent in machines of this type and their operation. It is also recognized that inherent and other risks or dangers exist for those who are in the process of approaching, loading, unloading, and departing from passenger tramways. This rule is intended to result in passenger tramways that are designed, constructed, operated, and maintained in a manner that helps reduce danger and exposure to risk to passengers and maintenance and operational personnel. It is intended to be construed accordingly and to be read, construed and applied with sections 27, 200 and 202-c of the Labor Law.

(b) No provision of this Part (rule) as amended effective (insert date adopted), requires or is intended to require any modifications to any passenger tramway whose plan review was completed prior to the effective date of this code, and which complies with prior editions or versions of this Part (rule) or with variations granted and in effect thereto, except as may be needed to carry out the provisions of subdivision (d). Existing passenger tramways, when removed and reinstalled, shall be classified as new installations.

(c) New installations and those with plan reviews completed after the effective date of this Code shall be in compliance with this Part (rule).

(d) A passenger tramway modification shall be defined as an alteration of the current design of the passenger tramway which results in:

(1) a change in the design speed of the system;

(2) a change in the rated capacity by changing the number of carriers, spacing of carriers, or load capacity of carriers;

(3) a change in the path of the rope;

(4) any change in the type of brakes and/or backstop devices or components thereof;

(5) a change in the structural arrangements;

(6) a change in power or type of prime mover or auxiliary engine;

(7) a change to control system logic.

(e) Adoption of technological improvements in materials and advances in techniques is essential to enable the industry to keep pace with progress. If a designer or manufacturer proposes to use materials or methods not covered by this standard, those materials, methods, or both, shall be clearly identified. And complete design and test information shall be provided to the purchaser or owner and the Commissioner.

32-1.4 Definitions.

(a) Aerial lift. Ropeways on which passengers are transported in cabins or on chairs and that circulate in one direction between terminals without reversing the travel path.

(b) Aerial Tramway. Ropeways on which passengers are transported in cable-supported carriers and are not in contact with the ground or snow surface, and in which the carrier(s) reciprocate between terminals. Also called a reversible.

(c) Approved. In respect to a device or material: in compliance with a subsisting resolution of approval adopted by the board (prior to 1975); in respect to action by the Commissioner: made the subject of a resolution of approval.

(d) Attendant. The individual assigned to particular duties or functions in the operation of a passenger tramway (also see conductor).

(e) Basic Life Support (BLS). Medically acceptable non-invasive procedures used to sustain life.

(f) Bicable system. A system that uses separate track cable(s) to support the carriers and separate rope(s) to control motion of the carriers.

(g) Board. The Industrial Appeals Board of the State of New York and prior to 1975, the Board of Standards and Appeals of the State of New York.

(h) Brake. A brake is a device which, if applied, accomplishes braking.

(i) Braking. Braking is the process of absorbing energy in order to maintain or reduce the speed of the tramway.

Note: The typical resistance's effective in absorbing the energy of a tramway include:

(a) the inherent resistance in the system (e.g., friction);

(b) incidental resistance (e.g., slope, gravity, wind);

(c) applied resistance (e.g., brake, power unit ramping down)

(j) Bull wheel. A bull wheel is a terminal sheave that deflects the haul rope 150 degrees or more. When under power, the sheave is referred to as a drive sheave (or drive bull wheel); when

acting as a movable tensioning device, it is referred to as a tension sheave (or tension bull wheel); and when it is acting simply as a fixed return for the haul rope, it is referred to as a fixed return sheave (or fixed return bull wheel).

(k) Cabin. An enclosed or semi-enclosed compartment for transporting passengers; most often used on aerial tramways and detachable grip aerial lifts.

(l) Carrier. The structural and mechanical assemblage in or on which the passenger of a tramway system is transported. Unless qualified, the carrier includes, for example, the carriage or grip, hanger, and cabin or chair.

(m) Chair. A chair is an open or semi-open seat used on an aerial lift.

(n) Chair height. Chair height (seat height) is the distance between the top surface, including padding, of the chair seat to the loading or unloading point surface. This distance shall take into account the longitudinal swing of the chair, which lowers the chair height.

(o) Circuit, Electrical Power. The electrical power circuit is a normally de-energized circuit which when energized provides electrical power to the drive motor, other lift-related electrical power equipment, or both.

(p) Circuit(s), Bypass. A circuit(s) that partially or entirely circumvents monitoring devices and remote signal inputs of a malfunctioning operating circuit to allow operation of the system, under the specific conditions set forth for each tramway type.

(q) Circuit(s), Control Power. The control power circuit(s) is a normally de-energized circuit(s). When energized this circuit provides power to the operating control circuit.

(r) Circuit(s), Operating Control. The operating control circuit(s) is a normally de-energized circuit(s). When energized these circuits provide power to all electrical control functions responsible for start, stop, run, and speed control. De-energizing the operating control circuits causes the system to stop or remain at rest.

(s) Commissioner. The Commissioner of Labor of the State of New York.

(t) Conductor. An attendant assigned to duties or functions in an enclosed carrier (also see supervisor).

(u) Conveyor. A class of outdoor transportation wherein skiers, or passengers on recreational devices, are transported uphill on a flexible moving element.

(v) Conveyor Belt. The flexible moving element on a conveyor that consists of multiple tread plates or belting.

(w) Deropement. The term used when a rope or cable leaves its operating position relative to the groove of a sheave, carriage wheel, or saddle.

(x) Design Capacity. The number of passengers per hour (pph) established by the designer as the current ultimate operating capability of the facility in the direction specified.

(y) Detachable grip lifts. Tramway systems on which carriers circulate around the system alternately attaching to and detaching from a moving haul rope(s). The tramway system may be monocable or bicable.

(z) Electromagnetic Wire Rope Testing. Electromagnetic wire rope testing (EWRT) is any of several nondestructive testing procedures which derive indications of wire rope condition from sensors measuring electromagnetic flux in or adjacent to the rope resulting from imposition of a known flux within the wire rope.

(aa) Emergency Shutdown. A shutdown is a stop which occurs when it is detected that the normal stop, service stop, or both, have failed to function properly and takes priority over all other stop

functions or devices. When initiated, one or more brakes shall be applied and power shall be removed from the power unit. Removing power from the power unit shall mean:

(1) Electric Motor: Full load rated contactor or circuit breaker disconnect devices operates to shut down the motor.

(2) Internal Combustion Engine: Engine shuts down (see also normal stop).

(ab) Fiber rope. A stranded or braided rope made from natural or synthetic fibers.

(ac) Fixed Grip Lifts. Tramway systems on which carriers remain attached to a haul rope. The tramway system may be either continuous or intermittent circulating, and either monocable or bicable.

(ad) Foot Passenger. A foot passenger is any person utilizing a passenger tramway who is not a skier.

(ae) Gondola. A name used to describe detachable grip aerial lifts using cabins.

(1) A cabin used on an aerial lift.

(af) Gravity Foundation. A Foundation designed to stand by itself, relying only on soil bearing conditions and it's own weight to support a structure without movement.

(ag) Grips, Detachable. Haul rope grips that are detached from the moving haul rope at station(s) or terminal(s) during normal operation.

(ah) Grips, Fixed. Haul rope grips that remain continuously attached to the haul rope during normal operation.

(ai) Grips, Haul Rope. Haul rope grips are those devices by which carriers are attached to the haul rope.

(aj) Guard rail. A horizontal rail secured to uprights erected along sides of loading and unloading areas not used for access or egress to prevent persons from falling or contacting dangerous moving parts.

(ak) Hanger. Structural element connecting a cabin, chair, or other passenger-carrying device to the track cable carriage or haul rope grip.

(al) Haul Rope. A wire rope used on a passenger tramway that provides motion to a carrier(s) and is powered by the drive sheave.

(am) Hereafter. On or after effective date of this code.

(an) Length. Of a tramway, the maximum possible distance of point to point passenger travel.

(ao) Monocable system. A system that uses a single haul rope to both support and control motion of the carriers.

(ap) Normal Stop. A normal stop is a stop in which the prime mover may be involved in braking and in which the tramway comes to rest in a controlled manner (also see service stop).

(aq) Operator. A person qualified to operate a tramway, lift or tow (see also attendant).

(ar) Overhauling. Overhauling is an operating condition in which unbalanced loading is sufficient to overcome line and drive friction and create a torque, acting to produce rotation of drive sheave in either direction when all brakes and the prime mover are inactive.

(as) Owner. The owner of the tramway, or the lessee of the whole thereof, or the agent in charge of the tramway. The term includes the State of New York, any political subdivision thereof, and any body corporate.

(at) Passenger Ropeway. Passenger ropeway includes all devices that carry, pull, or push passengers along a level or inclined path (excluding elevators) by means of a haul rope or

other flexible element that is driven by a power unit remaining essentially at a single location.

(au) Passenger Tramway. Passenger Tramways shall include Aerial Tramways, Aerial Lifts, Passenger ropeways, and other towing devices.

(av) Programmable Logic Controller (PLC). Any solid-state automatic device that has programmable memory and is used to process input and output logic functions.

(aw) Recreational Device. Tube, sled, luge, cart, etc. Except a skier, which is pulled uphill on the surface with a passenger riding on device.

(ax) Qualified Engineer. A Qualified Engineer is an engineer who is registered as a Professional Engineer in his/her state of residency or primary practice.

(ay) Rated capacity. The maximum load which a tramway is designed and installed to handle at the rated speed.

(az) Rated speed. The speed at which a tramway designed to operate.

(ba) Rope. Unless otherwise specified, the term, rope, shall mean wire rope, which consists of several strands twisted together. (The terms, rope, wire rope, and cable, are interchangeable, except where, by the context, the general term, cable, refers to either a wire rope or strand used as a track cable.)

(bb) Ropeway. See Passenger Ropeway.

(bc) Rotation-resistant rope. Wire rope consisting of inner strands laid in one direction covered by a layer of strands laid in the opposite direction. This has the effect of counteracting torque by reducing the tendency of the finished rope to rotate.

(bd) Service stop. A service stop is a stop that occurs in a controlled manner without the power source being involved in the braking process (also see emergency shutdown).

(be) Shall. The word "Shall" is always mandatory.

(bf) Sheaves. Sheaves are pulleys or wheels grooved for rope.

(bg) Sheave unit. A sheave unit is the largest assembly of sheaves that are independently articulated on a common shaft.

(bh) Sheave, counterweight. A counterweight sheave is a sheave used in the counterweight reeving system that is active during normal operations.

(bi) Sheave, deflection. A deflection sheave is a terminal sheave that deflects the haul rope at least 10 degrees but less than 150 degrees.

(bj) Sheave, terminal. A terminal sheave is a haul rope sheave at a terminal that rotates continuously when the haul rope is moving and deflects the haul rope by an angle of 10 degrees or more.

(bk) Sheaves, diameter of. Wherever the term, diameter, is used in specifying sheaves, it refers to the diameter at the bottom of sheave grooves (tread diameter).

(bl) Sheaves, haul rope. Haul rope sheaves are sheaves that support or hold down the haul rope at towers or terminals. (The angle of rope deflection is usually small.)

(bm) Skier. A skier is any person utilizing a device that attaches to at least one foot or the lower torso for the purpose of sliding on a slope. The device slides on the snow or other surface of a slope and is capable of being maneuvered and controlled by the person using the device.

(bn) Skimobile. A type of lift where the passengers are transported in open or enclosed cars which ride on a rigid structural system and are propelled by a wire rope or chain.

(bo) Stop gate. A stop gate is a type of automatic stopping device that, when actuated by a passenger's weight, contact, or passage, will automatically stop the tramway.

(bp) Stop. A stop is function initiated by a command that decelerates the tramway and brings it to rest (also see brake).

(bq) Strand. Unless otherwise specified, "strand" shall mean wire strand, consisting of several wires twisted together, as compared with wire rope which consists of several strands twisted together.

(br) Supervisor. A person in responsible charge of passenger tramway operations and personnel (also see operator).

(bs) Surface lifts. Surface lifts are those tramways on which passengers are propelled by means of a circulating overhead wire rope while remaining in contact with the ground or snow surface. Connection between the passengers and the wire rope is by means of a device attached to and circulating with the haul rope, known as a "towing device".

(bt) Towing device. A carrier, fixed or detachable, used on surface lifts to pull passengers. Classification or description is by the seat configuration and action of the extension element (i.e., J-Bar, T-Bar, Platter or similar).

(bu) Tow path. The path along which a passenger is towed on a surface lift or tow from the load point to a point beyond the stop gate equal to 150% of the distance required to stop the empty surface lift or tow operating at full speed.

(bv) Towing handle. A device attached to a wire rope on a wire rope tow to pull passengers (i.e., handle, button, platter).

(bw) Tows, fiber rope. Fiber rope tows are those ropeways on which the passengers grasp the circulating fiber rope and are thus propelled while supported by the ground or snow surface. The haul rope remains adjacent to the passenger track at an elevation that permits passengers to maintain their grasp on that rope throughout that portion of the tow length that is designed to be traveled.

(bx) Tows, wire rope. Wire rope tows are those ropeways on which the passengers grasp a towing handle attached to a circulating wire rope and are propelled in one direction only by that rope while remaining in contact with the ground or snow surface. The haul rope remains adjacent to the track of the passengers at an elevation that permits them to maintain their grasp on the towing handle throughout that portion of the tow length that is designed to be traveled.

(by) Track cable saddle. A track cable saddle is a component designed to directly support a track cable.

(bz) Track cable. A wire rope or strand used to support a carrier or carriers on a bicable system.

(ca) Tramway. As used in this Part (rule), this term refers to passenger tramway and its definition.

(cb) Transmission line. A light, power or communication conductor operating at a potential exceeding 50 volts.

32-1.5 Quality program.

(a) The manufacturer, supplier, and installer shall maintain quality programs to verify that the installed parts conform to design requirements.

(b) Design. A Qualified Engineer shall design, or be in responsible charge of the design of, new

and modified passenger tramways.

(c) Construction. For all tramways, other than rope tows and wire rope tows, a Qualified Engineer shall certify to the owner that the construction and installation has been completed in accordance with the final design plans and specifications.

32-1.6 General requirement of safety. A ski tow or other passenger tramway shall be so designed, constructed, operated and maintained as to provide reasonable protection against personal injuries to employees and the public. No person knowingly shall suffer or permit such device to be used for passenger transportation when it is so defective in any respect as to be reasonably capable of causing personal injury. When so defective, a ski tow or other passenger tramway shall constitute machinery in a dangerous condition within the meaning of subdivision 2 of section 200 of the Labor Law.

32-1.7 Approval of materials and devices. Except as hereinafter specifically provided, approval by the Commissioner is not required in respect to a passenger tramway or any material or device associated therewith. A material or device which the board (prior to 1975) or Commissioner has approved pursuant to section 21 of the Labor Law for use in complying with this Part (rule) may be used, subject to the requirement of the resolution of approval, as if by the Part (rule) specifically authorized, any general or special provision of this Part (rule) notwithstanding.

32-1.8 Plans and specifications.

(a) Acceptance required. No person shall make an installation of a passenger tramway or make a major alteration thereto except in accordance with plans and specifications thereof previously found acceptable by the Commissioner on the basis of indicated compliance with this Part (rule). Plans and specifications shall be in the English language and dimensions shall be in inches and feet.

(b) Submission for acceptance. Plans and specifications and such alterations or revisions thereof as may be necessary shall be submitted in triplicate to the Commissioner by the owner or his authorized agent, together with such additional information as the Commissioner may require. Assembly drawings for all installations except, rope tows and wire rope tows, shall bear the seal and signature of a New York State licensed Professional Engineer. Tower structure, terminal structure, footing and foundation drawings, except for rope tows and wire rope tows, shall also bear the seal and signature of a New York State licensed Professional Engineer.

(1) Drawings shall contain: A list of major components, a statement confirming compatibility of the major components to the total system, and of the system to the site. Certification for each major component that it meets the requirements of this Code given by a Qualified Engineer and/or officer of the company which supplies the component. Major components are:

Drive motors
Gear reducers
Tensioning systems
Carriers
Rope grips
Tower sheave assemblies
Bullwheel assemblies

Brakes
Safety Circuits

32-1.9 Registration.

(a) Registration required. Operation of any passenger tramway without having filed with the Commissioner an application for a certificate of registration, or while a registration certificate is suspended, is prohibited. Operation of any passenger tramway without a current registration certificate is prohibited.

(b) Application for registration. The owner of each passenger tramway shall apply to the Commissioner on forms supplied by the Commissioner for initial registration of the tramway. The Commissioner, if satisfied on the basis of test and inspection that the tramway is in compliance with this Part (rule), shall issue a registration certificate to the owner. Each certificate shall relate to a specific tramway at a specific location and shall expire one year from the date of its initial issuance and thereafter on a date in each succeeding year as specified by the Commissioner unless renewed prior to such date. The Commissioner's signature and the date shall be placed upon the certificate when annual reinspection and test indicate conformity with this Part (rule). Where non-conformance with the provisions of this Part (rule) is found in the course of inspection or test the Commissioner may, at his discretion, remove and retain the certificate until the tramway is found to comply with the provisions of this Part (rule) at which time the Commissioner may reissue the certificate by endorsement thereof.

(c) Posting of certificate of registration. The certificate of registration for a tramway shall be posted in an appropriate, conspicuous place.

(d) Control of certificate. The Commissioner may by order repossess a certificate of registration and after a hearing on due notice suspend or cancel the same for good cause.

32-1.10 Personal injury report. By the close of the first business day following notification that any person may have sustained a serious personal injury connected with the operation or use of a tramway or a part thereof, the owner shall by telephone or otherwise report the same to the Commissioner.

32-1.11 Severability. If any provision of the Part (rule) or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of the Part (rule) which can be given effect without the invalid provisions or applications and to this end the provisions of this Part (rule) are declared to be severable.

32-1.12 Adoption of standards.

(a) The Commissioner of Labor adopts the following standards, as referenced in this Part and hereinafter referred to as provided below.

(1) NFPA 37 Standard for Stationary Combustion Engines and Gas Turbines, 1998 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. (hereinafter "NFPA 37")

(2) NFPA 30 Flammable and Combustible Liquids Code, 1996 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. (hereinafter "NFPA 30")

(3) NFPA 58 Liquefied Petroleum Gas Code, 2001 Edition, National Fire Protection

Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. (hereinafter "NFPA 58")

(4) Safety Standard for Mechanical Power Transmission Apparatus, 2000 Edition, The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990 (hereinafter "ASME B15.1")

(5) ANSI B77.1-1999 American National Standard for Passenger Ropeways - Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors - Safety Requirements, 1999 Edition, American National Standards Institute, 11 West 42nd Street, New York, NY 10036 (hereinafter "ANSI B77.1")

(6) NFPA 780 Standard for the Installation of Lighting Protection Systems, 1998 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. (hereinafter "NFPA 780")

(7) NFPA 70 National Electric Code, 1999 Edition, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. (hereinafter "NFPA 70")

(8) C2-1997 National Electrical Safety Code, 1997 Edition, Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 (hereinafter "NES C2")

(b) Copies of referenced material are available for copying and inspection at the New York State Department of Labor, Division of Safety and Health, W. Governor Averell Harriman State Office Building Campus, Building 12, Albany, New York or at the Department of State in Albany, New York.

SUBPART 32-2
GENERAL PROVISIONS
Aerial Tramways

Section 32-2.1 This Subpart covers aerial tramways on which passengers are transported in cable supported carriers and are not in contact with the ground or snow surface. Carriers reciprocate between the terminals, propelled and controlled by a haul rope operating through drive and tensioning equipment installed in the terminals.

(a) Aerial tramway systems may have a single carrier, or group of carriers, that move back and forth on a single path of travel; or, two carriers, or groups of carriers, oscillating between terminals on two (usually very nearly parallel) paths of travel. The systems may be monocable or bicable.

(b) Provisions of this Subpart envision a system having a reversible operating mode. Systems using a fixed attachment, individual carrier, grouped carrier, or chair, in a reversing operation (as opposed to continuous or intermittent circulation with stop-to-load feature) shall refer to Subpart 4 or this Part (rule) for applicable component requirements not covered in Subpart 2.

CHAPTER I - DESIGN AND INSTALLATION
Subchapter A - General

32-2.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-2.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the aerial tramway type and location:
- (1) electric power lines and their supports;
- (2) railways;
- (3) highways;
- (4) structures;
- (5) rock and earth slides, cave-ins, washouts, and the like;
- (6) snow creep and avalanches;
- (7) wind action;
- (8) icing;
- (9) ski slopes and trails;
- (10) rivers and gullies;
- (11) buried installations, including pipelines;
- (12) crossing or close proximity to other passenger tramways;
- (13) control of air space below, above, and adjacent to the installation;
- (14) carrier height above all surfaces;
- (15) passenger accessibility.

(b) RESERVED

32-2.4 Width of clearing. The clearing shall be wide enough to prevent adjacent vegetation from interfering with the aerial tramway. Carriers shall not contact trees or vegetation during operational surges, or during maximum design wind conditions, or both. Trees and other vegetation shall be cleared a minimum of 5 feet (1.53 meters) from haul ropes or track cables and carriers under normal (non-surge) operating conditions. Clearings shall be maintained to avoid washouts that might endanger the installation (see section 32-2.59).

32-2.5 Path of rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration.

(a) Vertical clearances. Along the line between terminal and intermediate station structures, the following minimum vertical clearances shall exist between the lower edge of the carrier or ropes and the terrain or other possible obstacles, including snow pack:
- (1) 5 feet (1.53 meters) shall exist between the lower edge of the carrier or ropes and the terrain or other possible obstacles, including snow pack;
- (2) 8 feet (2.44 meters) when foot passenger traffic is permitted under the line;

(3) 15 feet (4.57 meters) where skiing or controlled vehicle access is permitted under the line;

(4) 25 feet (7.62 meters) where public vehicle transportation is permitted underneath the aerial tramway line (roads, railroads, and the like).

(b) Horizontal clearances.

(1) The minimum clearance between two passing carriers, each inclined 20% from vertical, shall not be less than:
The larger of 3.28 feet (1 meter) or 3.28 feet (1 meter) plus the following:
0.004 (X-492) (feet) or 0.004 (X-150) (meters)
X = the chord distance, in feet (meters), from the point of the carriers passing to the nearest tower or track-cable supporting structure.

(2) The distance between haul ropes (or track cables), for the purpose of these checks, shall be considered as equal to the gage of the line.

(c) RESERVED

(d) Track cable saddles (bicable systems). Towers and terminals shall be arranged so as to keep the track cable in the saddles under the most adverse design operating and nonoperating conditions. Track cable restraining devices or provisions may be used, as required, at the discretion of the designer. These provisions shall not interfere with any track cable movement or any track cable brake operation. Maximum wind velocity and other design limits used for structures under nonoperating conditions and the limiting values intended for operating conditions shall be specified by the designer.

(e) Haul rope sheave units (bicable systems). Haul rope sheave units are generally of the support type. "Depression" or "hold-down" sheave units not covered by this Part (rule) shall be subject to the requirements of sections 32-1.7 and 32-1.8 of this Rule.

(f) Rope guidance (bicable systems). All line sheave units, including both high- and low-tower sheave assemblies, shall be provided with fair leads or guides to accomplish the following:

(1) permit the unobstructed passage of a carrier gripped to the haul rope, independent of the position of the haul rope guided by the fair leads, as the carrier approaches the sheave assembly;

(2) guide the haul rope into the sheave groove when it has been lifted in normal operations or for other reasons;

(3) provide the rope guidance necessary beneath sheave assemblies and adjacent structures to prevent entanglement of the haul rope as it is returned by the carrier to normal operating position from any location it may assume due to any anticipated operational displacement.

(g) Intermediate structures (bicable systems). Auxiliary intermediate structures (i.e., haul rope carriers and slack carriers) shall be provided to support sheave units as required to maintain a minimum clearances specified in section 32-2.5(a) of this rule**.**

32-2.6 Carrier speed. The maximum carrier speed shall be that specified by the designer and established as functional by testing and operational performance (see sections 32-2.12(b) and 32-2.29).

32-2.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include

dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal conditions. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) Structures. On bicable systems, torsional displacement of towers under the most adverse design conditions shall be limited to a value that will not cause deropement of the track cable from the saddle.

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost susceptible soil or solid rock. Foundations on rock shall be firmly anchored to solid rock, unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for protection of foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus wind acting simultaneously.

32-2.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power and the communication system shall be functional and audible during a power failure.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators shall be visible even in bright sunlight.

(c) An additional system of two-way voice communication from operating room to all carriers and to opposite terminal platform shall be provided where carriers are attended by a conductor.

32-2.9 Internal combustion engine installation.

(a) Fuel tanks for combustion engines. Fuel tanks shall have adequate capacity to permit uninterrupted operation during the normal operating period. Internal combustion engines hereafter installed shall comply with NFPA 37.

(1) On internal combustion engines hereafter installed, liquid fuels shall be supplied and handled in accordance with NFPA 30. Gas fuels shall be in accordance with NFPA 58. Liquid fuels stored outside of a motor room, either above ground or below ground, shall be in compliance with the appropriate regulatory authority.

(2) For the purposes of interpreting NFPA 37, the auxiliary power units utilizing a combustion engine shall be considered, "used for emergency purposes". Also, "on roof of structure" shall mean "on the drive terminal structure". Structural members shall not be used as fuel tanks.

(3) An integral tank is a fuel tank furnished by the engine manufacturer. It shall be securely mounted to the engine assembly and protected against vibration, physical damage, engine heat, and the heat of exhaust piping.

EXCEPTION: The aerial tramway manufacturer may supply an integral or day gasoline fuel tank for mounting on a combined drive-tension carriage or an overhead fixed drive terminal. The tank shall be sized 25 gallons (94.6 liters) maximum, constructed, and installed in accordance with applicable provisions of NFPA 37.

Standard portable marine fuel tanks (boat tanks) can be used in lieu of an integral fuel tank. Such tanks are limited to 7 gallons (26.5 liters) capacity and shall be secured while in use.

(5) Fill pipes located beyond the sides of the building or motor room shall have a locked fuel cap. Fill pipes shall be located to avoid toxic fumes and fire hazard during refueling.

(b) Exhaust systems. Exhaust systems shall be designed and installed to discharge to the atmosphere in a manner which does not allow precipitation to enter the exhaust system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields for a distance of 8 feet (2.44 meters) above the floor or other walking or working surface, or to the ceiling if less than 8 feet (2.44 meters), and shall be insulated where they pass through combustible building materials.

(c) Ventilation. Internal combustion engine products of combustion shall be exhausted to and dispersed in the outer air. The machine room shall be ventilated so as to prevent air contamination within the room from the products of combustion , which tends to injure the health of any person therein or to create a fire or explosion hazard (see section 32-2.19(c)).

32-2.10 Loading and unloading areas. Platforms, ramps, and related units comprising the loading and unloading areas of an aerial tramway are integrally related to its operation. They shall be designed and installed in conformance with applicable criteria.

(a) Platforms shall be provided with sufficient space to accommodate passengers waiting to embark and passengers disembarking the cabins. Provisions for separation of incoming and outgoing passengers shall be made to guide passengers to and from the cabins.

(b) Elevated loading areas shall be protected on all sides by guardrails, safety nets or ramps.

32-2.11 Passenger removal from stranded carriers.

(a) General. Aerial tramways shall be provided with means to evacuate passengers from stranded carriers (see section 32-2.58(g)). An auxiliary hauling rope, emergency car system, or other means acceptable to the Commissioner shall be provided in cases of extreme height or hazardous terrain.

(b) Carrier evacuation. Where carrier height and terrain crossing conditions permit ready access to a shelter area, aerial tramways may depend partially or entirely upon evacuation to lower passengers from stranded carriers. When this method is used, the apparatus employed shall be stored aboard the carrier, or a means of roping up the apparatus shall be stored aboard the carrier.

32-2.12 Acceptance inspection and tests.

(a) Acceptance Inspection. Before an aerial tramway that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) Terminal and tower rope/cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;

(ii) lubrication of all moving parts;

(iii) alignment and clearances of all open gearing;

(iv) installation and alignment of all drive components;

(v) position and freedom of movement of counterweights or other tension systems and carriages;

(vi) haul rope alignment at entrance to bull wheels;

(vii) operation of all electrical components, including circuit protection and grounding;

(viii) brake torque testing;

(ix) minimum clearances for track cable and haul rope sags under the most adverse static loading;

(x) proper alignment of track cable saddles and haul rope sheave units;

(xi) actual testing of evacuation equipment and procedures at the most difficult location;

(xii) proper location of towers and terminals in accordance with the plans and specifications.

(b) Acceptance tests. Before an aerial tramway that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit an acceptance test procedure. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Thorough load and operating tests shall be done in the presence of the Commissioner and shall be performed under full loading and any partial loading that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. The functioning of all push-button stops, automatic stops, limit switches, deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loading (see section 32-2.17). Motive power and all braking devices (see section 32-2.18) shall be proved adequate under the most adverse loading.

(2) Prior to the acceptance inspection and the above acceptance tests, the aerial tramway shall be operated, with empty carriers on the line, for at least 16 hours, at least 6 of which is continuous to check for the overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tension systems,

and other related conditions.

(3) All terminal and line equipment shall be thoroughly checked both before and during the continuous run test.

32-2.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the aerial tramway design to render the system inoperable when necessary for the protection of personnel working on the aerial tramway. See section 32-2.53 for placement of applicable warning signs.

(a) Aerial Tramways, hereafter installed shall incorporate an audible warning device that signals of an impending start of the ropeway. After the start button is pressed, the device shall sound an audible alarm for a minimum of 2 seconds and shall continue until the ropeway begins to move. The audible device shall be heard inside and outside all terminals and machine rooms above the ambient noise level.

Subchapter B - Terminals and Stations.

32-2.14 Power units.

(a) General. All aerial tramways shall be equipped with at least two power units, one of which meets the requirements of section 32-2.14(b).

(1) All power units shall have capacity to handle the most unfavorable design loading conditions, including the starting of an aerial tramway loaded to 110% of capacity in weight.

(2) Where manual multi-speed transmissions are used on a power unit, they shall not be shifted when the aerial tramway is moving.

(3) Where reverse capability is provided on a power unit for any aerial tramway, provisions shall also be made to prevent accidentally shifting into reverse whenever the aerial tramway is operating.

(b) Auxiliary power unit. An auxiliary power unit (APU) with an independent power source shall be provided to move the carrier(s) to a terminal in the event of failure of the primary power unit.

(1) A single auxiliary power unit shall not be used except to unload passengers and for maintenance purposes. This unit shall be electrically wired to meet the requirements of section 32-2.45(b) so that it can be stopped by the Emergency Shutdown Circuit. The auxiliary power unit shall not depend upon the mechanical integrity of the prime mover to drive the unit. The prime mover shall be disconnectable in the event of a mechanical lockup.

(2) The auxiliary power unit shall be designed to become operational and move the carriers to terminal areas within 1 hour from the time of initiating its connection.

32-2.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting an aerial tramway under the most unfavorable design loading conditions without exceeding design rating. They shall have a service factor appropriate for the application.

32-2.16 Bearings, clutches, couplings, and shafting. Bearings, clutches, couplings, shafting and universal joint shafts (cardan shafts) shall be selected on the basis of the manufacturer's published data for the particular use.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.
(b) All shafting shall be designed in accordance with accepted standard practices.
(c) Guarding and containment shall be in accordance with the provisions of section 32-2.19

32-2.17 Acceleration and speed control. The drive equipment shall be designed to accelerate the line smoothly and to avoid severe oscillations or undulation under any loading condition. In order to avoid discomfort to the passengers caused by undue longitudinal swinging of the carrier or by excessive acceleration or deceleration and in order to start and stop the carriers smoothly, acceleration shall be limited to 1 foot (0.3 meter) per second squared under the most adverse design condition. The aerial tramway is to be started at its lowest point of speed range after any type of stop.

(a) The drive shall be capable of moving the unloaded system at reduced speed for rope inspection and equipment maintenance. This reduced-speed operation may be obtained by the use of the auxiliary power unit.
(b) In addition, the following requirements shall be incorporated in the design:
    (1) provision shall be made for smooth deceleration of the aerial tramway during a normal stop and when actuating the automatic drive brakes described in section 32-2.18. The operation of the drive sheave brake shall not result in deceleration of the aerial tramway that exceeds 7 feet (2.1 meters) per second squared under the most adverse design conditions;
    (2) carrier(s) shall be brought to a stop for loading and unloading, and provisions shall be made to keep the carrier(s) stationary during the loading and unloading process. The control room shall contain, in full view of the operator, indicators that will show the location of the carrier(s) at all times;
    (3) provision shall be made for overhauling loads. The system shall always operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under section 32-2.18;
    (4) the mechanism for line speed measurement where a forward overhauling condition exists shall be arranged to directly detect either haul rope lineal speed or bullwheel rotational speed;
    (5) if the speed of the aerial tramway can exceed the rated speed by more than 10%, an automatic overspeed device shall be provided that will initiate a stop;
    (6) the controls of the prime mover shall provide sufficiently smooth accelerating and deceleration ramps so that acceleration stays within the allowable limits and excessive swing is not introduced.

32-2.18 Brakes.

(a) General. The aerial tramway shall have the following friction type brakes:
- service brake (see section 32-2.18(b));
- drive sheave brake (see section 32-2.18(c));

- track cable brake (see section 32-2.32(b)).

(1) All drive braking systems shall be designed and monitored to ensure that:

(i) once the aerial tramway begins movement in the intended direction, the brakes are maintained in the open position;

(ii) the service brake shall not open prior to the drive system developing torque;

(iii) multiple brakes or brake systems shall not be simultaneously applied such that excessive deceleration is applied to the aerial tramway under any condition of loading;

(iv) the failure of one braking system to properly decelerate the aerial tramway shall automatically initiate a second braking system, if any.

(2) The service brake and drive sheave brake shall be designed such that failure of one braking system shall not impair the function of the other systems, and all brakes shall have the braking force applied by springs, weights, or other approved forms of stored energy.

(3) The service brake and drive sheave brake shall be designed to assure operation under all anticipated conditions.

(4) Deceleration rates specified in section 32-2.17 shall be achieved by each brake without the aid of other braking devices or drive regeneration.

(5) All drive braking systems shall be capable of operation to comply with the daily inspections and periodic testing.

(6) A Qualified Engineer shall furnish a written procedure to be followed and specify the auxiliary equipment necessary for periodic testing and adjustment of the holding force of each brake. The means of testing shall be acceptable to the Commissioner.

(7) Such testing shall be performed weekly, and the results recorded as part of the normal maintenance during the operating season, but only when the aerial lift is not open to the public. During the acceptance testing and the weekly testing the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

(b) Service brake.

(1) The service brake can be located at any point in the drive train such that there is no belt, friction clutch, or similar friction-type device between the brake and the drive sheave.

(2) The service brake shall be an automatic brake to stop and hold the aerial tramway under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall have the design capability to decelerate the aerial tramway at a rate of 2 feet (0.61 meter) per second squared when operating under the most unfavorable condition of overhauling load and at full speed.

(c) Drive sheave brake. Drive sheave brake controls shall be located and the brake activated in a manner that deceleration will begin within 3 seconds after the operator or attendant reacts to the stimulus to apply the brake.

(1) The drive sheave brake shall operate on the drive sheave assembly.

(2) Application of the drive sheave brake shall automatically disconnect the power source to the power unit in use. This brake shall act automatically when the speed of the haul rope exceeds the design speed by 15% in either direction or if the carriers travel beyond their normal stopping position in either terminal.

(3) The drive sheave brake shall be capable of being activated both manually and automatically. The brake shall be capable of stopping and holding the aerial tramway under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall have the design capability to decelerate the aerial tramway operating at full speed, with the design loading condition most unfavorable to stopping, at 1.5 feet (0.46 meter) per second squared and within the parameters specified in section 32-2.17. Controls shall not be more than 6 feet from the normal operating position of the operator.

32-2.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provisions shall be made for appropriate containment of said components. On tramways hereafter installed, guards shall conform to ASME B15.1.

(1) Protection against static electricity shall be provided.

(2) Fire-fighting device(s) shall be available.

(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.

(c) Machinery housed in a machine room. The machine room shall be adequately ventilated (see section 32-2.9(c)). It shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of the machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. On lifts installed after 1995, means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-2.20 Sheaves in terminals and stations.

(a) General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

(1) When unlined sheave grooves are used for wire rope, they shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

(2) When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

(b) Haul rope terminal sheaves (Bull wheels and deflection sheaves). Provisions shall be incorporated in the terminal design to retain the terminal sheaves in their approximate normal operating position in the event of failure of the bearings, shaft, or hub.

(1) The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope, provided that no gripping device passes around the sheave. The minimum diameter shall be 80 times the nominal haul rope diameter in cases where gripping devices pass around the sheave.

(2) The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave. A flange extension of 1 1/2 times the rope diameter (measured radially from the bottom of the rope groove) shall be deemed adequate for retention.

(3) Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove. The design coefficient of friction for a particular sheave liner shall not exceed the following values shown in Table 32.2-1.

Table 32.2-1

Design coefficient of friction for sheave liners

Sheave liner	Coefficient of friction
Steel or cast iron grooves	0.070
Leather	0.150
Rubber, neoprene, or others	0.205

(c) Counterweight rope sheaves and sheaves not specifically covered elsewhere in this rule. The minimum diameters for these sheaves shall be as indicated in Table 32.2-2.

(1) Condition A is applicable where bending around sheaves is of major importance. This condition shall be used as a minimum design criterion for track cable counterweight ropes.

(2) Condition B is applicable where bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, and the like.

(3) Condition C is applicable to sheaves that are not intended to rotate due to any tension sheave movement but are intended to rotate only due to counterweight adjustment.

(4) In the case of a locked coil track cable passing over a sheave or roller chain and connected directly to a counterweight, the radius of curvature of the sheave or the roller chain shall not be less than 100 times the cable diameter or 1200 times the greater dimension of the cross section of the largest wire of the cable, whichever is greater.
NOTE: In shaped wire, consider the greater dimension - width or height; not diagonal measure.

(5) Provisions shall be made to assure that all counterweight sheaves rotate freely.

Table 32.2-2
Minimum diameters for counterweight ropes sheaves and sheaves not specifically covered elsewhere in this rule

	SHEAVE DIAMETER		
Rope type	Condition A	Condition B	Condition C
6 X 7	72d	42d	24d
6 X 19	45d	30d	20d
6 X 37	27d	18d	12d

NOTE: d equals the nominal rope diameter.

(d) Haul rope line sheaves. Haul rope line sheaves shall be designed to perform their function under the most adverse design loading and operating conditions. See section 32-2.28 for rope guidance and retention requirements.

32-2.21 Tension sheave carriages.

(a) General. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion produced by the most unfavorable design loading and operating conditions.

(b) Rigid mounted carriages. For carriage arrangements with vertical motion, guides shall be provided. For all carriage arrangements other than those whose motion is vertical, the mounting that travels under the action of the tension system shall be supported on rigid straight rails by means of wheels. All loads, including torsional loads, due to driving torque and braking shall be considered, and the structure and carriage shall adequately transmit these loads to the foundation.

32-2.22 Tension systems.

(a) General. Counterweights, hydraulic and pneumatic cylinders, or other suitable devices shall be used to provide the tensioning requirements of the particular installation. All devices used to provide the tension shall have sufficient travel to adjust to all normal operating changes in loading and temperature.

(1) The tension for haul ropes and track cables for all modes of operation shall be determined by the design engineer. Tension systems may be automatic or manual; however, all systems shall have monitoring equipment that will automatically prevent operation outside of design limits (see section 32-2.24(b)(3)).

(2) Tension systems may be adjustable to provide proper tensions for different modes of aerial tramway operation.

(3) The tension system design shall consider changes, for each mode of operation, in tensions due to rope elongation, friction, and other forces affecting traction on driving, braking, or holding sheaves, tower and sheave loading, and maximum vertical loads on grips to

assure that tensions remain within design limits.

(b) Hydraulic and pneumatic systems. Hydraulic and pneumatic cylinders, when used, must have sufficient ram travel to accommodate all normal operating changes in loading and temperature. Provisions shall be made to keep the cylinder free from climatic induced conditions and contaminants that may interfere with free movement.

(1) If the system fails to provide the design operating pressure, the aerial tramway shall be able to be operated to unload passengers.

(2) Cylinders and their attachments shall each have a minimum factor of safety of 5. The factor of safety is equal to the ultimate tensile strength of the cylinder divided by the maximum steady state design tension.

(3) The systems providing operating pressure for the cylinder shall have a minimum factor of safety of 5 unless a high velocity check valve or flow control device is used where the pressure line is connected to the cylinder. The check valve shall be rated to hold twice the normal operating pressure. The remainder of the system shall not exceed the manufacturer's published working pressure. Provisions shall be made to restrict the movement of pressure lines or hoses should they become severed under pressures. When pneumatic storage cylinders, accumulators, or other similar devices are used, they shall be located so that they cannot be knocked over or damaged.

(c) Counterweights. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow, ice, water, and other materials from accumulating under and around the counterweights and interfering with their free movement. Visual access shall be provided to areas beneath and above all counterweights contained in enclosures or pits. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

(d) Wire ropes in tension systems. Counterweight ropes shall have a factor of 6 when new. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining the factor of safety. See ANSI B-77.1, Section 7 for additional requirements. No rotation-resistant ropes shall be used as counterweight ropes (see section 32-1.4(bc)).

(1) Counterweight ropes shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

(2) When wire ropes are used with pneumatic or hydraulic cylinders, they shall be adjusted so that connecting devices will not contact the reeving devices before the ram reaches the travel limits of the cylinder.

(e) Chains in tension systems. Roller, leaf, or welded link chains may be used in tension systems as specified in ANSI/B-77.1 Section 7.

(1) For chain used as a tensioning component, where the chain does not pass through or around sprockets, the minimum factor of safety shall be 5.

(2) For applications of chain where any sprockets are used, the minimum factor of safety shall be 6.

(f) Cable winches or chain adjusting devices. Winches or other mechanical devices that are used for take-up and remain part of the system shall have a minimum factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. A safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch. The diameter of the winding drum shall not be less than the specified minimum sheave diameters referenced as Condition C in section 32-2.20(c)(3) for rope.

32-2.23 Anchoring devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

(a) The diameter of a drum for track cable anchorage shall be not less than:
  (1) 65 times the cable diameter; or
  (2) 600 times the greater of height or width dimension of the outside wire.

(b) Cable shall be secured with a minimum of three wraps on the bollard and two clamps plus a gage clamp.

(c) Wire ropes or strands and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

(d) All connections of ropes or cables used in anchoring devices shall be in accordance with the requirements of ANSI B-77.1 Section 7.

32-2.24 Manual and automatic control devices. All control devices and switches shall conform to the requirements of section 32-2.45.

(a) Manual control devices. The following manual control devices that will initiate a stop shall be installed and conspicuously and permanently marked:
  (1) a stop device at each terminal platform;
  (2) a stop device on the conductor's control console in each carrier when a conductor is required in the carrier;
  (3) a stop device at the operator's station;
  (4) emergency shutdown device (see sections 32-2.35 and 32-2.45(b)).

(b) Provisions for automatic stop devices. The following automatic stop devices or systems shall be installed:
  (1) a device(s) that will be actuated in the event manual or automatic controls fail to reduce aerial tramway speeds to design values at critical control points along the line;
  (2) a device(s) that will stop the aerial tramway before the carrier reaches its limit of travel. An adequate bumper system shall also be installed;
  (3) a device(s) that will stop the aerial tramway before any counterweight, other tension system device, or tension sheave carriage reaches either end of its travel, or when the tension system exceeds its range of normal operating travel. When pneumatic or hydraulic tension systems are used, pressure-sensing devices shall also be incorporated that will stop the aerial tramway system in case the operating pressure goes above/below the design pressure range. Such pressure-sensing devices shall be located close to the actual tensioning device. It shall not be possible to isolate the pressure sensor from the

actual tensioning device;

(4) a device that will be actuated by the application of a track cable brake. These devices shall effect an emergency shutdown;

(5) a device that will stop the aerial tramway in the event a cabin door is not closed;

(6) a mechanical overspeed device mounted on the driving sheave shall effect an emergency shutdown in the event of a 15% overspeed;

(7) a device that will effect a stop of the aerial tramway in the event of inadvertent actuation of the brake system(s);

(8) a device that will stop the aerial tramway in the event that the haul rope comes in contact with the track cable or other grounded equipment (bicable systems only).

32-2.25 Terminal entrance and exit guides. Guide rails with curved ends shall be provided so that entrance and exit of carriers to and from the platforms can be accomplished smoothly and with minimum impact when carriers are deflected from the vertical 10 degrees laterally and, simultaneously, 10 degrees longitudinally.

Subchapter C - Line Structures

32-2.26 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of section 32-2.7.

(a) Means shall be provided for ready access from the ground to all tower tops. Work platforms shall be provided to access all line sheave or saddle assemblies atop a tower. Permanently installed lifting frames shall be installed to facilitate lifting haul rope or track cable or both, on all towers.

(b) Towers shall be identified with successive numbers at least 6 inches high and clearly visible when looking both up and down the lines.

32-2.27 Tower guides and clearances.

(a) Suitable guides shall be provided to prevent the carriers from contacting intermediate towers or other fixed objects.

(b) On bicable systems with track cable brakes, the guides shall be designed to limit swing to that permitted by the relationship between brake and saddle. If open windows are used on the tower side, a clearance of at least 18 inches (460 mm) shall be maintained at the window height when the carrier is swung inward the maximum amount permitted by the design. On unattended cabins, the windows on the tower side shall be kept closed or screened.

32-2.28 Haul rope sheaves and mounts. The tread diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope unless an elastomer liner is used. The requirements in this section (32-2.28) apply generally to sheaves that support or hold down the haul rope at towers on a monocable system, but where applicable shall also apply to the haul rope of a bicable system. These requirements shall apply to both sides of each aerial tramway.

(a) Maximum allowable sheave load. The maximum allowable load per sheave shall be determined by the aerial tramway designer.

(b) Sheave and sheave unit design. Sheave flanges shall be as deep as possible, considering other features of the system. At the same time, rope attachments shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Attachments shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of the attachments and sheaves. Furthermore, rope attachments, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind the guides, and so that ropes and attachments cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

(1) Suitable guards, of sufficient strength to resist the lateral forces caused by an inside deropement, shall be installed.

(2) Construction of the entire sheave unit shall be such that the rope cannot become entangled in the sheave unit in the event that the rope leaves the sheave toward the outside.

(3) On each sheave unit, rope-catching devices shall be installed to reduce the risk of the rope moving excessively in the direction of the load on the sheave unit in the event of deropement. These devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. They shall be designed to permit the passage of the rope and attachments after deropement.

(4) On each sheave unit, suitable devices shall be installed and maintained that will stop the aerial tramway in case of deropement (see section 32-2.24(b)(8)).

(5) If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

(6) Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

(7) See also section 32-2.5 for the effect of tower height and location on sheave units.

(c) Haul rope retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading, except as required for carrier passage (bicable system only).

(1) The carrier shall not leave the track cable if the design haul rope tension is increased by 50% or decreased by 33% (bicable system only).

(2) For monocable aerial tramways only, under the most adverse design loading conditions (excluding dynamic effects) the minimum load of the haul rope on a group of support sheaves at a tower shall not be less than the largest of the following values: 100 pounds (445 newtons) per sheave; or 300 pounds (1335 newtons) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to the 10 times sum of the adjacent span lengths expressed in meters of slope length).

(3) When the rope elevation at a tower lies below a straight line joining the rope elevations at the adjacent towers, the haul rope shall not leave the group of sheaves when the haul rope tension is 1.5 times its maximum design value at the point, and there are no carriers in

adjacent spans.

32-2.29 Track cable saddles and mounts. The radius of a track cable saddle shall be determined by the one of the following criteria that requires the largest radius:

(a) to be large enough to minimize bending stresses in the cable. In any event, the radius shall be equal to at least 1200 times the largest dimension of the outer wire of the cable;
NOTE: In shaped wire, consider the width or height, not the diagonal measurement.

(b) to be large enough to provide smooth transition of the carriage assembly from span to span;

(c) to be large enough to reduce the bearing pressure to a value that will permit proper lubrication of the cable to facilitate sliding in the saddle groove;

(d) to be large enough so that the radial acceleration of the carrier is not greater than 6.6 feet (2.0 meters) per second calculated as follows:
V^2/R is not greater than 6.6 feet (2.0 meters) per second squared
V = Carrier speed in feet (meters) per second
R = Radius of shoe in feet (meters)

(1) The minimum pressure on the saddle shoes shall be not less than 1.5 times the pressure required to hold the rope in contact with the shoes when a wind force of 6 pounds per square foot (290 pascals) is applied upwards on the rope, parallel to the reaction on the tower.

(2) The saddle shall be long enough to ensure that, under maximum loading conditions, the cable will not come into contact with the end of the saddle groove.

(3) Saddles shall be designed so that the track cable brake, if any, may function at the time the carrier is passing the saddle without deropement of the carriage wheels.

(4) Saddles shall permit free passage of the carriage even when the carrier is swinging laterally to its design limit as it approaches or passes the tower.

(5) If the gage of the aerial tramway is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum to avoid deropement of the carriage wheels as they pass over the saddle.

(6) See also section 32-2.5 for effect of height and location of towers on saddles.

Subchapter D - Line Equipment

32-2.30 Haul rope. Wire rope design and installation shall conform to the requirements of ANSI B77.1 Section 7.

(a) Factor of safety. Haul ropes shall have a minimum static factor of safety of 5 when new. Static factor of safety is equal to the nominal breaking strength divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

(b) Factor of safety for spliced haul rope with an independent wire rope center. Where a spliced haul rope with an independent wire rope center (IWRC) is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

32-2.31 Track cable. All track cables shall comply with the requirements of ANSI B77.1 Section 7. Track cables consisting of one strand made up entirely of round wires (commonly called smooth coil track strand) shall not be permitted. Wire rope, if used as track cables, shall have an independent wire rope or strand center.

(a) Factor of safety. Track cables shall have a minimum static factor of safety of 3 and a minimum dynamic factor of safety of 2.5, when new. Dynamic loads shall include the load imposed upon the track cable due to application of track cable brakes.

(b) Track cable installation. The designer of the aerial tramway shall provide detailed information concerning handling and installation of the track cable. These instructions shall be consistent with the track cable manufacturer's recommendations. Any handling after installation shall be in accordance with this advice.

32-2.32 Track cable carriage (Bicable systems).

(a) Carriage wheels. On bicable systems, the weight of the loaded carrier and haulage rope reactions shall be distributed to carriage wheels so that the load on any wheel shall not exceed that recommended for the track cable or the wheel liner material for the wheel diameter selected. In no event shall the load per wheel exceed 1/80 of the minimum design tension in the track cable when track strand is used with unlined wheels or 1/60 with resilient liner material. If wire rope is used as a track cable, the load per wheel shall not exceed 1/40 of the minimum design tension in the track cable.

(1) The carriage shall be equipped with a device that will, as far as possible, hold the carriage on the track cable in the event of a deropement of the wheels.

(2) In areas where icing conditions exist, the carriage shall be equipped with ice scraping devices that cannot contact the track cable under normal anticipated operating conditions.

(b) Track cable brakes. Each carrier on a reversible aerial tramway using the bicable system shall be equipped with a brake that will grip the track cable. The track cable brake shall be provided to reduce the risk of injury to passengers in the cabin(s). The brake shall be applied by springs or other approved forms of stored energy. The design conditions for a track cable brake shall include the failure of the haul or counter rope.

(1) The brake shall be capable of:

(i) holding a fully loaded carrier in case of a haul rope or counter rope failure (see note);

(ii) holding a fully loaded carrier at the point of maximum gradient of the track cable with a safety factor of 1.5 with new brake liners;

(iii) holding a fully loaded carrier at the point of maximum gradient of the track cable, considering a safety factor of 1.0, with brake liners, worn due to an applied braking distance described below at maximum travel speed.

Distance in feet		Distance in meters
$V^2/15750$	OR	$0.75\ V^2$
V = feet/min		V = M/s

(iv) automatically functioning in case of either a haul rope or counter rope failure (see note);

(v) manual activation by the conductor in the cabin.

(3) The track cable brake shall be designed to stop the aerial tramway while reducing the risk of damage to the track cable, carrier, or structures under all design conditions and shall

conform to the requirements of section 32-2.5(d). Application of the track cable brake shall automatically effect an emergency shutdown (see section 32-2.24(b)(4)).

NOTE: A counter rope is that portion of the haul rope on a double reversible system that connects the carriers but does not pass around the drive sheave.

32-2.33 Carriers. The carrier and all components shall be designed by Qualified Engineers in accordance with accepted practices of design. If the design has not had prior successful use for passenger transportation, its adequacy shall be verified by test loadings, trial operations, and tests under repeated loadings. The maximum capacity of each cabin shall be specified by the aerial tramway designer (see section 32-2.53(b)(1).

(a) Hanger. The hanger shall be securely attached to the carriage or haul rope attachment and to the cabin in such a manner that it cannot work loose. Haul rope attachment grips, used on monocable systems, shall conform to the requirements of Subpart 4, sections 32-4.32 and 32-4.63 of this rule.

(1) The hanger shall be of sufficient vertical length that, under the worst design condition of longitudinal swing, the top of the cabin cannot strike the haul rope, the track cables, or the bottom of a tower saddle. In any event, the carrier shall be able to swing longitudinally without interference to an angle of 15 degrees from the vertical at the most adverse locations.

(2) Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the aerial tramway designer. Where used, they shall operate smoothly and without danger of deropement of the carriage wheels or the haul rope.

(b) Cabin. Fully enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. The minimum opening shall be 32 inches (815 mm). Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

(1) All windows shall be of shatter-resistant material.

(2) Means of emergency evacuation of passengers shall be provided.

(3) The maximum capacity of each cabin, both in pounds and kilograms and number of passengers, shall be posted in a conspicuous place in each cabin.

(4) Cabin floor space available to passengers shall not be less than 2.5 square feet (0.232 square meter) per person for the first 15 passengers and 2 square feet (0.186 square meters) for each passenger thereafter. A minimum clear floor space for wheelchairs of 48 inches by 30 inches (1220 mm X 760 mm) shall be provided.

(5) Floor surfaces shall be slip resistant.

(6) A cabin door key shall be placed under glass, posted to prohibit use except under specified emergency conditions.

32-2.34 RESERVED

Subchapter E - Personnel

32-2.35 Provisions for operating personnel.

(a) General. Operator and attendant stations shall be located to provide visual surveillance of the station and the line in the vicinity of the station or in a cabin. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:
   (1) the communications and controls required of the station;
   (2) the operating instructions and emergency procedures;
   (3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.

(c) The operator shall be located where he/she can observe the aerial tramway in operation and may be located in a cabin. The physical appearance, operation, and location of emergency shutdown devices shall differentiate them from other operating devices or controls. The operator's controls and communicating devices shall be within reach without leaving his/her position.

Subchapter F - Operational and Maintenance Manuals

32-2.36 Operational manual. The designer of each new or reinstalled aerial tramway shall prepare an operational manual, in English, for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-2.37 Maintenance manual. The designer of each new or reinstalled aerial tramway shall provide with delivery of the installation a maintenance manual, in English, for each installation. The manual shall describe recommended maintenance and testing procedures, including:

(a) types of lubricants required and frequency of application;
(b) definitions and measurements to determine excessive wear;
(c) recommended frequency of service to specific components;
(d) carrier testing procedures and acceptance criteria;
(e) brake testing and adjustment.
(f) dynamic testing procedures.

CHAPTER II - ELECTRICAL DESIGN AND INSTALLATION

Subchapter A - Design and Installation Testing

32-2.38 General. Prior to operation of newly installed aerial tramways or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this part (Rule) and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

(a) Electrical system acceptance test. Upon the completion of the acceptance test and before public operation of the aerial tramway, the design and function of software and/or replay logic shall be certified by the Qualified Engineer of record and the certification shall be included in the acceptance test report. Any modifications made to the electrical design shall be clearly marked on the on-site documentation and signed by a Qualified Engineer. (see also section 32-2.12)

(b) Software security. The "as built" documents shall include a procedure, developed by the lift manufacturer or Qualified Engineer, to ensure the security of the software logic and operating parameters that will control the aerial tramway. Upon completion of the acceptance testing, this procedure shall be implemented in a manner that will prevent unauthorized personnel from making changes to the logic or operating parameters. All programmable logic and parameters shall be documented.

32-2.39 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-2.40 Location. No aerial lift shall pass under any transmission line operating at a potential exceeding 50 volts. All electrical power transmission wiring located near aerial tramways shall comply with the applicable requirements of NES C2.

32-2.41 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

32-2.42 Voltage limitations for overhead circuits. Signal, communication, and control circuits may be supported between towers that support the aerial tramway. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring down circuits for telephone systems.

32-2.43 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.

(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of NFPA 70.

(c) Insulation. All control wiring is excepted from the requirements of Article 725-27 (b) of NFPA 70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the aerial tramway centerline, shall be ground fault protected.

32-2.44 Grounding.

(a) Structures. All metallic structures shall be bonded to form a grounding electrode system as defined in Article 250 NFPA 70 for the purpose of grounding the control circuit in such a manner that an inadvertent ground, anywhere in the control circuit, would stop the aerial

tramway as required in section 32-2.45(a). Electrical continuity of all metal parts of the structures shall be assured by mechanical connection and shall be electrically bonded to the common bonding conductor.

(b) Drive terminal structure. The drive terminal structure shall have one point referred to as a ground point. If an electrical prime mover is used, the electric service grounding conductor shall terminate at this point, as well as the structure's ground referenced in part 32-2.44(a). All dc and ac electrical systems shall be referenced to this point. On lifts installed after 1995 the ground point shall be as defined in NFPA 70.

(1) Under the worst-case conditions, the resistance from the ground point to any grounded point within the aerial tramway system shall not exceed 50-ohms, for the purposes of grounding the control circuit. The grounding system for the aerial tramway shall not be used as a grounding system for any other system not related to the aerial tramway system.

(2) To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, circulating ground and air currents, all terminal and line structures shall be bonded together with a bonding conductor.

(c) Haul rope grounding. Grounding sheaves with conductive liners or equivalent means shall be provided at one location for the purpose of grounding haul ropes and track cables, as applicable, for static electrical discharge. For the haul rope on bicable systems or monocable systems with an isolated or insulated haul rope incorporated in the operating circuitry, no means of grounding are required when the operating circuit takes into consideration static electrical discharge.

(d) Lightning protection. If lightning protection is provided, it shall follow the NFPA 780.

32-2.45 Operating control circuits.

(a) Operating circuits. All aerial tramway systems shall contain one or more normally de-energized circuit(s) that, when energized, allow(s) the system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type. An exception to this requirement is allowed for magnetic or optically operated automatic stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All aerial tramway systems shall include a normally de-energized circuit that, when energized, allows the system to run and when interrupted, effects a shutdown (see section 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the aerial

tramway while using the operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the aerial tramway.

(1) Any one of the following conditions is considered a loss of control of an aerial tramway:
   (i) aerial tramway will not SLOW DOWN when given the command to do so;
   (ii) aerial tramway will not STOP when given the command to do so;
   (iii) aerial tramway OVERSPEEDS beyond control settings and/or maximum design speed.;
   (iv) aerial tramway ACCELERATES faster than normal design acceleration;
   (v) aerial tramway SELF-STARTS or SELF-ACCELERATES without the command to do so;
   (vi) aerial tramway REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and in the machine room. The shutdown device shall be conspicuously and permanently marked and shall be red in color (see section 32-2.35).

(c) Bypass circuits. A temporary bypass circuit may be installed for malfunctions in operating control circuitry (see section 32-2.58(i)).

32-2.46 Electrical prime mover and power circuits.

(a) Electrical prime mover. All aerial tramway systems equipped with electrical prime movers (electrical motors) shall have phase-loss protection on all power phases and undervoltage protection or overvoltage protection, or both, when speed regulation can be adversely affected by such voltage variations.

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:
   (1) field loss (dc motors);
   (2) speed feedback loss;
   (3) overspeed;
   (4) overcurrent.

Subchapter B - Night Operations

32-2.47 General. For nighttime operation, operating aerial tramways shall be provided with lighting systems. Lighting shall be provided at loading and unloading areas.

32-2.48 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-2.49 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures

shall be designed to maintain proper lamp operating characteristics.

32-2.50 Location. Lights shall be mounted on substantial poles or standards. Aerial tramway towers and terminal structures may be used for supporting lights, subject to the following requirements:

(a) approval shall be obtained from a Qualified Engineer;
Note: Approval of a Qualified Engineer is not required for lights installed on Towers prior to 1995, and are in compliance with AV 39.

(b) the service conductors to each aerial tramway tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the aerial tramway;

(c) a separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure;

(d) all metallic raceways on a tower or terminal structure shall be grounded;

(e) the lighting installation shall not conflict with other requirements of this Part (rule) and shall not interfere with operations of the aerial tramway in any manner.

32-2.51 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(a) regular unloading of aerial tramway facilities;

(b) emergency evacuation of carriers;

(c) operation of the auxiliary drive.

CHAPTER III - OPERATION AND MAINTENANCE

Subchapter A - Personnel Safety

32-2.52 General and personnel safety. This subsection covers the requirements for operation and maintenance of aerial tramways. Many requirements are listed elsewhere in Subpart 2, since they also regulate installation and design. Operating and maintenance personnel shall be familiar with applicable provisions of this Chapter and the aerial tramway operational and maintenance manuals (see Chapter I, Subchapter F of this Subpart).

(a) Procedures for the operation and performance of maintenance on detachable aerial lifts shall include the precautionary measures necessary to reduce the risks for the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(b) Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

32-2.53 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the

aerial tramway operations shall be adequately lighted for night operation. Additional signs, deemed necessary by the owner, may be posted, but not detract attention from any required sign.

(1) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.

(2) The sign "Personnel Working on Tramway - Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when persons are working on the aerial tramway (see section 32-2.13).

(b) The following information shall be prominently posted on the interior of each cabin:

(1) the maximum capacity of each carrier in pounds and kilograms and number of passengers. This shall also be posted at each loading area;

(2) instructions for procedure in emergencies.

Subchapter B - Operations

32-2.54 Personnel Reversible aerial tramways shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. Procedures for loading and unloading passengers, including passengers with common adaptive equipment, shall be included in the training. One or more persons familiar with emergency procedures shall be on the site at all times when the aerial tramway is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific aerial tramway.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for operation, and shall have the authority to deny access to the aerial tramway to any person who, in the supervisor's opinion, is not fit or competent to use the aerial tramway without danger to that person, others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the aerial tramway under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

(b) Operators. An operator shall be in charge of each aerial tramway. This operator shall be trained and experienced in normal operational and emergency procedures, and such training shall be documented. Operators shall be at least 18 years of age.

(c) Attendants. An attendant will be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view, and such training shall be documented.

(d) Conductors. Conductors, if required by the specifics of the design and installation, shall be trained for duty in connection with enclosed cabins, including loading and unloading procedures, communications, and the use of door locks and keys. The conductor shall be familiar with load limits and applicable safety regulations, well versed in the use of any manual switches under his/her control, and thoroughly trained in the use of emergency evacuation equipment and procedures, and such training shall be documented.

(e) First aid. One or more persons trained to provide first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when an aerial tramway is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

32-2.55 Minimum operating personnel. The following personnel are the minimum that shall be required:

(a) an operator who shall be in charge of the aerial tramway;

(b) one attendant who shall be on duty at each loading/unloading platform or station.

(1) Additional attendants or conductors may be required by the specifics of the design and installation.

(2) A conductor may also act as a platform or station attendant.

32-2.56 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:

(1) to determine that all aerial tramways are operational and that all operating personnel are trained, equipped, and fit to perform their duties;

(2) to discontinue operations on any aerial tramway due to physical, weather, personnel, or other reasons;

(3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:

(1) to assume responsible charge of the aerial tramway;

(2) to assign and supervise all attendants on his/her aerial tramway;

(3) to maintain an operational logbook as required in section 32-2.64;

(4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant and conductor. The duties of the attendant and conductor shall be as follows:

(1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;

(2) to advise and assist passengers, as required;

(3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the aerial tramway immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-2.57 Operational procedures. The required operational procedures as set forth in section 32-2.57 through and including section 32-2.58 of this rule shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-2.36).

(a) Control of passengers. Each aerial tramway shall have a definite method for marshalling passengers for loading and unloading. Fences, gates and alternate access and/or loading methods may be required to implement the system for individuals/groups.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be

conducted. As a minimum, the inspection shall consist of the following:

(1) a visual inspection of each terminal, station, and the entire length of the aerial tramway;

(2) assurance that the tension system is functional and that tension system devices (counterweights, cylinders, carriages, and the like) have adequate travel with approximate clearances at both ends;

(3) operation of all manual and automatic switches in terminals, stations, and loading and unloading areas;

(4) operation of all drive braking systems;

NOTE: The designer of the aerial tramway system may specify that this inspection is to take place while the aerial tramway is not moving.

(5) operation of communication systems;

(6) operation of the aerial tramway, including a visual inspection of all ropes and carriers;

(7) operation of the auxiliary engine until it reaches normal operating temperature.

(8) checking each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis;

(9) for those aerial tramways having primary-power internal combustion engines, determining that the fuel quantity is sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the aerial tramway. During refueling, power units shall be shut down. The aerial tramway shall be operated using the APU for at least 30 minutes per month.

(10) inspecting the loading and unloading facilities and, if necessary, clearing them of ice and snow to permit the ingress and egress of passengers;

(11) inspecting and checking the mechanical features of the carriers for correct operation.

(c) Access to facilities. Entrances to all machinery, operators', and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-2.58 Operational requirements.

(a) General. The supervisor and operator of each aerial tramway shall review the requirements of Chapter I of this Subpart to ascertain that the original design and installation conditions have not been altered in a manner such as to violate the requirements of the Rule.

(b) Starting. No aerial tramway shall be started except at the direction of or following clearance by the operator. Aerial tramways while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation only.

(c) RESERVED

(d) Stops. After any stop of an aerial tramway, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) Damage to carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed or repaired as soon

as feasible.

(f) Hazardous conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the aerial tramway shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial tramways are operated. No aerial tramway shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the aerial tramway is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to unload all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

(g) Evacuation. The owner of each aerial tramway shall submit to the Commissioner, in triplicate, a detailed written plan for evacuation of passengers from cabins or carriers in the event of a power failure or breakdown. The procedures set forth in the evacuation plan shall be tested, at any location on the lift, in the presence of the Commissioner at his request. The Commissioner, when satisfied with the evacuation plan and the results of the test, shall notify the owner in writing of such acceptance. A copy of the accepted plan shall be kept on the premises and shall be readily available to the Commissioner's representative.

(1) The written evacuation plans shall include but not be limited to the following:

(i) the definition of the line of authority in the event of an evacuation. This line of authority shall list:

(a) the individuals or positions responsible for determining the need for an evacuation;

(b) the individuals or positions responsible for ordering an evacuation;

(c) the individuals or positions responsible for performing the evacuation, for first aid, and for ground care of evacuated passengers.

(ii) a description of the equipment necessary for evacuation and where it will be stored;

(iii) provisions for adequate training in the functions performed in the evacuation process at least once each operating season. Such training is to include at least one evacuation drill, which is to be recorded in the operational log of each aerial tramway (see 32-2.64);

(iv) an estimate of the time necessary for the total evacuation of each aerial tramway and any conditions which might cause this time to exceed 2 hours of the lift stoppage;

(v) description of unusual terrain conditions and how each of these conditions will be deal with during an evacuation;

(vi) an estimate of when the evacuation should begin in the event the aerial tramway becomes inoperable;

(vii) provisions for communications with passengers of an inoperable aerial tramway, the frequency of such communication, how soon after the aerial tramway becomes inoperable such communication to the passengers will start, and the

frequency of communications thereafter;

(viii) the methods of evacuation to be used for the typical passenger and the methods to be used for incapacitated passengers and non-ambulatory passengers;

(ix) provisions for communication with the evacuation teams;

(x) provisions for suspending the evacuation in the event that the aerial tramway is made operable during the evacuation;

(xi) provisions for control and assistance of evacuated persons until released;

(xii) provisions for a written post-evacuation report available for review by the Commissioner.

(2) All nonmetallic rope used for evacuation shall be of nylon or polyester (Dacron) fiber of either laid or braided construction. Laid rope of nylon shall be of a hard lay. These ropes shall be either of a static rescue type or dynamic mountaineering type. Breaking strength, when new, shall be at least 15 times the maximum expected operating load but in no case less than 5,000 pounds. No natural fiber or polypropylene ropes shall be used.

(3) These ropes shall be carefully stored when not in use and shall be examined after each completed aerial tramway evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

(4) Carabiners, if used, shall be of the locking type.

(h) Termination of daily operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the aerial tramway after it has been shut down. Loading ramps, as required, shall be closed and so signed. When either loading or unloading portions of an intermediate station is not in operation, it shall be so signed and the loading station shall be closed to public access.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this paragraph shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating circuit malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the aerial tramway supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;

(5) the operator control panel shall indicate that a bypass is in use;

(6) when a required aerial lift control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the lift until the malfunction is corrected.

Subchapter C - Maintenance

32-2.59 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance and testing requirements of the designer or a Qualified Engineer (see section 32-2.37) shall be followed. Maintenance and testing records shall be kept (see section 32-2.66).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:
   (1) all wire rope, strand, and chain;
   (2) line sheave units, sheaves, bearings, and liners;
   (3) bull wheels, bearings, and liners;
   (4) tension systems;
   (5) drive system, including bearings and couplings;
   (6) braking systems;
   (7) electrical control systems;
   (8) communication systems;
   (9) carriers;
   (10) structures;
   (11) aerial tramway line (see section 32-2.4).

(c) Dynamic testing. A written schedule for systematic dynamic testing shall be developed and followed for all lifts, regardless of date of installation. The schedule shall establish frequencies and conditions for the periodic testing. The testing shall simulate or duplicate inertial loadings. The test load shall be equivalent to the design live load. Dynamic testing shall be performed at intervals not exceeding seven (7) years. The schedule shall include, but not be limited to, testing of the following:
   (1) braking systems;
   (2) auxiliary power units;
   (3) tension systems;
   (4) electrical systems.

32-2.60 Maintenance personnel. Aerial tramways shall be maintained by trained and competent personnel, and the owner shall be responsible for their supervision and training, and such training shall be documented. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and regulations of the specific aerial tramway.

Subchapter D - Inspections and Testing

32-2.61 RESERVED

32-2.62 Wire rope, strand, and chain inspection. Inspection of wire rope strand and chain shall comply with ANSI B77.1, Section 7, parts 7.4.1, 7.4.2, and 7.4.4. A copy of the report signed by the person performing the inspection shall be kept at the site, available to the Commissioner.

32-2.63 Carrier testing.

(a) All carriages, hangers, and cabins shall be tested against acceptance criteria, established by the designer or manufacturer; or in cases in which the designer or manufacturer is no longer in business and the original criteria is no longer applicable, by a Qualified Engineer.

(b) Each carriage, hanger, and cabin shall be uniquely identified by the manufacturer or the owner. If any defects are found, the designer/manufacturer/Qualified Engineer shall be consulted. Units failing to meet the acceptance criteria shall not be placed back into service until their defects are corrected.

(c) If the carriages, hangers, and cabins are tested by an agency other than the original equipment manufacturer, then the original aerial tramway manufacturer shall receive a copy of the test procedure and results. In all cases, the owner shall receive a copy of the test procedure and the test results.

Subchapter E - Records

32-2.64 Operational log. A logbook shall be maintained for each aerial tramway. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;
(e) record of compliance with daily operational inspection including loading and unloading platforms and ramps.
(f) position and condition of the tension carriage, counterweights, or other tension system devices;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator;
(i) record of aerial tramway evacuations and evacuation drills (see section 32 -2.58(g)(1)(iii)).

32-2.65 Wire rope, strand, and chain log. A logbook shall be maintained for each aerial tramway, giving the following information on each rope, strand, and chain:

(a) specification
(b) copy of certified test report;
(c) date installed;
(d) splicing certificate for each splice or laid-in strand;
(e) record of lubrication, including type of lubricant and date applied;
(f) record of maintenance inspections;
(g) report of wire rope, strand, and chain inspection;
(h) report of accidents or injury to wire rope, strand, or chain;
(i) documentation of end attachment.

32-2.66 Maintenance log. A signed complete log shall be maintained wherein the actual execution of

maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct

32-2.67 Dexterity and ability. A passenger who uses an aerial tramway shall be presumed to have sufficient physical dexterity or personal assistance to negotiate and be evacuated from the aerial tramway safely.

32-2.68 Embarkation and disembarkation. A passenger shall get on and get off an aerial tramway at designated areas. No passenger shall embark without first understanding the proper loading, riding, and unloading procedures of the aerial tramway.

32-2.69 Riding. Passengers, while riding an aerial tramway shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the aerial tramway. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

SUBPART 32-3
GENERAL PROVISIONS
Detachable Grip Aerial Lifts

Section 32-3.1 This Subpart covers that class of passenger ropeways on which the carriers circulate around the system, alternately attaching and detaching from the moving haul rope. The carriers travel from one terminal to the other along one path and return along another path, making U-turns in both terminals. This Subpart does not include ropeways wherein the passengers are in contact with the ground or snow during the trip. The aerial lifts covered by this Subpart are of the bicable or monocable type. The carriers may be open chairs, cars, or cabins.

CHAPTER I - DESIGN AND INSTALLATION
Subchapter A - General

32-3.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-3.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the aerial lift type and location:

(1) electric power lines and their supports;
(2) railways;
(3) highways;
(4) structures;
(5) rock and earth slides, cave-ins, washouts, and the like;

(6) snow creep and avalanches;
(7) wind action;
(8) icing;
(9) ski slopes and trails;
(10) rivers and gullies;
(11) buried installations, including pipelines;
(12) crossing or close proximity to other passenger ropeways;
(13) control of air space below, above, and adjacent to the installation;
(14) carrier height above all surfaces;
(15) passenger accessibility.

(b) RESERVED

32-3.4 Width of clearing. The clearing shall be wide enough to prevent adjacent vegetation from interfering with the aerial lift. Carriers shall not contact trees or vegetation during operational surges or during maximum design wind conditions, or both. Trees and other vegetation shall be cleared a minimum of 5 feet (1.53 meters) from haul ropes or track cables and carriers under normal (non-surge) operating conditions. Clearings shall be maintained, to avoid washouts that might endanger the installation (see section 32-3.59).

32-3.5 Path of rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration.

(a) Vertical clearances. The following reference points will be used in determining vertical clearances for these carrier/passenger combinations:
(1) For cabins and empty chairs, vertical clearances shall be referenced from the lowest point of the carrier.
(2) For chairs carrying foot passengers, vertical clearances shall be referenced from a point 2 feet (0.61 meters) below the top of the chair seat.
(3) For chairs carrying skiers, vertical clearances shall be referenced from a point 5 feet (1.53 meters) below the top of the chair seat.
(4) Along the line between terminals, the following vertical clearances shall exist between the above carrier reference points and the terrain or other obstacles, including maximum design snow depth:
(i) Where skiing is permitted beneath the lift, a minimum of 8 feet (2.44meters)shall be maintained;
(ii) Where the clearance is less than 8 feet (2.44 meters), provisions shall be made to prevent access by unauthorized persons to the area beneath the aerial lift.
(5) On detachable aerial lifts installed after 1995, under the most adverse loading conditions, while the aerial lift is being operated, a minimum space of 5 feet (1.53 meters) shall be maintained between the lower edge of carriers or ropes and the terrain, vehicles, or other possible obstacles, including snow.

(6) On lifts installed after 1995, where aerial lifts cross one another, the following conditions shall be met:

(i) any deropement of the upper aerial lift shall cause both aerial lifts to stop and a deropement of the lower aerial lift that reduces the clearance between the aerial lifts shall cause both aerial lifts to stop;

(ii) the minimum vertical clearance between the haul rope of the lower aerial lift and the top of the carrier seat of the upper aerial lift shall be 15 feet (4.6 meters) under the most adverse loading conditions.

(b) Horizontal clearances.

(1) Line clearances. The minimum distance between passing carriers, each swung 10 degrees inward from the vertical, shall be the greater of the following:

(i) 30 inches (760 mm); or

(ii) 1/2% of the span length (applies to gondolas only).

(iii) The distance between haul ropes (or track cables), for the purpose of these checks, shall be considered as equal to the gage of the line.

(iv) There shall be no contact between any tower machinery or obstruction and any part of a carrier when a carrier is swung in any of the following conditions: 15 degrees laterally from vertical or 15 degrees longitudinally from vertical; the combination of 15 degrees lateral and 15 degrees longitudinal; the combination of the lateral angle alpha and 15 degrees longitudinal, where alpha is equal to 5 degrees plus the angle created by a 250-pound (113 kg) passenger positioned in the passenger chair seat causing the greatest angle of inclination, in a static condition, in any direction.

(2) Special clearance requirements for chair lifts used for skiing. The following clearance requirements shall be met to prevent entanglement of skis with the tower structure. Clearance is herein defined to mean the distance between the inner limit of the passenger seat and clearance line or surface of the tower.

(i) With the carrier swinging laterally 10 degrees from the vertical position, if clearance is less than 24 inches (610 mm) from any open frame tower or 18 inches (460 mm) from any closed tubular tower, ski tip deflectors shall be provided on each side where passengers wearing skis are allowed, to reduce the risk of the skis being caught in the structure. Such deflectors shall be at least 6 feet (1.83 meters) in height, extending 36 inches (915 mm) above and 36 inches (915 mm) below average foot level.

(ii) A tubular tower with permanent ladder rungs shall be considered as an open-frame tower, unless it can be demonstrated that ski tips cannot be caught in the ladder. In this case, the tower may be considered as a closed-tubular tower.

(3) Terminal clearances. Posts, obstructions, or structures shall have at least 4 feet (1.22 meters) of clearance from the edge of an open carrier passenger seat or open cabin body (measured from the outermost attachments on, or parts of the carrier, while the carrier is hanging in a vertical position). The following exceptions shall be permitted in terminal areas:

(i) control consoles shall have at least 18 inches (60 mm) of clearance when the carrier is constrained by the carrier guidance system;

(ii) carrier guidage may have unrestricted clearance if measures are taken to protect passengers and operators;

(iii) handrails, signage, and their supports that are designed to reduce the risk of injury

to passengers and that are located after the unloading point and prior to the loading point may have unrestricted clearance;

(iv) structural components of the aerial lift shall have at least 18 inches (460 mm) of clearance when the carrier is constrained by the carrier guidage system. On aerial lifts being used primarily for skiers, terminal structural components shall have 18 inches (460 mm) of clearance when fitted with ski tip deflection guards or 30 inches (760 mm) without such guards.

(v) Carriers as they approach, enter, and exit the terminal areas and their related structures, while attached to the haul rope, shall have the same clearance as required when passing a line structure (see section 32-3.4(b)(1)).

(c) Path of rope adjustment. When terminals, towers, or both, contain provisions for a change in height of the rope or track supports, in order to meet normal changes in operational requirements, such provisions shall be controlled as follows:

(1) the designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments;

(2) where range of adjustments allows possible operator error resulting in improper sheave loading, a system to readily verify the proper profile, without the use of tools, shall be incorporated into the installation.

(d) Track cable saddles (Bicable systems). Towers and terminals shall be arranged so as to keep the track cable in the saddles under the most adverse design operating and nonoperating conditions. Track cable restraining devices or provisions may be used, as required, at the discretion of the designer. These provisions shall not interfere with any track cable movement. Maximum wind velocity and other design limits used for structures under nonoperating conditions and the limiting values intended for operating conditions shall be specified by the designer.

(e) Haul rope sheave units (Bicable systems). Haul rope sheave units are generally of the support type. "Depression" or "hold-down" sheave units not covered by this Part (rule) shall be subject to the requirements of sections 32-1.7 and 32-1.8 of this rule.

(f) Rope guidance (Bicable systems). All line sheave units, including both high- and low-tower sheave assemblies, shall be provided with fair leads or guides to accomplish the following:

(1) permit the unobstructed passage of a carrier gripped to the haul rope, independent of the position of the haul rope guided by the fair leads, as the carrier approaches the sheave assembly;

(2) guide the haul rope into the sheave groove when it has been lifted in normal operations or for other reasons;

(3) provide the rope guidance necessary beneath sheave assemblies and adjacent structures to prevent entanglement of the haul rope as it is returned by the carrier to normal operating position from any location it may assume due to any anticipated operational displacement.

(g) Intermediate structures (bicable systems). Auxiliary intermediate structures, (i.e., haul rope carriers and slack carriers) shall be provided to support sheave units as required to maintain the minimum clearances specified in section 32-3.5(a) of this rule.

32-3.6 Capacity, speed, and after-launch acceleration/deceleration. Smooth acceleration and deceleration

of the carrier shall be accomplished to and from full rope speed. Provisions shall be made to ensure that the carrier spacing shall never be less than the distances specified in the design.

(a) The designer shall specify the maximum design capacity in each direction and the design loading conditions under which the aerial lift may be operated (see section 32-3.28(c)). The maximum rope speed shall be that specified by the designer and established as functional by testing and operational performance.

(b) The maximum rate of the carrier's horizontal deceleration (negative acceleration) shall not exceed 5 feet per second squared (1.52 meters per second squared) under any operating condition while the carrier is attached to the hauling rope.

32-3.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal conditions. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) Structures. On bicable systems, torsional displacement of towers under the most adverse design conditions shall be limited to a value that will not cause deropement of the track cable from the saddle.

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost-susceptible soil or solid rock. Foundations on rock shall be firmly anchored to solid rock, unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for the protection of the foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus the wind acting simultaneously.

32-3.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power and the communication system shall be functional and audible during a power failure.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

32-3.9 Internal combustion engine installation.

(a) Fuel tanks for combustion engines. Fuel tanks shall have adequate capacity to permit uninterrupted operation during the normal operating period. Internal combustion engines hereafter installed shall comply with NFPA 37.

(1) On internal combustion engines hereafter installed, liquid fuels shall be supplied and handled in accordance with NFPA 30. Gas fuels shall be in accordance with NFPA 58. Liquid fuels stored outside of a motor room, either above ground or below ground, must be in compliance with the appropriate regulatory authority.

(2) For the purposes of interpreting NFPA 37, the auxiliary power units utilizing a combustion engine shall be considered, "used for emergency purposes". Also, "on roof of structure" shall mean "on the drive terminal structure". Structural members shall not be used as fuel tanks.

(3) An integral tank is a fuel tank furnished by the engine manufacturer. It shall be securely mounted to the engine assembly and protected against vibration, physical damage, engine heat, and the heat of exhaust piping.

EXCEPTION: The aerial lift manufacturer may supply an integral or day gasoline fuel tank for mounting on a combined drive-tension carriage or an overhead fixed drive terminal. The tank shall be sized 25 gallons (94.6 liters) maximum, constructed, and installed in accordance with applicable provisions of NFPA 37.

(4) Standard portable marine fuel tanks (boat tanks) can be used in lieu of an integral fuel tank. Such tanks are limited to 7 gallons (26.5 liters) capacity and shall be secured while in use.

(5) Fill pipes located beyond the sides of the building or motor room shall have a locked fuel cap. Fill pipes shall be located to avoid toxic fumes and fire hazard during refueling.

(b) Exhaust systems. Exhaust systems shall be designed and installed to discharge to the atmosphere in a manner that does not allow precipitation to enter the exhaust system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields for a distance of 8 feet (2.44 meters) above the floor or other walking or working surface, or to the ceiling if less than 8 feet (2.44 meters), and shall be insulated where they pass through combustible building materials.

(c) Ventilation. Internal combustion engine products of combustion shall be exhausted to and dispersed in the outer air. The machine room shall be ventilated so as to prevent air contamination within the room from the products of combustion which tends to injure the health of any person therein or to create a fire or explosion hazard (see section 32-3.19(c)).

32-3.10 Loading and unloading areas. Platforms, ramps, corrals, and mazes comprising the loading and unloading areas of an aerial lift are integrally related to its operation. They shall be designed and installed in conformance with applicable criteria. Handrails, nets, steps, or ramps shall be provided to reduce the risk of injury to passengers and maintenance and operating personnel, when required. Terminals, towers, and other structures or obstacles adjacent to the loading and unloading areas shall be designed or guarded to reduce the possibility of entanglement with these items.

(a) Loading areas for chair lifts. The loading area length, profile, and loading point shall be installed according to the carrier speed, carrier type, conveyor system, passenger type, and

aerial lift design.

(1) Load Gates, artificial surfaces, and other loading aids when used shall be designed and installed with regards to all passengers.

(2) At least one point of access to the lift shall have a minimum clearance width of 36 inches (915 mm) to accommodate skiers using adaptive equipment.

(3) Approach paths to the loading platform shall be approximately level or slightly down-sloped to facilitate passengers moving to the loading point. The approach path shall be such that waiting passengers have a view of the loading area. The load waiting area shall be free of obstructions and marked, roped, or fenced in a manner to guide passengers to the loading marker.

(4) The “wait here” point shall be marked. This marker shall be located to provide horizontal clearance between passengers at the “wait here” point and passing carriers.

(5) The Loading Point shall be approximately level, marked as to where passengers are to position themselves using a “load here” marker located in/on the platform/snow surface. The width of the “load here” marker shall not be greater than the carrier width.

(6) Chair seats shall be maintained not more than 22 inches (560 mm) above grade at all loading areas.

(7) Elevated loading areas shall be protected on all sides by guardrails, safety nets or ramps.

(b) Loading areas for gondolas and chair lifts primarily serving foot passengers. The loading area shall be provided with approximately level load platforms and the necessary handrails, steps, or ramps to provide guidance and passenger control.

(c) Unloading areas. The unloading area length, profile unload point, and exit ramp shall be installed according to the carrier speed, carrier type, conveyor system, type of passenger, and aerial lift design.

(1) The approach end of the unloading area shall be fitted with inclined guards as necessary to reduce the risk of passengers or their equipment from being entangled with the platform edges.

(2) For chair lifts, the unloading point where the passengers stand up and disembark shall be marked on or near the unloading surface. For unloading skiers on a snow surface, this point shall be at the breakover point where the exit ramp starts. This point shall be signed "Unload Here," as required in section 32-3.53(c)(6).

(3) For chair lifts, the exit ramp for skiers shall be sloped downward no more than 30 percent.

(4) For aerial lifts used primarily for foot passengers, there shall be provided approximately level unload platforms and the necessary handrails, steps or ramps to exit the unload area. The exit route for foot passengers shall be designated.

(5) For chair lifts, the width of the unloading path and exit ramp shall be greater than the carrier width.

(6) For chair lifts, there shall be no impediment to obstruct passengers inadvertently failing to unload at the unload point. Appropriate guards are required to prevent catching equipment or passengers failing to unload and passing the unload point.

(7) Chair seats shall be maintained not more than 22 inches (560 mm) above grade at all unloading areas.

(8) Side protection. Elevated unloading areas shall be protected on all sides by guardrails, safety net or ramp.

(d) Intermediate stations for chair lifts. Intermediate loading and unloading stations are prohibited unless the carriers are slowed or detached from the haul rope and slowed to within the maximum allowable carrier speeds listed in Table 32.4-1 of Subpart 4 of this rule.

32-3.11 Provisions for evacuation. Aerial lifts shall be provided with means to evacuate passengers from stranded carriers. Provisions shall be made in the design of the aerial lift for emergency evacuation of all passengers. (see section 32-3.58.(g)).

32-3.12 Acceptance inspection and tests.

(a) Acceptance inspection. Before an aerial lift that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) Terminal and tower rope/cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;

(ii) lubrication of all moving parts;

(iii) alignment and clearances of all open gearing;

(iv) installation and alignment of all drive components;

(v) position and freedom of movement of counterweights or other tension systems and carriages;

(vi) haul rope alignment at entrance to bull wheels;

(vii) operation of all electrical components, including circuit protection and grounding;

(viii) brake torque testing;

(ix) minimum clearances for track cable and haul rope sags under the most adverse static loadings;

(x) proper alignment of track cable saddles and haul rope sheave units;

(xi) actual testing of evacuation equipment and procedures at the most difficult location;

(xii) proper location of towers and terminals in accordance with the plans and specifications.

(b) Acceptance tests. Before an aerial lift that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit an acceptance test procedure. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Thorough load and operating tests shall be done in the presence of the Commissioner and shall be performed under full loading and any partial loadings that may provide the most

adverse operating conditions. Test load per carrier shall be 110% of the design live load. The functioning of all push-button stops, automatic stops, limit switches, deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings (see section 32-3.17). Motive power and all braking and rollback devices (see section 32-3.18) shall be proved adequate under the most adverse loadings.

(2) Prior to the acceptance inspection and the above acceptance tests, the aerial lift shall be operated, with empty carriers on the line, for at least 16 hours, at least 6 of which are continuous to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tension systems, and other related conditions.

(3) All terminal and line equipment shall be thoroughly checked both before and during the continuous run test.

32-3.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the aerial lift design to render the system inoperable when necessary for the protection of personnel working on the aerial lift. See section 32-3.53 for placement of applicable warning signs.

(a) The aerial lift shall incorporate an audible warning device that signals an impending start of the ropeway. After the start button is pressed, the device shall sound an audible alarm for a minimum of 2 seconds and shall continue until the ropeway begins to move. The audible device shall be heard inside and outside all terminals and machine rooms above the ambient noise level.

Subchapter B - Terminals and Stations

32-3.14 Power units.

(a) General. All aerial ropeways shall be equipped with at least two power units; one of which meets the requirements of section 32-3.14(b).

(1) All power units shall have capacity to handle the most unfavorable design loading conditions, including the starting of the aerial lift loaded to 110% of capacity in weight.

(2) Where manual multispeed transmissions are used on a power unit, they shall not be shifted when the aerial lift is moving.

(3) Where reverse capability is provided on a power unit for an aerial lift, provisions shall also be made to prevent accidentally shifting into reverse whenever the aerial lift is operating.

(b) Auxiliary power unit. An auxiliary power unit (APU) with an independent power source shall be provided that can readily be used to unload the line in the event of failure of the primary power unit. This unit shall be electrically wired to meet the requirements of section 32-3.45(b) so that it can be stopped by the Emergency Shutdown Circuit. As a minimum, the auxiliary power unit shall be capable of starting and moving a line with all carriers loaded to 110% of capacity in weight in a forward direction at not less than 100 feet per minute (0.51 meters per second) or at an average speed in feet per minute equal to 1/60 the slope length of the aerial lift in feet (meters per second equal to 1/3600 the slope length of the aerial lift in meters),

whichever is greater. The auxiliary power unit shall not depend upon the mechanical integrity of the prime mover to drive the unit.

(1) The auxiliary power unit shall be designed to become operational and move the carriers to terminal areas within 1 hour from the time of initiating its connection.

(2) Auxiliary units shall be used only for unloading of passengers and maintenance work.

32-3.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting an aerial lift under the most unfavorable design loading conditions without exceeding design rating. They shall have a service factor appropriate for the application.

32-3.16 Bearings, clutches, couplings and shafting. Bearings, clutches, couplings, shafting and universal joint shafts (cardan shafts) shall be selected on the basis of the manufacturer's published data for the particular use. Guarding and containment shall be in accordance with the provisions of section 3-3.19.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

(b) All shafting shall be designed in accordance with accepted standard practices.

32-3.17 Acceleration and speed control. The drive equipment shall be designed to accelerate the line smoothly and to avoid severe oscillation or undulation under any loading condition. The aerial lift shall be started at its lowest point of speed range after any type of stop.

(a) For service stops and emergency shutdowns, the minimum average rate of the carrier's horizontal deceleration shall be 1.0 feet per second squared (0.3 m/s^2) with a maximum horizontal deceleration rate of 5 feet per second squared (1.52 m/s^2) under any operating condition while the carrier is attached to the haul rope.

(b) The rate of the carrier's acceleration to, and deceleration from, the design rope speed shall not exceed 8 feet per second squared (2.44 meters per second squared) under the most unfavorable braking condition. The interval between carriers shall be controlled by automatic carrier spacers or other suitable systems. Unbalanced loading shall be controlled to the extent required by the design through the use of automatic carrier counters or other suitable systems.

(c) The drive shall be capable of moving the unloaded system at reduced speed for rope inspection and equipment maintenance. This reduced-speed operation may be obtained by the use of the auxiliary power unit.

(d) On installations in which a forward overhauling condition exists:

(1) provisions shall be made for an overhauling load so that the system shall operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under section 32-3.18 of this rule. Where the provision made for controlling an overhauling load consists of regenerative capability or a similar characteristic in the power unit itself, the auxiliary power unit shall have a comparable capability;

(2) provision shall be made for slowing and stopping the aerial lift drive automatically if the line speed exceeds the design speed by more than 10%.

NOTE: Design values of line speed pertain to the design speed for the particular condition of operation (that is, skiers or foot passengers).

(i) Where the aerial lift is not rated for downhill passenger traffic, the following number of loaded carriers, loaded no more closely than 4 times the minimum carrier spacing, shall be permitted for the carrying of authorized persons downhill; the requirements for slowing and stopping the aerial lift drive automatically as set forth in section 32-3.17(d)(2) shall be waived:

Total number of carriers on lift (both sides)	Maximum number of loaded carriers on downhill rope
Less than 60	2
60 to 120	3
Over 120	4

(ii) For the purpose of this section only, authorized persons are defined to include all persons, whether employees of the aerial lift owner or not, who are authorized by the owner or the owner's representatives to be carried on the aerial lift.

(iii) All installations in which downhill traffic is either limited or not permitted shall be so identified with clearly visible signs at loading or unloading areas, and this information shall be further contained in operating instructions posted in these areas.

(3) On detachable aerial lifts installed after 1995, the mechanism for line speed measurement where a forward overhauling condition exists shall be arranged to directly detect either haul rope lineal speed or bull wheel rotational speed.

32-3.18 Brakes and rollback devices.

(a) General. The aerial lift shall have the following friction-type brakes and other devices as specified in Table 32.3-1:

- service brake (see section 32-3.18(b));
- drive sheave brake (see section 32-3.18(c));
- rollback device (see section 32-3.18(d)).

(1) All braking systems shall be designed and monitored to ensure that:

(i) once the aerial lift begins movement in the intended direction, the brakes are maintained in the open position;

(ii) the service brake shall not open prior to the drive system developing sufficient torque to prevent overhauling;

EXCEPTION: For an aerial lift that overhauls only in the reverse direction, a drive train backstop (32-3.18(e)) may be used in lieu of the above.

(iii) multiple brakes or brake systems shall not be simultaneously applied such that excessive deceleration is applied to the aerial lift under any condition of loading;

(iv) the failure of one braking system to properly decelerate the aerial lift shall automatically initiate a second braking system, if any.

(2) The service brake, drive sheave brake, and rollback device shall be designed such that failure of one braking system will not impair the function of the other systems, and all brakes shall have the braking force applied by springs, weights, or other approved forms

of stored energy.

(3) The service brake, drive sheave brake, and rollback device shall be designed to assure operation under all anticipated conditions.

(4) Deceleration rates specified in section 32-3.17 shall be achieved by each brake without the aid of other braking devices or drive regeneration.

(5) Each braking system shall be capable of operation to comply with daily inspections and periodic testing.

(6) A Qualified Engineer shall furnish a written procedure to be followed and specify the auxiliary equipment necessary for periodic testing and adjustment of the holding force of each brake, rollback, and backstop device. The means of testing shall be acceptable to the Commissioner.

(7) Such testing shall be performed weekly and the results recorded; as part of the normal maintenance during the operating season, but only when the aerial lift is not open to the public. During the acceptance testing and the weekly testing the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

(8) If a device is permanently installed to cause a brake, or rollback device, to be disabled for testing or reverse rotation, it shall be monitored so that the aerial lift cannot be operated in its normal mode when the brake is so disabled.

Table 32.3-1
Required stopping devices

Aerial lift category	Service brake	Drive sheave brake	Rollback device	Retarding device (see 32-3.17)
Self braking: A lift that decelerates, stops, and remains stopped within the service brake performance requirements without a braking device	Required*	Required	Not required	Not required
Non-overhauling: A lift that will not accelerate in either direction when it is not driven, but is not self-braking	Required	Required	Not required	Not required
Overhauling, reverse direction: A lift that will accelerate in the reverse direction when it is not driven	Required*	Required	Required	Not required
Overhauling, forward direction: A lift that will accelerate in forward direction when it is not driven	Required	Required	Not required	Required

*A service brake is not required if the overhauling, reverse direction aerial lift will meet the service brake stopping requirements under the most unfavorable design loading conditions.

(b) Service brake.

(1) The service brake can be located at any point in the drive train such that there is no belt, friction clutch, or similar friction-type device between the brake and the drive sheave.

(2) The service brake shall be an automatic brake to stop and hold the aerial lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted such that it will stop the aerial lift from full speed, with the design loading condition most unfavorable to stopping, within the conditions specified in section 32-3.17.

(3) The brake shall be in a normally applied position. It shall be held open for operation of the aerial lift and shall be applied when power is removed or the aerial lift is stopped.

(c) Drive sheave brake. The drive sheave brake shall operate on the drive sheave assembly.

(1) Application of the drive sheave brake shall automatically disconnect the power source to the power unit in use. This brake shall act automatically when the speed of the haul rope exceeds the design value by 15% in either direction on an overhauling aerial lift.

(2) The drive sheave brake shall be capable of being activated both manually and automatically. The brake shall be capable of stopping and holding the aerial tramway under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted so that it will stop the aerial lift from full speed, with the design loading condition most unfavorable to stopping, within the parameters specified in section 32-3.17.

(3) Controls shall not be more than 6 feet from the normal operating position of the operator.

(d) Rollback device. The rollback device shall act directly on the drive sheave assembly or the haul rope. When it has been determined that under the most adverse design loading condition, haul rope slippage will not occur, the rollback device may be located at the return sheave assembly. However, the rollback device shall not be located at other than the drive station, unless its location will not decrease the factor of safety of the haul rope below the minimum permissible value whenever the rollback device is statically engaged. The rollback device shall automatically prevent reverse rotation of the aerial lift, before the aerial lift travels in excess of 3 feet in the reverse direction.

(e) Drive train backstop. A drive train backstop device may be installed on an aerial lift. If used, it shall conform to the following requirements:

(1) a drive train backstop device is a one-way or overriding clutch device. The drive train shall be so arranged that there is no belt, friction clutch, or similar friction-type device between the backstop device and the drive sheave;

(2) the backstop device shall be rated for the maximum design load;

(3) under the most unfavorable design loading condition, the backstop device shall automatically prevent reverse rotation of the aerial lift before the aerial lift travels in excess of 36 inches (91 cm) in the reverse direction;

(4) all backstops shall be disengageable as required for the individual testing of brakes.

32-3.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provision shall be made for appropriate containment of said components. On detachable aerial lifts installed after 1995, guards and containment shall conform to ASME B15.1.

(1) Protection against static electricity shall be provided.

(2) Fire-fighting device(s) shall be available.

(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.

(c) Machinery housed in a machine room. The machine room shall be adequately ventilated. (see section 32-3.9(c)). It shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of the machinery shall permit proper maintenance. A door with a suitable lock

shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. On lifts hereafter installed, means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-3.20 Sheaves in terminals and stations.

(a) General. All sheaves, including their mounting and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

(1) When unlined sheave grooves are used for wire rope, they shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

(2) When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

(b) Haul rope terminal sheaves (Bull wheels and deflection sheaves). Provisions shall be incorporated in the terminal design, of lifts hereafter installed, to retain the terminal sheaves in their approximate normal operating position in the event of failure of the bearings, shaft, or hub.

(1) Provisions shall be incorporated in the terminal and rope retention design to control the position of the rope, including possible overhaul, to minimize the effects of its departure from its normal operating position.

(2) The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave. A flange extension of 1-1/2 times the rope diameter (measured radially from the bottom of the rope groove) shall be deemed adequate for retention.

(3) Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove. The design coefficient of friction for a particular sheave liner shall not exceed the values shown on Table 32.3-2.

Table 32.3-2

Design coefficient of friction for sheave liners

Sheave liner	Coefficient of friction
Steel or cast iron grooves	0.070
Leather	0.150
Rubber, neoprene, or others	0.205

(c) Sheaves in Tension systems and sheaves not specifically covered elsewhere in this rule. The minimum diameters for these sheaves shall be as indicated in Table 32.3-3.

(1) Condition A is applicable where bending around sheaves is of major importance. This condition shall be used as a minimum design criterion for track cable counterweight ropes.

(2) Condition B is applicable where bending around sheaves is important, but some sacrifice

in rope life is acceptable to achieve reduction in weight, economy in design, and the like.

(3) Condition C is applicable to sheaves that are not intended to rotate due to any tension sheave movement but are intended to rotate only due to counterweight adjustment.

(4) In the case of a locked coil track cable passing over a sheave or roller chain and connected directly to a counterweight, the radius of curvature of the sheave or the roller chain shall not be less than 100 times the cable diameter or 1200 times the greater dimension of the cross section of the largest wire of the cable, whichever is greater.

Note: In shaped wire, consider the greater dimension-width on height; not diagonal measures.

(5) Provisions shall be made to assure that all counterweight sheaves rotate freely.

Table 32.3-3
Minimum diameters for sheaves in tension systems and sheaves not specifically covered elsewhere in this rule

	SHEAVE DIAMETER		
Rope type	Condition A	Condition B	Condition C
6 X 7	72d	42d	24d
6 X 19	45d	30d	20d
6 X 37	27d	18d	12d

NOTE: d equals the nominal rope diameter.

(d) Haul rope line sheaves.

(1) General. The requirements of section 32-3.28 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(i) sheaves that carry no load other than the weight of the rope and carriers;

(ii) sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves;

(iii) sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means.

(2) In such cases, the design shall be modified to meet the requirements of the particular installation.

32-3.21 Tension sheave carriages.

(a) General. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion produced by the most unfavorable design loading and operating conditions.

(b) Rigid mounted carriages. The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the tension system shall be supported on rigid, straight rails by means of wheels or other low friction devices. All design loads including torsional loads due to driving torque, braking torque, or reactions of a rollback

device shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations.

(c) Mechanical stops for rigid mounted carriages. Mechanical stops shall be provided to prevent overtravel of the carriage and the tension sheave. These stops, and the terminal structure, shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the tension system reaction on the bull wheel.

32-3.22 Tension systems.

(a) General. Counterweights, hydraulic and pneumatic cylinders, or other suitable devices shall be used to provide the tensioning requirements of the particular installation. All devices used to provide the tension shall have sufficient travel to adjust to all normal operating changes in loading and temperature.

(1) The tension for haul ropes and track cables for all modes of operation shall be determined by the design engineer. Tension systems may be automatic or manual; however, all systems shall have monitoring equipment that will automatically prevent operation outside of design limits (see section 32-3.24(b)(3)).

(2) Tension systems may be adjustable to provide proper tensions for different modes of aerial lift operation.

(3) The tension system design shall consider changes, for each mode of operation, in tensions due to rope elongation, friction, and other forces affecting traction on driving, braking, or holding sheaves, tower and sheave loading, and maximum vertical loads on grips to assure that tensions remain within design limits.

(b) Hydraulic and pneumatic systems. Hydraulic and pneumatic cylinders, when used, shall have sufficient ram travel to accommodate all normal operating changes in loading and temperature. Provisions shall be made to keep the cylinder free from climatic induced conditions and contaminants that may interfere with free movement.

(1) If the system fails to provide the design operating pressure, the aerial lift shall be able to be operated to unload passengers.

(2) Cylinders and their attachments shall each have a minimum factor of safety of 5. The factor of safety is equal to the ultimate tensile strength of the cylinder divided by the maximum steady state design tension.

(3) The systems providing operating pressure for the cylinder shall have a minimum factor of safety of 5 unless a high velocity check valve or flow control device is used where the pressure line is connected to the cylinder. The check valve shall be rated to hold twice the normal operating pressure. The remainder of the system shall not exceed the manufacturer's published working pressures. Provisions shall be made to restrict the movement of pressure lines or hoses should they become severed under pressure. When pneumatic storage cylinders, accumulators, or other similar devices are used, they shall be located so that they cannot be knocked over or damaged.

(c) Counterweights. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow, ice, water, and other materials from accumulating under and around the counterweights and interfering with their free movement. Visual access shall be provided to areas beneath and above all

counterweights contained in enclosures or pits. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

(d) Wire ropes in tension systems. Wire ropes in tension systems shall have a minimum factor of safety of 6 when new. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining the factor of safety. See ANSI B77.1 Section 7 for additional requirements. No rotation-resistant ropes shall be used in tension systems (see section 32-1.4(bc)).

(1) Wire ropes in tension systems shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

(2) When wire ropes are used with pneumatic or hydraulic cylinders, they shall be adjusted so that connecting devices will not contact the reeving devices before the ram reaches the travel limits of the cylinder.

(e) Chains in tension systems. Roller, leaf, or welded link chains may be used in tension systems as specified in ANSI B77.1 Section 7.

(1) For chain used as a tensioning component, where the chain does not pass through or around sprockets, the minimum factor of safety shall be 5.

(2) For applications of chain where any sprockets are used, the minimum factor of safety shall be 6.

(f) Cable winches or chain adjusting devices. Winches or other mechanical devices that are used for take-up and remain part of the system shall have a minimum factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. A safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch. The diameter of the winding drum shall not be less than the specified minimum sheave diameters referenced as Condition C in section 32-3.20(c)(3).

32-3.23 Anchoring devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

(a) The diameter of a drum for track cable anchorage shall not be less than:

(1) 65 times the cable diameter; or

(2) 600 times the greater of height or width dimension of the outside wire;

(b) Cable shall be secured with a minimum of three wraps on the bollard and two clamps plus a gage clamp.

(c) Wire ropes or strands and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

(d) All connections of ropes or cables used in anchoring devices shall be in accordance with the requirements of ANSI B-77.1 Section 7.

32-3.24 Manual and automatic control devices. All control devices and switches shall conform to the requirements of 32-3.45.

(a) Manual control devices. Manual control devices that will initiate a stop shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in proximity to all loading and unloading areas. The control devices shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls. All start/run/stop and speed control devices shall be conspicuously and permanently marked with the proper function.

(b) Provisions for automatic stop devices. The following automatic stop devices or systems shall be installed:

(1) a device(s) that will stop the aerial lift in the event a carrier grip does not engage properly to the haul rope at every grip attachment point;

(2) a device(s) that will stop the aerial lift in the event a carrier does not disengage the haul rope properly at every grip disengaging point;

(3) a device(s) that will stop the aerial lift before any counterweight, other tension system device, or tension sheave carriage reaches either end of its travel or when the tension system exceeds its range of normal operating travel. When pneumatic or hydraulic tension systems are used, pressure-sensing devices shall also be incorporated that will stop the aerial lift system in case the operating pressure goes above/below the design pressure range. Such pressure-sensing devices shall be located close to the actual tensioning device. It shall not be possible to isolate the pressure sensor from the actual tensioning device;

(4) a system that will prevent carrier collision in the receiving and launching mechanisms. The system shall include devices that will automatically stop the system before any carriers can come together while they are in the decelerating or accelerating process;

(5) in the case of open chair carriers or mechanical requirements for minimum spacing in the stations, a system to prevent abnormal carrier spacing throughout the conveying system. The system shall include devices that will automatically stop the system in the event of abnormal carrier spacing. Open chair carriers shall not be allowed to come together;

(6) if the line speed exceeds the design speed by 10%, the service brake shall slow and stop the aerial lift automatically;

(7) a system or device that will automatically apply the drive sheave brake when the speed of the haul rope exceeds the design value by 15% in either direction on an overhauling aerial lift.

(8) on lifts using chairs, automatic stopping device beyond each unloading area. The device shall automatically stop the aerial lift in the event a passenger rides beyond the intended point of unloading. The automatic stop device may be delayed or overridden momentarily by the operator or attendant.

32-3.25 Terminal entrance and exit guides. From the point where the grip first enters the terminal rails or guides to the point where the grip or carrier is stabilized, provisions shall be made to accept the carriers and the grips into the terminal at the design speed when the carriers are swung to the limits specified in section 32-3.5(b)(1).

Subchapter C - Line Structures

32-3.26 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of 32-3.7. Where guyed towers are used and guys intersect the ground the guys shall be marked for visibility with a blaze orange designation.

(a) Means shall be provided for ready access from the ground to all tower tops. On lifts installed after 1995, permanent ladders are required for heights above those accessible by portable ladders. Portable ladders, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed. Portable ladders extending more than 20 feet (6.10 meters) shall not be used.

(b) On lifts installed after 1995, permanent anchor points shall be provided on all tower tops for the attachment of fall protection devices.

(c) Towers shall be identified with successive numbers at least 6 inches high and clearly visible when looking both up and down the lines.

(d) Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

32-3.27 RESERVED

32-3.28 Haul rope sheaves and mounts. The tread diameter of a haul rope sheave shall not be less than 10 times the nominal diameter of the haul rope unless an elastomer liner is used. The requirements in this section (32-3.28) apply generally to sheaves that support or hold down the haul rope at towers on a monocable system, but where applicable shall also apply to the haul rope of a bicable system. These requirements shall apply to both sides of each aerial lift.

(a) Maximum allowable sheave load. The maximum allowable load per sheave shall be determined by the aerial lift designer.

(b) Sheave and sheave unit design. Sheave flanges shall be as deep as possible, considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of the grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

(1) Suitable guards, of sufficient strength to resist the lateral forces caused by an inside deropement, shall be installed.

(2) Construction of the entire sheave unit shall be such that the haul rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

(3) On each sheave unit, rope-catching devices shall be installed to reduce the risk of the rope moving excessively in the direction of the load on the sheave unit in the event of deropement. They shall be designed to permit the passage of the rope and grips after deropement. The catcher shall be independent from the sheave. On detachable aerial

lifts hereafter installed these devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. In addition, on lifts hereafter installed, when the catcher is located so that the rope cannot move in the direction of the load when it passes from the edge of the sheave to a position in the catcher, the catcher shall extend a minimum of two rope diameters beyond the center of the rope when the rope has reached the point where the deropement switch device initiates a stop.

(4) On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

(5) This section applies only to detachable aerial lifts installed after 1995. On lifts where the carrier speed exceeds 600 feet per minute (3.0 meters per second), at least one device that senses the position of the rope shall be installed on each sheave unit. The device shall initiate a stop before the rope leaves the sheave in the horizontal direction or when the rope is displaced in the vertical direction by one rope diameter plus the distance that the rope is displaced vertically from the sheave by the grip. If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

(6) Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

(7) See also section 32-3.5 for the effect of tower height and location on sheave units.

(c) Haul rope retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. On lifts hereafter installed, this criterion shall be deemed to have been met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall not be less than the largest of the following values: 100 pounds (445 newtons) per sheave; or 300 pounds (1335 newtons) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length). When the rope elevation at the tower lies below a straight line joining the rope elevations at the adjacent towers, the haul rope shall not leave the group of sheaves under either of the following conditions:

(i) when the haul rope tension is 1.5 times its maximum design value at the point, using no carriers in adjacent spans;

(ii) when a rope is under tension of the tension system alone (bare rope) or with any arrangement or number of empty carriers on the line.

(iii) the minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall not be less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to 10 times the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (1000 newtons) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

(3) Condition C: For line structures where the carrier is either wholly or partially supported or depressed on tracks, or by other means, in lieu of retaining the haul rope in the sheave groove, the following design criteria shall be fulfilled without exceeding the maximum allowable loads.

(i) Under the most adverse loading conditions, the load of the carrier onto the track when fully engaged shall be not less than the largest of the following values: 450 pounds (2000 newtons); or the design gross load per carrier; or a value in pounds equal to two-thirds of the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to 10 times the sum of the adjacent span lengths expressed in meters of slope length).

(ii) The carrier shall not leave the track if the design cable haul rope tension is increased by 50% or decreased by 33%.

32-3.29 Track cable saddles and mounts. The radius of a track cable saddle shall be determined by the one of the following criteria that requires the largest radius:

(a) to be large enough to minimize bending stresses in the cable. In any event, the radius shall be equal to at least 1200 times the largest dimension of the outer wire of the cable;

NOTE: In shaped wire, consider the width or height, not the diagonal measurement.

(b) to be large enough to provide smooth transition of the carriage assembly from span to span;

(c) to be large enough to reduce the bearing pressure to a value that will permit proper lubrication of the cable to facilitate sliding in the saddle groove;

(d) to be large enough so that the radial acceleration of the carrier is not greater than 6.6 feet (2.0 meters) per second squared calculated as follows:

V^2/R is not greater than 6.7 feet (2.0 meters) per second squared

V = Carrier speed in feet (meters) per second

R = Radius of shoe in feet (meters)

(1) The minimum pressure on the saddle shoes shall be not less than 1.5 times the pressure required to hold the rope in contact with the shoes when a wind force of 6 pounds per square foot (290 pascals) is applied upwards on the rope, parallel to the reaction on the tower.

(2) The saddle shall be long enough to ensure that, under maximum loading conditions, the cable will not come into contact with the end of the saddle groove.

(3) Saddles shall permit free passage of the carriage even when the carrier is swinging laterally to its design limit as it approaches or passes the tower.

(4) If the gage of the aerial lift is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum to avoid deropement of the carriage wheels as they pass over the saddle.

(5) See also section 32-3.5 for the effect of height and location of towers on saddles.

Subchapter D - Line Equipment

32-3.30 Haul rope. Wire rope design and installation shall conform to the requirements of ANSI B77.1 Section 7.

(a) Factor of safety. When the slope length of the installation is less than 3000 feet (914.4 meters), the haul rope shall have a minimum static factor of safety of 5 when new. On lifts hereafter installed, for slope lengths greater than 3000 feet (914.4 meters), the haul rope may have a minimum static factor of safety of 4.5 when new. Static factor of safety is equal to the nominal breaking strength divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

(b) Factor of safety for spliced haul rope with an independent wire rope center. Where a spliced haul rope with an independent wire rope center (IWRC) is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

32-3.31 Track cable. All track cables shall comply with the requirements of ANSI B77.1 Section 7. Track cables consisting of one strand made up entirely of round wires (commonly called smooth coil track strand) shall not be permitted. Wire rope, if used as track cables, shall have an independent wire rope or strand center.

(a) Factor of safety. Track cables shall have a minimum static factor of safety of 3 and a minimum dynamic factor of safety of 2.5 when new.

(b) Track cable installation. The designer of the aerial lift shall provide detailed information concerning handling and installation of the track cable. These instructions shall be consistent with the track cable manufacturer's recommendations. Any handling after installation shall be in accordance with this advice.

32-3.32 Haul rope grip.

(a) General. The haul rope grip shall be of a type that has been approved by a Qualified Engineer. The manufacturer shall permanently affix a unit identification, serial number(s) and nominal rope size marking to each grip. Each grip shall be nondestructively tested before public use, and such testing shall be documented.

(b) The design of the haul rope grip shall incorporate the following:

(1) a specification sheet for each grip design that as a minimum specifies materials, fabrication methods, allowable rope sizes, allowable rope construction, carrier weight, maximum rope angle, maximum line sheave load, operational temperature range, production inspection criteria and design operating tolerances;

(2) the rope grip shall be designed to pass the rope catchers in the event of deropement;

(3) when the grip is loaded in its normal operating position to a value equal to the dead load plus six (6) times the live load, no part of the grip shall be stressed to a value greater than the ultimate strength of the material;

(4) grip parts whose stress is not changed by application of live load shall be designed on the basis of allowable stress of not more than the yield point of the material divided by 3.0;

(5) in the design of springs, where used, the allowable stress may be increased if fatigue tests are conducted and independently certified to provide assurances that the fatigue life of the actual spring is adequate for the various loads;

(6) grips shall be designed to resist, with a minimum factor of safety of 3.6 with respect to the yield point of the material(s), the stresses resulting from horizontal loads including centrifugal force, grip capture forces, and terminal guide rail forces;

(7) the grip material shall be selected for optimum impact resistance;

(8) the grip clamping mechanism shall not reach its mechanical limit of travel with a 10% combined reduction from the nominal haul rope diameter and total allowable grip wear;

(9) a change of rope diameter of ± 10% from the nominal shall not cause a reduction of grip force by more than 25% for a new grip;

(10) at the nominal rope diameter the minimum factor of safety for the slipping force shall be 3. Slipping force is defined as P sin α, where P is the dead plus live load of the carrier and α is the maximum rope angle produced by any design loading condition;

(11) the opening of the grip jaws shall accommodate, without contact, a coupling with a haul rope of the 10% above nominal diameter;

(12) no wedging on the haul rope by gravity may be incorporated in the design of the rope-to-jaw interface. Wedging on the haul rope by the spring force may be incorporated in the design of the rope-to-jaw interface provided jaw wear is limited as a retirement criterion to maintain wedge effect;

(13) if energy storage devices produce the gripping force, the failure of one device shall not reduce the slipping force factor of safety below 1.5 for haul ropes between 90% and 110% of nominal rope diameter;

(14) the grip jaw surfaces that contact the rope shall encircle at least 75% of the nominal haul rope circumference for a minimum distance of 1.5 times the rope diameter;

(15) the designer shall consider required pluck forces in the design of the grip. Pluck force shall be tested and recorded for each new grip design. Pluck force is force perpendicular to the rope applied at the center of each grip;

(16) the carrier swing angles under worst design conditions of longitudinal swing shall not result in reaching any mechanical limit of travel. In any event, the minimum carrier swing angles without reaching any mechanical limit of travel shall be the sum of the maximum rope angle plus 15 degrees;

(17) grip parts shall be finished to resist corrosion.

(c) Grip testing requirements.

(1) Grip testing shall be performed to confirm design calculations. Grip tests shall simulate as a minimum the maximum design loads for the range of haul rope diameters, carrier loads, and maximum rope angle allowed.

(2) Grips that are new in design or have had their specifications revised shall have the following tests performed and independently certified:

(i) Fatigue testing shall be performed in accordance with ANSI B77.1 section 3.1.4.3.2 Table 3-4:

(ii) Grips shall be tested to 500,000 clamping/unclamping cycles on a rope or

equivalent. Manufacturers recommended maintenance and parts replacement may be performed during this test.

(iii) Grips shall be tested to 15,000 terminal entry/exit cycles, 5,000 of which to be fully loaded with maximum traversing.

(iv) Carrier swing angles without reaching any mechanical limit of travel between grip and hanger shall be tested and documented.

(3) Failure of any grip component, while testing, is defined as permanent deformation, wear on component parts or initiation of any stress related crack that exceeds design operating tolerances. In addition, the grip, at the conclusion of above testing, shall meet the provisions of section 3-32(a). If failure occurs, the grip shall be redesigned and the above Grip Testing Requirements shall be repeated.

(4) The manufacturer's quality control provisions shall assure that the grips produced and their parts meet the designer's specifications and would pass the foregoing testing requirements. Testing documents for each produced grip shall include serial number(s), NDT testing, slip force testing, and final assembly inspection

(d) Lift/Grip interface

(1) Maximum loads. The maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope. Where two grips are used for a single carrier, the foregoing requirement may be applied to each grip, provided that:

(i) the two grips are independent of each other (that is, articulated in such a manner that they are independently loaded);

(ii) the clear length of haul rope between the two grips equals or exceeds one-half rope lay.

(2) Attachment. At each carrier launching position, devices shall be installed that will stop the ropeway if any grip incorrectly attaches to the haul rope. (see 3.24(b)) Upon Clamping to the haul rope, the differential of carrier velocity and rope speed shall not unduly affect either passenger comfort or mechanical wear.

(3) Lift/Grip Interface Testing

(i) Slippage Testing. The grip shall maintain 3 times the force required to move a loaded carrier along a properly lubricated haul rope at nominal diameter at the steepest incline. The ropeway designer shall specify the force below which the grip will not slip and the required testing equipment and procedures. As a minimum the grip shall be tested after each grip is removed for periodic nondestructive testing and maintenance. When testing, the grip shall not move more than 25% of the rope diameter.

(ii) Grip Force. The design of the ropeway shall include provisions that check the grip's ability to produce the force required to meet the minimum grip force equivalent to the slippage force defined above at least once for each revolution of the grip through the system. If the gripping force of the grip falls below the minimum required, the design of the system shall include provisions to stop the lift. Passengers shall not be loaded on those carriers until it is verified that the grip in question is producing the minimum required force.

(iii) Incorrect Attachment. The designer shall incorporate provisions to stop the grip and carrier in a controlled fashion when a grip is incorrectly attached to the rope.

The path of the rope from the terminal where passengers are loaded shall be approximately level or inclined upward for a length at least equal to:

$$L\ (\text{feet}) = \frac{V^2\ (\text{ft/minute})}{14{,}400} \quad \text{or}$$

$$L\ (\text{meters}) = \frac{V^2\ (\text{ft/meters/sec})}{1.22}$$

L = Length of level or inclined upward rope

V = rope speed during passenger loading at that station

An incorrectly attached grip tripping the last checking switch shall cause the rope to stop in a distance not greater than the calculated length "L" or in the case where a greater length of level or inclined upward rope is provided, in a distance not greater than the length provided.

(iv) Grip maintenance testing. The aerial lift designer or manufacturer shall develop procedures and acceptance criteria for testing grips for the owner to comply with 32-3.64.

32-3.33 Carriers for detachable lifts. Qualified Engineers shall design the carrier and all components in accordance with accepted practices of design.

(a) Hanger. The hanger shall be securely attached to the carriage or haul rope grip and to the cabin in such a manner that it cannot work loose.

(1) The hanger shall be of sufficient vertical length that, under the worst condition of longitudinal swing, no portion of the chair or cabin can contact any rope or any tower machinery components.

(2) Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the ropeway designer.

(b) Cabins. Fully enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. The minimum opening door width shall be 32 inches (815 mm). Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

(1) The horizontal gap between the cabin door opening floor edge and platform edge shall be not greater than 1 inch (25.4 mm). The height of the cabin floor to the platform edge shall be within ± ½ inch (12.7 mm). Where it is not operationally or structurally practical to meet these requirements, platform devices, vehicle devices, system devices, or bridge plates shall be provided for independent loading.

(2) All windows shall be of shatter-resistant material.

(3) Means of emergency evacuation of passengers shall be provided.

(4) The maximum capacity of each cabin, both in pounds and kilograms and number of passengers, shall be posted in a conspicuous place in each cabin.

(5) The width of cabin seats shall be at least 18 inches (460 mm) per person. If passengers are to remain standing, floor space of 2.5 square feet (0.23 square meter) per person shall be available. The minimum clear floor space in accessible cabins shall be 48 inches by 30 inches (1220 mm X 760 mm). Where special accessible cabins are used, it is recommended the waiting interval not exceed 10 minutes.

(6) All carriers shall be clearly identified with numbers located on each end of each carrier.

(7) Semi-open carriers shall meet applicable requirements for enclosed cabins and open chairs.

(c) Track cable carriage wheels (Bicable systems). On bicable systems, the weight of the loaded carrier and haulage rope reactions shall be distributed to carriage wheels so that the load on any wheel shall not exceed that recommended for the track cable or the wheel liner material for the wheel diameter selected. In no event shall the load per wheel exceed 1/80 of the minimum design tension in the track cable when track strand is used with unlined wheels or 1/60 with resilient liner material. If wire rope is used as a track cable, the load per wheel shall not exceed 1/40 of the minimum design tension in the track cable.

(1) The carriage shall be equipped with a device that will, as far as possible, hold the carriage on the track cable in the event of a deropement of the wheels.

(2) In areas where icing conditions may exist, the carriage shall be equipped with ice scraping devices that cannot contact the track cable under normal anticipated operating conditions.

(d) Chairs. Chair-lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.

(1) All carriers shall be uniquely identified with numbers visible to the operator and attendant.

(2) Each chair shall be equipped with a railing at each side, to a height of not less than 4 inches (100 mm) above the seat for a distance of not less than 12 inches (305 mm) from the back of the seat.

(3) For aerial lifts operating primarily for skiers, the thickness of the chair seat front, including padding, shall not exceed 5 inches (125mm) from the top of the seating surface to the bottom of the curl. Tilt back angle of the seat bottom shall be a minimum of 7 degrees when loaded. Loaded shall mean an evenly distributed load using the test criteria. Provisions shall be made to keep the tails of skis from passing through and becoming trapped in open spaces between framework, safety restraints and chair seat underside.

(4) For aerial lifts operating primarily for foot passengers, each chair shall be equipped with a restraining device that will no open under forward pressure.

(5) The chair shall be designed to accommodate equipment for the purpose of emergency evacuation of passengers.

32-3.34 Carrier Testing. Carrier testing shall be performed to confirm design calculations. Carrier tests shall simulate as a minimum the maximum design for carrier loads including restraining bars, foot rests, bubbles, etc.

(a) Carrier tests shall verify the carrier's ability to support a vertical load during the testing by arranging loads to simulate individual passenger positions.

(b) Carriers that are new in design or have had their specifications revised shall have the following tests performed, independently certified, and the results included in the ropeway documents:

(1) Fatigue testing shall be performed using one of the two methods shown in ANSI B77.1 section 3.1.4.5 table 3-5.

(2) Carriers shall be tested to 15,000 terminal entry and exits, 5,000 of which are to be fully loaded with maximum transverse swing.

(3) Carriers shall be tested simulating horizontal loads and forces, to verify parts of the

assembly have a factor of safety of 3.6 with resect to the yield point of the material(s). Horizontal loads include centrifugal loads, grip capture forces, or guide rail forces that stress the hangers as they enter and pass through the terminals.

(c) Failure of any carrier component, while testing, is defined as permanent deformation, wear on component parts or initiation of any stress related crack that exceeds design operating tolerances. If failure occurs, the carrier shall be redesigned and the above carrier testing requirements shall be repeated.

Subchapter E - Personnel

32-3.35 Provisions for operating personnel.

(a) General. Operator and attendant stations shall be located to provide visual surveillance of the station and the line in the vicinity of the station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:

(1) the communications and controls required of the station;

(2) the operating instructions and emergency procedures;

(3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.

(c) The aerial lift operator who operates the aerial lift shall observe the aerial lift in operation and shall have an unobstructed view of its controls, including required brake controls and communicating devices, which shall be not more than 6 feet from his/her operating position. A clear and unobstructed path to such controls shall be maintained at all times. Loading and unloading areas shall have lift stopping devices located convenient to the attendants assigned to those points. The physical appearance, operation, and location of emergency shutdown devices shall differentiate them from other operating devices or controls.

(d) Loading and unloading areas shall have manual stopping devices located conveniently to the attendants assigned to those areas (see section 32-3.24(a)).

Subchapter F - Operational and Maintenance Manuals

32-3.36 Operational manual. The designer of each new or reinstalled aerial lift shall prepare an operational manual, in English, for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-3.37 Maintenance manual. The designer of each new or reinstalled aerial lift shall provide with delivery of installation, a maintenance manual, in English, for each installation. The manual shall describe recommended maintenance procedures, including:

(a) types of lubricants required and frequency of application;

(b) definitions and measurements to determine excessive wear;

(c) recommended frequency of service to specific components;

(d) grip and hanger testing procedures and acceptance criteria;

(e) brake testing and adjustment.
(f) Dynamic testing procedures

CHAPTER II - ELECTRICAL DESIGN AND INSTALLATION

Subchapter A - Design and Installation Testing

32-3.38 General. Prior to operation of newly installed aerial lifts or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this Part (rule) and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

(a) Electrical system acceptance test. Upon the completion of the acceptance test and before public operation of the aerial lift, the design and function of software and/or replay logic shall be certified by the Qualified Engineer of record and the certification shall be included in the acceptance test report. Any modifications made to the electrical design shall be clearly marked on the on-site documentation and signed by a Qualified Engineer. (see also section 32-3.12)

(b) Software security. The “as built” documents shall include a procedure, developed by the lift manufacturer or Qualified Engineer, to ensure the security of the software logic and operating parameters that will control the aerial tramway. Upon completion of the acceptance testing, this procedure shall be implemented in a manner that will prevent unauthorized personnel from making changes to the logic or operating parameters. All programmable logic and parameters shall be documented.

32-3.39 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-3.40 Location. All electrical power transmission wiring located near or proposed to cross over aerial lifts shall comply with the applicable requirements of NES C2. No aerial lift shall pass under any transmission line operating at a potential exceeding 50 volts.

32-3.41 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

32-3.42 Voltage limitations for overhead circuits. Signal, communication, and control circuits may be supported between towers that support the aerial lift. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

32-3.43 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.

(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of NFPA 70.

(c) Insulation. All control wiring is excepted from the requirements of Article 725-27(b) of NFPA 70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the aerial lift centerline, shall be ground fault protected.

32-3.44 Grounding.

(a) Structures. All metallic structures shall be bonded to form a grounding electrode system as defined in Article 250 NFPA 70 for the purpose of grounding the control circuit in such a manner that an inadvertent ground, anywhere in the control circuit, would stop the aerial lift as required in section 32-3.45(a). Electrical continuity of all metal parts of the structures shall be assured by mechanical connection and shall be electrically bonded to the common bonding conductor.

(b) Drive terminal structure. The drive terminal structure shall have one point referred to as a ground point. If an electrical prime mover is used, the electric service grounding conductor shall terminate at this point, as well as the structure's ground referenced in section 32-3.44(a). All dc and ac electrical systems shall be referenced to this point. On lifts installed after 1995 the ground point shall be as defined in NFPA 70.

(1) Under the worst-case conditions, the resistance from the ground point to any grounded point within the aerial lift system shall not exceed 50-ohms, for the purpose of grounding the control circuit. The grounding system for the aerial lift shall not be used as a grounding system for any other system not related to the aerial lift system.

(2) To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminals and line structures shall be bonded together with a common bonding conductor. The bonding conductor may be the support or messenger cable of an overhead control cable, the ground shield for an underground control cable, or some other conductor running the full length of the aerial lift system, bonded to each of the terminals and the line structures and shall be of sufficient conductance to meet the 50-ohm requirement.

(c) Haul rope grounding. Grounding sheaves with conductive liners or equivalent means shall be provided at one location for the purpose of grounding haul ropes and track cables, as applicable, for static electrical discharge. For the haul rope on bicable systems or monocable systems with an isolated or insulated haul rope incorporated in the operating circuitry, no means of grounding are required when the operating circuit takes into consideration static electrical discharge.

(d) Lightning protection. If lightning protection is provided, it shall follow NFPA 780.

32-3.45 Operating control circuits.

(a) Operating circuits. All aerial lift systems shall contain one or more normally de-energized

circuit(s) that, when energized, allow(s) the system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type. An exception to this requirement is allowed for magnetic or optically operated automatic stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit is of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All aerial lift systems shall include a normally de-energized circuit that, when energized, allows the system to run and, when interrupted, effects an emergency shutdown (see section 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the aerial lift while using the operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the aerial lift.

(1) Any one of the following conditions is considered a loss of control of an aerial lift:

(i) aerial lift will not SLOW DOWN when given the command to do so;

(ii) aerial lift will not STOP when given the command to do so;

(iii) aerial lift OVERSPEEDS beyond control settings and/or maximum design speed;

(iv) aerial lift ACCELERATES faster than normal design acceleration;

(v) aerial lift SELF-STARTS or SELF-ACCELERATES without the command to do so.

(vi) aerial lift REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and in the machine room. The shutdown device shall be conspicuously and permanently marked and shall be red in color (see section 32-3.35).

(c) Bypass circuits. A temporary bypass circuit may be installed for malfunctions in operating control circuitry (see section 32-3.58(i)).

32-3.46 Electrical prime mover and power circuits.

(a) Electrical prime mover. All aerial lift systems equipped with electrical prime movers (electrical motors) shall have phase-loss protection on all power phases and undervoltage protection or overvoltage protection, or both, when speed regulation can be adversely affected by such voltage variations.

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:

(1) field loss (dc motors);
(2) speed feedback loss;
(3) overspeed;
(3) overcurrent.

Subchapter B - Night Operations

32-3.47 General. For nighttime operation, operating aerial lifts shall be provided with lighting systems. Lighting shall be provided at loading and unloading areas.

32-3.48 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-3.49 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp-operating characteristics.

32-3.50 Location. Lights shall be mounted on substantial poles or standards. Aerial lift towers and terminal structures may be used for supporting lights subject to the following requirements:

(a) approval shall be obtained from a Qualified Engineer;
Note: Approval of a Qualified Engineer is not required for lights installed on towers prior to 1995, and is in compliance with AV-39.
(b) the service conductors to each aerial lift tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the aerial lift;
(c) a separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure;
(d) all metallic raceways on a tower or terminal structure shall be grounded;
(e) shall not interfere with operations of the aerial lift in any manner.

32-3.51 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(a) regular unloading of an aerial lift;
(b) emergency evacuation of carriers;
(c) operation of the auxiliary drive.

CHAPTER III - OPERATION AND MAINTENANCE

Subchapter A - Personnel Safety

32-3.52 General and personnel safety. This subsection covers the requirements for operation and maintenance of detachable aerial lifts. Many requirements are listed elsewhere in Subpart 3, since they also regulate installation and design. Operating and maintenance personnel shall be familiar with applicable provisions of this Chapter and the aerial lift operational and maintenance manuals (see Chapter I, Subchapter F

of this Subpart).

(a) Procedures for the operation and performance of maintenance on detachable aerial lifts shall include the precautionary measures necessary to reduce the risks for the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(b) Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

32-3.53 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the aerial lift operations shall be adequately lighted for night operation. Additional signs, deemed necessary by the owner, may be posted but not detract from the attention from any required sign.

(1) Instructions and warnings for use of aerial lifts shall be posted at loading areas and may include the duties and obligations of the passenger, as well as the Skier's Responsibility Code (see Chapter III, Subchapter F, of this Subpart).

(2) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.

(3) The sign "Personnel Working on Lift - Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when persons are working on the aerial lift (see section 32-3.13).

(b) Additional signs for gondola lifts. The maximum capacity of each cabin in pounds and kilograms and number of passengers shall be posted at each loading area.

(1) A sign shall be visible at all points of downhill loading, listing downhill capacity and maximum rope speed during passenger loading.

(2) The following information shall be prominently posted on the interior of each carrier:

(i) the maximum capacity of each cabin in pounds and kilograms and number of passengers;

(ii) instructions for procedure in emergencies.

(c) Additional signs for detachable chair lifts. The following signs shall be posted:

(1) For skier operations, a sign stating the nominal loading chair height ± 2 inches (50 mm). The sign shall be posted with riding instructions.

(2) "Remove Pole Straps from Wrists - Until Unloaded" (at loading area for aerial lifts used primarily for skiers);

(3) "Check for Loose Clothing and Equipment." (two signs required - one at the loading area and one in the vicinity of the "Prepare to Unload" sign);

(4) “Wait Here” (at wait here point);

(5) "Load Here" - (at loading point);

(6) "Keep Ski Tips Up" (on aerial lifts used primarily by skiers, ahead of any point where skiers are carried and skis may come in contact with a platform or the snow surface);

(7) "Prepare to Unload" (ahead of unloading area);

(8) Unload Here" (for skiers, at breakover point of unload platform);
(9) "Stop Gate" (if applicable);
(10) a sign shall be visible at all points of downhill loading, listing downhill capacity and maximum rope speed during passenger loading;
(11) "Close Restraint Bar";
(12) "Open Restraint Bar";
(13) "Emergency Stop Switch".

Subchapter B - Operations

32-3.54 Personnel. Detachable grip aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. Procedures for loading and unloading passengers, including passengers with common adaptive equipment, shall be included in the training. One or more persons familiar with emergency procedures shall be on the site at all times when the aerial lift is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific aerial lift.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for the operation, and shall have the authority to deny access to the aerial lift to any person who, in the supervisor's opinion, is not fit or competent to use the aerial lift without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the aerial lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

(b) Operators. An operator shall be in charge of each aerial lift. This operator shall be trained and experienced in normal operational and emergency procedures, and such training shall be documented. Operators shall be at least 18 years of age.

(c) Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view, and such training shall be documented.

(d) Conductors. If a Conductor is recommended by the manufacturer, they shall be trained for duty in connection with enclosed cabins, including loading and unloading procedures, communications, and the use of door locks and keys. The conductor shall be familiar with load limits and applicable safety regulations, well versed in the use of any safety switches under his/her control, and thoroughly trained in the use of emergency evacuation equipment and procedures, and such training shall be documented.

(e) First aid. One or more persons trained to provide first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when an aerial lift is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

32-3.55 Minimum operating personnel. The following personnel are the minimum that shall be required:

(a) an operator who shall be in charge of each aerial lift;

(b) one attendant who shall be on duty at each loading area;

(c) one attendant who shall be on duty at each unloading area.

NOTES: (1) An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the entire aerial lift operation.

(2) A station used for both loading and unloading of a single aerial lift may be staffed by a single attendant at the loading area when both the loading and unloading can be kept under surveillance by the attendant. This note does not apply to lifts when used primarily for foot passengers.

(3) Additional attendants or conductors may be required by the specifics of the design and installation.

32-3.56 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:

(1) to determine that all aerial lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties;

(2) to discontinue operations on any aerial lift due to physical, weather, personnel, or other reasons;

(3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:

(1) to assume responsible charge of the aerial lift;

(2) to assign and supervise all attendants on his/her aerial lift;

(3) to maintain an operational logbook as required in section 32-3.64;

(4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant and conductor. The duties of the attendant and conductor shall be as follows:

(1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;

(2) to advise and assist passengers, as required;

(3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the aerial lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-3.57 Operational procedures. The required operational procedures as set forth in sections 32-3.57 through and including 32-3.58 of this rule shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-3.36).

(a) Control of passengers. Each aerial lift shall have a definite method for marshaling passengers for loading and unloading. Fences, gates, and alternate access and/or loading

methods may be required to implement the system for individuals/groups.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) a visual inspection of each terminal, station, and the entire length of the aerial lift;

(2) assurance that the tension system is functional and that tension system devices (counterweights, cylinders, carriages, and the like) have adequate travel with appropriate clearances at both ends;

(3) operation of all manual and automatic switches in terminals, stations, and loading and unloading areas;

(4) operation of all braking systems;

NOTE: The designer of the aerial lift system may specify that this inspection is to take place while the aerial lift is not moving.

(5) operation of communication systems;

(6) operation of the aerial lift, including a visual inspection of all ropes and carriers;

(7) checking each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis;

(8) operation of the auxiliary engine until it reaches normal operating temperature;

(9) operation of the anti-collision system to determine that it is properly adjusted to prevent a collision;

(10) for those aerial lifts having primary power internal combustion engines, determining that the fuel quantity is sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the aerial lift. During refueling, power units shall be shut down;

(11) The aerial lift shall be operated using the APU at least 30 minutes per month;

(12) inspecting the loading and unloading areas and preparing them for the ingress and egress of passengers;

(13) clearing carriers of ice and snow to the extent necessary to permit operation, and inspecting and checking all mechanical features.

(c) Access to facilities. Entrances to all machinery, operators' and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-3.58 Operational requirements.

(a) General. The supervisor and owner of each aerial lift shall review the requirements of Chapter I of this Subpart to ascertain that original design and installation conditions have not been altered in a manner such as to violate the requirements of the rule.

(b) Starting. No aerial lift shall be started except at the direction of, or following clearance by, the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation.

(c) Loading and unloading platforms. The maze or coral, loading platform surface, breakover point, and the load/unload seat height shall be reasonably maintained according to the prevailing weather conditions and established operating procedures.

(d) Stops. After any stop of an aerial lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) Damage to carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line as soon as feasible.

(f) Hazardous conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the aerial lift shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated. No aerial lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the aerial lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to unload all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

(g) Evacuation. The owner of each aerial tramway shall submit to the commissioner, in triplicate, a detailed written plan for evacuation of passengers from cabins or carriers in the event of a power failure or breakdown. The procedures set forth in the evacuation plan shall be tested, at any location on the lift, in the presence of the Commissioner at his request. The Commissioner, when satisfied with the evacuation plan and the results of the test, shall notify the owner in writing of such acceptance. A copy of the accepted plan shall be kept on the premises and shall be readily available to the Commissioner's representative.

(1) The written evacuation plans shall include but not be limited to the following:

(i) the definition of the line of authority in the event of an evacuation. This line of authority shall list:

(*a*) the individuals or positions responsible for determining the need for an evacuation;

(*b*) the individuals or positions responsible for ordering an evacuation;

(*c*) the individuals or positions responsible for performing the evacuation, for first aid, and for ground care of evacuated passengers.

(ii) a description of the equipment necessary for evacuation and where it will be stored;

(iii) provisions for adequate training in the functions performed in the evacuation process at least once each operating season. Such training is to include at least one evacuation drill, which is to be recorded in the operational log of each aerial lift (see section 32-3.65);

(iv) a statement that sufficient number of experienced evacuation personnel will be readily available to evacuate the entire lift within 2 hours of the lift stoppage and any conditions which might cause this time to be exceeded;

(v) description of unusual terrain conditions and how each of these conditions will be dealt with during an evacuation;

(vi) an estimate of when the evacuation should begin in the event the aerial lift becomes inoperable;

(vii) provisions for communications with passengers of an inoperable aerial lift, the frequency of such communication, how soon after the aerial lift becomes inoperable such communication to the passengers will start, and the frequency of communications thereafter;

(viii) the methods of evacuation to be used for the typical passenger, incapacitated passengers, common adaptive ski equipment, and non-ambulatory passengers;

(ix) provisions for communication with the evacuation teams;

(x) provisions for suspending the evacuation in the event that the aerial lift is made operable during the evacuation;

(xi) provisions for control and assistance of evacuated persons until released;

(xii) provisions for a written post-evacuation report available for review by the Commissioner.

(2) All nonmetallic rope used for evacuation shall be of nylon or polyester (Dacron) fiber of either laid or braided construction. Laid rope of nylon shall be of a hard lay. These ropes shall be either of a static rescue type or a dynamic mountaineering type. Breaking strength, when new, shall be at least 15 times the maximum expected operating load but in no case less than 5,000 pounds (17.8 kilonewtons). No natural fiber or polypropylene ropes shall be used.

(3) These ropes shall be carefully stored when not in use and shall be examined after each completed aerial lift evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

(4) Carabiners, if used, shall be of the locking type.

(5) A special separate written evacuation plan shall be provided when the aerial lift is used primarily for foot passengers such as for sight seeing or amusement rides. This plan shall include a specific outline for the evacuation of the very old and/or very young, including babes in arms. All of the requirements of section 32-3.58(g) shall apply to this plan including the requirement for training and evacuation drills.

(h) Termination of daily operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the aerial lift after it has been shut down. Loading ramps, as required, shall be closed and so marked. When either loading or unloading portions of an intermediate station is not in operation, it shall be so signed and the loading station shall be closed to public access.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this subsection shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating circuit malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the aerial lift supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close, visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;
(5) the operator control panel shall indicate that a bypass is in use;
(6) when a required aerial lift control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the lift until the malfunction is corrected.

Subchapter C – Maintenance and Dynamic Testing

32-3.59 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer or a Qualified Engineer (see section 32-3.37) shall be followed. Maintenance records shall be kept (see section 32-3.66).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:
(1) all wire rope, strand, and chain;
(2) line sheave units, sheaves, bearings, and liners;
(3) bull wheels, bearings, and liners;
(4) tension systems;
(5) drive system, including bearings and couplings;
(6) braking systems;
(7) electrical control systems;
(8) communication systems;
(9) carriers;
(10) grips;
(11) structures;
(12) lift line (see section 32-3.4).

(c) A written schedule for systematic dynamic testing shall be developed and followed. The schedule shall establish specific frequencies and conditions for periodic testing. The testing shall simulate or duplicate inertial loadings. The test load shall be equivalent to the design live load. Dynamic testing shall be performed at intervals not exceeding seven (7) years. The testing shall include, but not be limited to the following:
(1) braking systems;
(2) auxiliary power units;
(3) tension system;
(4) electrical systems.

32-3.60 Maintenance personnel. Detachable grip aerial lifts shall be maintained by trained and competent personnel, and the owner shall be responsible for their supervision and training, and such training shall be documented. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific aerial lift.

32-3.61 Rope grips. Detachable rope grips shall be disassembled for inspection, adjustment, and replacement of worn parts at intervals not to exceed those recommended by the designer. Components not meeting the minimum specifications of the manufacturer shall be replaced.

Subchapter D - Inspections and Testing.

32-3.62 Wire rope, strand, and chain inspection. Inspection of wire rope, strand, and chain shall comply with ANSI B77.1, Section 7, parts 7.4.1, 7.4.2, and 7.4.4. A copy of the report signed by the person performing the inspection shall be kept at the site, available to the Commissioner.

32-3.63 Grip and carrier testing.

(a) All grips, hangers, chairs, and cabins shall be tested against acceptance criteria established by the designer or manufacturer; or in cases in which the designer or manufacturer is no longer in business and the original criteria are no longer applicable, by a Qualified Engineer.

(b) Each grip, hanger, chair, and cabin shall be uniquely identified by the manufacturer or owner. The test sampling method shall identify the parts tested to assure a rotating minimum test sample of 10 or 10%, whichever is greater, of each aerial lift's grips, hangers, chairs, or cabins per year. Alternatively, all units may be tested every 6 years or 6000 hours, whichever comes first. If any defects are found, the designer/manufacturer/Qualified Engineer shall be consulted to determine whether an increased sample size is warranted. Units failing to meet the acceptance criteria shall not be placed back into service until their defects are corrected.

(c) If the grips, hangers, chairs, or cabins are tested by an agency other than the original equipment manufacturer, then the original aerial lift manufacturer shall receive a copy of the test procedure and results. In all cases, the owner shall receive a copy of the test procedure and the test results.

Subchapter E - Records

32-3.64 Operational log. A logbook shall be maintained for each aerial lift. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;
(e) record of compliance with daily operational inspection including loading and unloading platforms and ramps;
(f) position and condition of the tension carriage, counterweights, or other tension system devices;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator;
(i) record of aerial lift evacuations and evacuation drills (see section 32-3.58(g)(1)(iii)).

32-3.65 Wire rope, strand, and chain log. A logbook shall be maintained for each aerial lift, giving the

following information on each rope, strand and chain:

(a) specification;
(b) copy of certified test report;
(c) date installed;
(d) splicing certificate for each splice or laid-in strand;
(e) record of lubrication, including type of lubricant and date applied;
(f) record of maintenance inspections;
(g) report of wire rope, strand, and chain inspection;
(h) report of accidents or injury to: wire rope, strand, or chain;
(i) documentation of end attachment.

32-3.66 Maintenance log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct.

32-3.67 Dexterity and ability. A passenger who uses an aerial lift shall be presumed to have sufficient skiing ability, physical dexterity or personal assistance to negotiate and be evacuated from the aerial lift safely. Each passenger shall maintain control of his/her speed and course while loading or unloading the aerial lift.

32-3.68 Embarkation and disembarkation. A passenger shall get on and get off an aerial lift at designated areas. No passenger shall embark without first understanding the proper loading, riding, and unloading procedures (see section 32-3.53).

32-3.69 Riding. Passengers, while riding an aerial lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the aerial lift. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

SUBPART 32-4
GENERAL PROVISIONS
Fixed Grip Aerial Lifts

Section 32-4.1 This Subpart covers that class of passenger ropeways wherein the carriers circulate around the system, remaining attached to the haul rope. The carriers travel from one terminal to the other along one path and return along another path, making U-turns in both terminals. This Subpart does not include ropeways wherein the passengers are in contact with the ground or snow during the trip. The aerial lifts covered by this Subpart are of the monocable type. The carriers may be open chairs or cabins.

32-4.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-4.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the aerial lift type and location:
- (1) electric power lines and their supports;
- (2) railways;
- (3) highways;
- (4) structures;
- (5) rock and earth slides, cave-ins, washouts, and the like;
- (6) snow creep and avalanches;
- (7) wind action;
- (8) icing;
- (9) ski slopes and trails;
- (10) rivers and gullies;
- (11) buried installations, including pipelines;
- (12) crossing or close proximity to other passenger tramways;
- (13) control of air space below, above, and adjacent to the installation;
- (14) carrier height above all surfaces;
- (15) passenger accessibility.

(b) RESERVED

32-4.4 Width of clearing. The clearing shall be wide enough to prevent adjacent vegetation from interfering with the aerial lift. Carriers shall not contact trees or vegetation during operational surges, or during maximum design wind conditions, or both. Trees and other vegetation shall be cleared a minimum of 5 feet (1.53 meters) from haul ropes and carriers under normal (non-surge) operating conditions. Clearings shall be maintained to avoid washouts that might endanger the installation (see section 32-4.59).

32-4.5 Path of rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration.

(a) Vertical clearances.

(1) The following reference points will be used in determining vertical clearances for these carrier/passenger combinations:
- (i) For cabins and empty chairs – Vertical clearances shall be referenced from the lowest point of the carrier.
- (ii) For chairs carrying foot passengers – Vertical clearances shall be referenced from a point 2 feet (0.61 meters) below the top of the chair seat.
- (iii) For chairs carrying skiers – Vertical clearances shall be referenced from a

point 5 feet (1.53 meters) below the top of the chair seat.

(2) Along the line between terminals, the following vertical clearances shall exist between the above carrier reference points and the terrain or other obstacles, including maximum design snow depth:

(i) Where skiing is permitted beneath the lift, a minimum of 8 feet (2.44 meters) shall be maintained;

(ii) Where the clearance is less than 8 feet (2.44 meters), provisions shall be made to prevent access by unauthorized to the area beneath the aerial lift;

(3) Under the most adverse loading conditions, while the aerial lift is being operated, a minimum space of 5 feet (1.53 meters) shall be maintained between the lower edge of carriers or ropes and the terrain, vehicles, or other possible obstacles, including snow.

(4) Where aerial lifts cross one another, the following conditions shall bee met:

(i) Any deropement of the upper aerial lift shall cause both aerial lifts to stop and a deropement of the lower aerial lift that reduces the clearance between the aerial lifts shall cause both aerial lifts to stop;

(ii) The minimum vertical clearance between the haul rope of the lower aerial lift and the top of the carrier seat of the upper aerial lift shall be 15 feet (4.57 meters) under the most adverse loading conditions.

(b) Horizontal clearances.

(1) Line clearances. The minimum distance between passing carriers, each swung 10 degrees inward from the vertical, shall be the greater of the following:

(i) 30 inches (760 mm); or

(ii) 1/2% of the span length (applies to gondolas only).

(iii) The distance between haul ropes, for the purpose of these checks, shall be considered as equal to the gage of the line.

(iv) There shall be no contact between any tower machinery, guard, or obstruction, and any part of a carrier when a carrier is swung in any of the following conditions: 15 degrees laterally from vertical or 15 degrees longitudinally from vertical; the combination of 15 degrees lateral and 15 degrees longitudinal; the combination of the lateral angle alpha and 15 degrees longitudinal, where α (alpha) is equal to 5 degrees plus the angle created by a 250 pound (113 kg) passenger positioned in the passenger seat causing the greatest angle of inclination, in a static condition, in any direction.

EXCEPTIONS: Towers may be equipped with guards to limit lateral swing to not less than 8 degrees provided the following minimum clearances are maintained:

(1) On chair lifts. 12 inches (305 mm) between the innermost point on chair structure and the tower clearance line or surface;

(2) On gondola lifts with open windows on the tower side. 18 inches (460 mm) between the innermost point of cabin and the tower clearance line or surface.

(v) Guards may be placed to limit the swing of carriers between 8 and 15 degrees as required to maintain this clearance.

(vi) Guards shall be so shaped and located that a 30-degree lateral swing from vertical shall not place any part of the loaded or empty carrier on the inner side of the

guard. Guard configuration shall provide for reversal of carrier travel direction during testing or other special operating conditions and must preclude entanglement when a carrier is swung laterally 15 degrees.

(vii) On all towers, with or without guards, when a carrier is swung longitudinally by 15 degrees, there shall be no contact between any obstruction and any part of the carrier.

(2) Special clearances required for chair lifts used for skiing. For chair lifts used for skiing, the following clearance requirements shall be met to prevent entanglement of skis with the tower structure. Clearance is herein defined to mean the distance between the inner limit of the passenger seat and the clearance line or surface of the tower.

(i) With the carrier swinging laterally 10 degrees from the vertical position, or to the limit permitted by any guards, if clearances are less than 24 inches (610 mm) from any open frame tower or 18 inches (460 mm) from any closed tubular tower, ski tip deflectors shall be provided on each side where passengers wearing skis are allowed, to reduce the risk of skis being caught in the structure. Such deflectors shall be at least 6 feet (1.83 meters) in height, extending 36 inches (915 mm) above and 36 inches (915 mm) below average foot level.

(ii) A tubular tower with permanent ladder rungs shall be considered as an open-frame tower, unless it can be demonstrated that ski tips cannot be caught in the ladder. In this case, the tower may be considered as a closed-tubular tower.

(3) Terminal clearances.

In terminal areas, there shall be no contact between any terminal machinery, guide, or other lift structural component and any part of a loaded carrier when the carrier is swung from the vertical to plus or minus 15 degrees longitudinally from the vertical and /or the greater of:

(a) 15 degrees laterally from vertical;

(b) laterally 5 degrees plus the angle created by a 250 lb. (113.4 kilogram) passenger positioned in the passenger seat causing the greatest angle of inclination, in any direction.

Exceptions – Guides or similar devices including bull wheel flanges or reaction rings may be provided to limit lateral swing in either or both directions. Such guides or devices shall be designed to engage the carrier smoothly and allow plus or minus 15 degrees longitudinal swing from vertical. While the carrier is engaged in the guides, the following minimum clearances shall be maintained:

(1) On chair lifts, 18 inches (460 mm) between any point on the chair structure and any obstacle in the guarded direction;

(2) On gondola lifts with open windows, 18 inches (460 mm)between any point on the cabin and any obstacle in the guarded direction.

(ii) External structures, posts, or obstructions, other than lift structural components, shall have at least 4 feet (1.22 meters) of clearance from either edge of a loaded open carrier passenger seat or open cabin body (measured from the outermost attachments on or parts of the carrier while the carrier is hanging in a vertical position).

EXCEPTION: Control consoles may have a clearance of 30 inches

(760 mm).

(c) Path of rope adjustment. When terminals, towers, or both, contain provisions for a change in height of the rope in order to meet normal changes in operational requirements, such provision shall be controlled as follows:

(1) The designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments;

(2) Where range of adjustments allows possible operator error resulting in improper sheave loading, a system to readily verify the proper profile, without the use of tools, shall be incorporated into the installation.

32-4.6 Capacity and speed. The maximum carrier speed relative to the surface of loading and unloading platforms during loading or unloading operations shall not exceed the values shown in Table 32.4-1. The designer shall specify the design capacity in each direction. The speeds listed in Table 32.4-1 may be increased if a lift is slowed or stopped for loading and unloading, but in no case shall the speed exceed that specified by the designer and established as functional by testing and operational performance.

Table 32.4-1
Maximum relative carrier speed, in feet per minute (meters per second), for chair lifts with fixed grips

Passenger type	Single Chair	Double Chair	Triple Chair	Other Chairs
Skiers	600 (3.0)	550 (2.8)	500 (2.5)	450 (2.3)
Foot Passengers	350 (1.8)	300 (1.5)	275 (1.4)	250 (1.3)

Aerial lifts installed and approved to operate at 350 feet per minute prior to 1995 are exempted from the 300 feet per minute limit.

32-4.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal conditions. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) RESERVED

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost-susceptible soil or solid rock. Foundations on rock shall be firmly

anchored to solid rock, unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for protection of foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus wind acting simultaneously.

32-4.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power and the communication system shall be functional and audible during a power failure. On lifts installed prior to 1995 radiophones or suitable public address systems may be used.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

32-4.9 Internal combustion engine installation.

(a) Fuel tanks for combustion engines. Fuel tanks shall have adequate capacity to permit uninterrupted operation during the normal operating period. Internal combustion engines hereafter installed shall comply with NFPA 37.

(1) On internal combustion engines hereafter installed, liquid fuels shall be supplied and handled in accordance with NFPA 30. Gas fuels shall be in accordance with NFPA 58. Liquid Fuels stored outside the motor room, either above or below ground, shall be in compliance with the appropriate regulatory authority.

(2) For the purposes of interpreting NFPA 37, the auxiliary power units utilizing a combustion engine shall be considered, "used for emergency purposes". Also, "on roof of structure" shall mean "on the drive terminal structure". Structural members shall not be used as fuel tanks.

(3) An integral tank is a fuel tank furnished by the engine manufacturer. It shall be securely mounted to the engine assembly and protected against vibration, physical damage, engine heat, and the heat of exhaust piping.
EXCEPTION: The aerial lift manufacturer may supply an integral or day gasoline fuel tank for mounting on a combined drive-tension carriage or an overhead fixed drive terminal. The tank shall be sized 25 gallons (94.6 liters) maximum, constructed, and installed in accordance with applicable provisions of NFPA 37.

(4) Standard portable marine fuel tanks (boat tanks) can be used in lieu of an integral fuel tank. Such tanks are limited to 7 gallons (26.5 liters) capacity and shall be secured while in use.

(5) Fill pipes located beyond the sides of the building or motor room shall have a locked fuel cap. Fill pipes shall be located to avoid toxic fumes and fire hazard during refueling.

(b) Exhaust systems. Exhausts systems shall be designed and installed to discharge to the

atmosphere in a manner which does not allow precipitation to enter the exhaust system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields for a distance of 8 feet (2.44 meters) above the floor or other walking or working surface, or to the ceiling if less than 8 feet (2.44 meters), and shall be insulated where they pass through combustible building materials.

(c) Ventilation. Internal combustion engine products of combustion shall be exhausted to and dispersed in the outer air. The machine room shall be ventilated so as to prevent air contamination within the room from the products of combustion which tends to injure the health of any person therein or to create a fire or explosion hazard (see section 32-4.19(c)).

32-4.10 Loading and unloading areas. Platforms, ramps, corrals, mazes, and staging areas comprising the loading and unloading areas of an aerial lift are integrally related to its operation. They shall be designed and installed in conformance with the applicable criteria. Handrails, nets, steps, or ramps shall be provided to reduce the risk of injury to passengers and maintenance and operating personnel, when required. Terminals, towers, and other structures or obstacles adjacent to the loading and unloading areas shall be designed or guarded to reduce the possibility of entanglement with these items. Carriers passing loading and unloading areas shall not vary in height above the platform surfaces by more than 4 inches (100 mm) under the most adverse conditions of carrier design loadings and rope tensions. The haul rope shall approximately parallel the platform. Intermediate unloading and loading stations located in tandem to allow simultaneous unloading and loading shall have the unloading point and loading point separated by a distance in feet (meters) no less than 8 times the maximum rope speed in feet (meters) per second. When either the loading or unloading portions of an intermediate station is not in operation, it shall be so signed, and the loading station shall be closed to public access at the loading platform entrance.

(a) Loading areas. The loading area length, profile, and loading point shall be installed according to the aerial lift's speed, terminal sheave location, and carrier type, such as to minimize carrier swing while loading passengers.

(1) Load gates, artificial surfaces, and other loading aids when used shall be designed and installed with regards to all passengers. At least one point of access to the lift shall have a minimum clearance width of 36 inches (915 mm) to accommodate skiers using adaptive equipment.

(2) Approach paths to the loading platform shall be approximately level or slightly down sloped to facilitate passengers moving to the loading point. The approach paths shall be such that waiting passengers have a view of the loading area. The maze or corral area shall be approximately level, free of obstructions and marked, roped, or fenced in a manner to guide passengers to the “Wait Here” and “Load Here” markers. The corral and maze should be as straight as possible with gradual turns.

(3) For aerial lifts used primarily by foot passengers, the loading area shall be provided with approximately level load platforms and the necessary handrails, steps, or ramps to provide guidance and public control.

(4) The “Wait Here” point shall be marked. This marker shall be located to provide horizontal clearance between passengers at the “Wait Here” point and passing carriers.

(5) The loading point shall be approximately level, marked as to where the passengers are to position themselves using a “Load Here” marker located on/in the platform/snow surface. The width of the “Load Here” marker shall not be greater than the carrier width.

(6) Elevated loading areas shall be protected on all sides by guardrails, safety nets or ramps.

(b) Unloading areas. The unloading area length, profile, unload point, and exit ramp shall be installed according to the aerial lift's speed, terminal sheave location, and carrier type.

(1) The approach end of the unloading area shall be fitted with inclined guards as necessary to reduce the risk of passengers or their equipment from being entangled with the platform edges. The rope gradient shall not be more than 10 percent upward or downward.

(2) The unloading point where the passengers stand up and disembark shall be marked on or near the unloading surface. For unloading skiers on a snow surface, this point shall be at the breakover point where the exit ramp starts. The chair height shall not exceed 22 inches (560mm). This point shall be signed "Unload Here," as required in section 32-4.53(c)(6). An exit ramp for skiers shall not be sloped downward more than 40 percent.

(3) Foot passengers shall be provided with nearly level unload platforms and the necessary handrails, steps, or ramps to exit the unload area. The exit route for foot passengers shall be designated.

(4) The width of the unloading path on the unloading platform and the breakover point shall be greater than the carrier width. There shall be no impediment to obstruct passengers inadvertently failing to unload. Appropriate guards are required to reduce the risk of injury caused by catching equipment or passengers failing to unload and pass the unload point.

(5) Elevated unloading areas shall be protected on all sides by guard rails, safety net or ramp.

(6) When an aerial lift is designed for skiers to unload in close proximity to the haul rope terminal sheave, normally designated as bullwheel unloading, the following requirements shall be met:

(i) the unloading point and exit ramp shall be so located in relation to the point of tangency of the bull wheel, that the unloading passengers skiing down the ramp shall be able to accelerate away from their carrier;

(ii) the automatic stop device (stop gate) required in section 32-4.24(b)(1) shall be located to stop the aerial lift in the event a passenger fails to unload. Provisions shall be made to unload such passengers from the carrier onto an unload platform without lift reversal or carrying passengers beyond the platform.

32-4.11 Provisions for evacuation. Aerial lifts shall be provided with means to evacuate passengers from stranded carriers. Provisions shall be made in the design of the aerial lift for emergency evacuation of all passenger (see section 32-4.58(g)).

32-4.12 Acceptance inspection and tests.

(a) Acceptance inspection. Before an aerial lift that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) Terminal and tower rope working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer

responsible for design.

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;
(ii) lubrication of all moving parts;
(iii) alignment and clearances of all open gearing;
(iv) installation and alignment of all drive components;
(v) position and freedom of movement of counterweights or other tension systems and carriages;
(vi) haul rope alignment at entrance to bull wheels;
(vii) operation of all electrical components, including circuit protection and grounding;
(viii) brake torque testing;
(ix) minimum clearances for haul rope sags under the most adverse static loadings;
(x) proper alignment of haul rope sheave units;
(xi) actual testing of evacuation equipment and procedures at the most difficult location;
(xii) proper location of towers and terminals in accordance with the plans and specifications.

(b) Acceptance tests. Before an aerial lift that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit in writing an acceptance test procedure. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Thorough load and operating tests shall be done in the presence of the Commissioner and shall be performed under full loading and any partial loadings that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. For chair lifts wherein loaded chairs can pass around the terminal (see section 32-4.24(b)(1)(ii)), the test shall include passing a loaded carrier with 110% of the design live load around the bull wheel at full speed. The functioning of all push-button stops, automatic stops, limit switches, deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings (see section 32-4.17). Motive power and all braking and rollback devices (see section 32-4.18) shall be proved adequate under the most adverse loadings.

(2) Prior to the acceptance inspection and the above acceptance tests, the aerial lift shall be operated continuously at least 6 hours with empty carriers to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related conditions.

(3) All terminal and line equipment shall be thoroughly checked both before and during the continuous run test.

32-4.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the aerial lift

design to render the system inoperable when necessary for the protection of personnel working on the aerial lift. See section 32-4.53 for placement of applicable warning signs.

Subchapter B - Terminals and Stations

32-4.14 Power units.

(a) General. All aerial lifts shall be equipped with at least two power units, one of which meets the requirements section 32-4.14(b). All power units shall have capacity to handle the most unfavorable design loading conditions, including the starting of an aerial lift loaded to 110% of capacity in weight.

(1) Where manual multispeed transmissions are used on a power unit, they shall not be shifted when the aerial lift is moving.

(2) Where reverse capability is provided on a power unit for an aerial lift, provisions shall also be made to prevent accidentally shifting into reverse whenever the aerial lift is operating.

(b) Auxiliary power unit. An auxiliary power unit (APU) with an independent power source shall be provided that can readily be used to unload the line in the event of failure of the primary power unit. At least one auxiliary power unit shall not depend on the mechanical integrity of any other power unit to drive the ropeway. On Lifts installed after 1995 this unit shall be electrically wired to meet the requirements of section 32-4.45(b) so that it can be stopped by the Emergency Shutdown Circuit. As a minimum, the auxiliary power unit shall be capable of starting and moving a line with all carriers loaded to 110% of capacity in weight in a forward direction at not less than 100 feet per minute (0.5 meters per second) or at an average speed in feet per minute equal to 1/60 the slope length of the aerial lift in feet (meters per second equal to 1/3600 the slope length of the aerial lift in meters), whichever is greater.

(1) The auxiliary power unit shall be designed to become operational and move the carriers to terminal areas within 1 hour from the time of initiating its connection.

(2) Auxiliary units shall be used only for unloading of passengers, passenger evacuation and maintenance work.

32-4.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting an aerial lift under the most unfavorable design loading conditions without exceeding design rating. They shall have a service factor appropriate for the application.

32-4.16 Bearings, clutches, couplings, and shafting. Bearings, clutches, couplings, shafting and universal joint shafts shall be selected on the basis of the manufacturer's published data for the particular use.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

(b) All shafting shall be designed in accordance with accepted standard practices.

(c) Guarding and containment shall be in accordance with the provisions of section 32-4.19.

32-4.17 Acceleration and speed control. The drive equipment shall be designed to accelerate the line smoothly and to avoid severe oscillation or undulation under any loading condition. The aerial lift is to be

started at its lowest point of speed range after any type of stop.

(a) The drive shall be capable of moving the unloaded system at reduced speed for rope inspection and equipment maintenance. This reduced-speed operation may be obtained by the use of the auxiliary power unit.

(b) On installations in which a forward overhauling condition exists:

(1) Provisions shall be made for an overhauling load so that the system shall operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under section 32-4.18. Where the provision made for controlling an overhauling load consists of regenerative capability or a similar characteristic in the prime mover itself, the auxiliary power unit shall have a comparable capability;

(2) Provision shall be made for slowing and stopping the aerial lift drive automatically if the line speed exceeds the design speed by more than 10%.
NOTE: Design values of line speed pertain to the design speed for the particular condition of operation (that is, skiers or foot passengers).

(j) Where the aerial lift is not rated for downhill passenger traffic, the following number of loaded chairs, loaded no more closely than every fourth chair, shall be permitted for the carrying of authorized persons downhill; the requirements for a stop gate (section 32-4.24(b)(1)) beyond the downhill unloading area and for slowing and stopping the aerial lift drive automatically as set forth in section 32-4.17(b)(2) shall be waived.

Total number of carriers on chair lift (both sides)	Maximum number of loaded carriers on downhill rope
Less than 60	2
60 to 120	3
Over 120	4

(ii) For the purpose of this section only, authorized persons are defined to include all persons, whether employees of the aerial lift owner or not, who are authorized by the owner or the owner's representatives to be carried on the aerial lift.

(iii) All installations in which downhill traffic is either limited or not permitted shall be so identified with clearly visible signs at loading or unloading areas, and this information shall be further contained in operating instructions posted in these areas.

Table 32.4-2
Required Stopping Devices

Aerial lift category	Service Brake	Drive sheave brake	Roll-back device	Drive Train backstop	Retarding device (see 32-4.17)

Self braking: A lift that decelerates, Stops & remains stopped Within the service brake performance requirements without a braking delay	Not∗ Required	Required	Not Required	Not Required	Not Required
Non-overhauling: A lift that will not Accelerate in either Direction when it is not Driven, but is not self- Braking	Required	Required	Not Required	Not Required	Not Required
Overhauling reverse Direction A lift that will accelerate In the reverse direction When it is not driven	Required∗	Required	Required	Required	Not Required
Over hauling forward A lift that will accelerate In the forward direction When it is not driven	Required	Required	Not Required	Not Required	Required

∗ A service brake is not required if the overhauling, reverse direction aerial lift will meet the service brake stopping requirements under the most unfavorable design loading conditions.

32-4.18 Brakes and rollback device.

(a) General. The aerial lift shall have the following friction-type brakes and other devices as specified in Table 32.4-2:

- service brake (see section 32-4.18(b));
- drive sheave brake (see section 32-4.18(c));
- rollback device (see section 32-4.18(d));
- drive train backstop (see section 32-4.18(e)).

Exception: A drive train backstop is only required of lifts installed after 1995, existing lifts with drive train backstops shall comply with section 32-4.18(e).

(1) All braking systems shall be designed to ensure that:

(i) once the aerial lift begins movement in the intended direction, the brakes are maintained in the open position;

(ii) the service brake shall not open prior to the drive system developing sufficient torque to prevent overhauling.

EXCEPTION: For an aerial lift which overhauls only in the reverse direction, a drive train backstop may be used in lieu of the above.

(2) The service brake, drive sheave brake, rollback device, and drive train backstop device shall be designed such that failure of one system will not impair the function of the other systems, and all brakes shall have the braking force applied by springs, weights, or other approved forms of stored energy.

(3) The service brake, drive sheave brake, rollback, and drive train backstop devices shall be designed to assure operation under all anticipated conditions.

(4) Stopping distances specified in 32-4.18(b) shall be achieved by each brake without the aid of other braking devices or drive regeneration.

(5) Each braking system shall be capable of operation to comply with daily inspections required by 32-4.57(b)(4)).

(6) A Qualified Engineer shall furnish a written procedure to be followed, and specify the auxiliary equipment necessary, for periodic testing and adjustment of the holding power of each brake and backstop device. This procedure shall be performed during the acceptance test, and at the frequency specified, to demonstrate the ability of each brake to produce the required torque. The means of testing shall be acceptable to the Commissioner.

(7) Such testing shall be performed weekly and the results recorded; as part of the normal maintenance during the operating season, but only when the aerial lift is not open to the public.

(8) If a device is permanently installed to cause a brake, rollback, or drive train backstop device to be disabled for testing, it shall be monitored at the operator's station to give warning when the brake is so disabled.

(b) Service brake.

(1) The service brake can be located at any point in the drive train such that there is no belt, friction clutch, or similar friction-type device between the brake and the drive sheave.

(2) The service brake shall be an automatic brake to stop and hold the aerial lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted such that it will stop the aerial lift from full speed, with the design loading condition most unfavorable to stopping, in a distance not exceeding the larger of 10 feet (3.0<u>5</u> meters), or a distance in feet (meters) equal to $V^2/8000$ where V is the lift speed in feet per minute ($1.5\ V^2$ where V is the lift speed in meters per second).

(3) The brake shall be in a normally applied position. It shall be held open for operation of the aerial lift and shall be applied when power is removed or the aerial lift is stopped.

(c) Drive sheave brake. The drive sheave brake shall operate on the drive sheave assembly.

(1) Application of the drive sheave brake shall automatically disconnect the power source to the power unit in use. This brake shall act automatically when the speed of the haul rope exceeds the design value by 15% in either direction on an overhauling aerial lift.

(2) The drive sheave brake shall be capable of being activated both manually and automatically to stop and hold the aerial lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted so that it will stop the aerial lift from full speed, with the design loading condition most unfavorable to stopping, within the parameters specified in section 32-4.18(b).

(3) The controls for the brake shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls. Controls shall not be more than 6 feet from the normal operating position of the operator.

(d) Rollback device. The rollback device shall act directly on the drive sheave assembly or on the haul rope. When it has been determined that under the most adverse design loading condition, haul rope slippage will not occur, the rollback device may be located at the return sheave assembly. However, the rollback device shall not be located at other than the drive station, unless its location will not decrease the factor of safety of the haul rope below the minimum permissible value whenever the rollback device is statically engaged. Under the most unfavorable design loading condition, the rollback device shall automatically prevent reverse rotation of the aerial lift before the haul rope travels in excess of 36 inches (915 mm) in the reverse direction.

(e) Drive train backstop. A drive train backstop device shall conform to the following requirements:

(1) A drive train backstop device is a one-way or overriding clutch device. The drive train shall be so arranged such that there is no belt, friction clutch, or similar friction-type device between the backstop device and the drive sheave;

(2) The backstop device shall be rated for the maximum design load;

(3) Under the most unfavorable design loading condition, the backstop device shall automatically prevent reverse rotation of the aerial lift before the aerial lift travels in excess of 36 inches (915 mm) in the reverse direction;

(4) all backstops installed after 1995 shall be disengageable as required for the individual testing of brakes.

32-4.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provisions shall be made for appropriate containment of said components. On lifts installed after 1995 guards shall conform to ASME B15.1.

(1) Protection against static electricity shall be provided.

(2) Fire-fighting device(s) shall be available.

(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.

(c) Machinery housed in a machine room. The machine room shall be adequately ventilated (see section 32-4.9(c)). It shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of the machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. On lifts installed after 1995, means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-4.20 Sheaves in terminals and stations.

(a) General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and

installed in accordance with the recommendations of the manufacturer of the bearings.

(1) When unlined sheave grooves are used for wire rope, they shall be V-shaped and have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

(2) When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

(b) Haul rope terminal sheaves (Bull wheels and deflection sheaves). Provisions shall be incorporated in the terminal design on lifts installed after 1995 to retain the terminal sheave in its approximate normal operating position in the event of failure of the bearings, shaft, or hub.

(1) Provisions shall be incorporated in the terminal and rope retention design to control the position of the rope, including possible overhaul, to minimize the effects of its departure from its normal operating position.

(2) The minimum diameter of terminal sheaves shall be 80 times the nominal diameter of the haul rope. The sheave assembly or related structures shall be designed to minimize the probability of a deropement. A flange extension of 1 1/2 times the rope diameter (measured radially from the bottom of the rope groove) shall be one acceptable means of minimizing the probability of deropement when in full compliance with the provisions of section 32-4.20((d).

Table 32.4-3
Design coefficient of friction for sheave liners

Sheave liner	Coefficient of friction
Steel or cast iron grooves	0.070
Leather	0.150
Rubber, neoprene, or others	0.205

(3) Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove. The design coefficient of friction for a particular sheave liner shall not exceed the values shown on Table 32.4-3.

Table 32.4-4
Minimum diameters for counterweight rope sheaves and sheaves not specifically covered elsewhere in this rule

	SHEAVE DIAMETER		
Rope Type	Condition A	Condition B	Condition C
6 X 7	72d	42d	24d
6 X 19	45d	30d	20d
6 X 37	27d	18d	12d

Note – d equals the nominal rope diameter

(c) Sheaves in tension systems and sheaves not specifically covered elsewhere in this standard. The minimum diameters for these sheaves shall be as indicated in Table 32.4-4.

(1) Condition A is applicable where bending around sheaves is of major importance.

(2) Condition B is applicable where bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, and the like.

(3) Condition C is applicable to sheaves that are not intended to rotate due to any tension sheave movement but are intended to rotate only due to counterweight adjustment.

(4) Provisions shall be made to assure that all counterweight sheaves rotate freely.

(d) Haul rope line sheaves.

(1) General. The requirements of 32-4.28 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(i) sheaves that carry no load other than the weight of the rope and carriers;

(ii) sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves.

(2) In such cases, the design shall be modified to meet the requirements of the particular installation.

(3) Guide sheaves shall be located in order to prevent misalignment of rope entering and leaving the drive and return sheaves. Such sheaves shall be as close as practicable to the drive and return sheaves, but not farther than one diameter of the drive or return sheave from the point of tangency. Shoes, rollers, or sheaves shall be placed on the opposite side of the rope adjacent thereto, to prevent deropement in that direction.

(4) These requirements apply to all installations except floating tension sheave carriages (see section 32-4.21(d)).

32-4.21 Tension sheave carriages.

(a) General. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion produced by the most unfavorable design loading and operating conditions.

(b) Rigid mounted carriages. The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the tension system shall be supported on rigid, straight rails by means of wheels or other low friction devices. All design loads including torsional loads due to driving torque, braking torque, or reactions of a rollback device shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations.

(c) Mechanical stops for rigid mounted carriages. Mechanical stops shall be provided to prevent over-travel of the carriage and the tension sheave. On lifts installed after 1995, these stops, and the terminal structure, shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the tension system reaction on the bull wheel.

(d) Floating tension sheave carriages. The sheave mounting shall be installed and operated in such a manner that the haul rope, in every case, considering every possibility of overloading, remains in the center of the sheave groove. The lateral tilt of the sheave shall not exceed one degree from the horizontal when in a stationary position, and when the up-going and down-going unloaded carriers are equidistant from the sheave.

(1) To prevent excessive side tilt in the event that a loaded carrier passes around the sheave, 2 counterweight ropes shall be connected at 2 points on the mounting frame of the sheave. The connections of the tension system or anchor cables to the sheave frame and

the support points of the cables shall be spaced a minimum of 70% of the pitch diameter of the sheave and increased as necessary to limit the allowable lateral tilt of the sheave to a maximum of 6 degrees from the static position when passing a carrier with full design load.

(2) The design shall incorporate provision for adjustment to control the position of the haul rope entering the terminal sheave.

32-4.22 Tension systems.

(a) General. Counterweights, hydraulic and pneumatic cylinders, or other suitable devices shall be used to provide the tensioning requirements of the particular installation. All devices used to provide the tension shall have sufficient travel to adjust to all normal operating changes in loading and temperature.

(1) The tension for haul ropes for all modes of operation shall be determined by the design engineer. Tension systems may be automatic or manual; however, all systems shall have monitoring equipment that will automatically prevent operation outside of design limits (see 32-4.24(b)(3)).

(2) Tension systems may be adjustable to provide proper tensions for different modes of aerial lift operation.

(3) The tension system design shall consider changes, for each mode of operation, in tensions due to rope elongation, friction and other forces affecting traction on driving, braking, or holding sheaves, tower and sheave loading, and maximum vertical loads on grips to assure that tensions remain within design limits.

(b) Hydraulic and pneumatic systems. Hydraulic and pneumatic cylinders, when used, shall have sufficient ram travel to accommodate all normal operating changes in loading and temperature. Provisions shall be made to keep the cylinder free from climatic induced conditions and contaminants that may interfere with free movement.

(1) If the system fails to provide the design operating pressure, the aerial lift shall be able to be operated to unload passengers.

(2) Cylinders and their attachments shall each have a minimum factor of safety of 5. The factor of safety is equal to the ultimate tensile strength of the cylinder divided by the maximum steady-state design tension.

(3) The systems providing operating pressure for the cylinder shall have a minimum factor of safety of 5 unless a high-velocity check-valve or flow-control device is used where the pressure line is connected to the cylinder. The check valve shall be rated to hold twice the normal operating pressure. The remainder of the system shall not exceed the manufacturers published working pressures. Provisions shall be made to restrict the movement of pressure lines or hoses should they become severed under pressure. When pneumatic storage cylinders, accumulators, or other similar devices are used, they shall be located so that they cannot be knocked over or damaged.

(c) Counterweights. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow, ice, water, and other materials from accumulating under and around the counterweights and interfering with their free movement. Visual access shall be pro- vided to areas beneath and above all counterweights contained in enclosures or pits. When a counterweight is contained in a

structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

(d) Wire ropes in tension systems. Wire ropes in tension systems shall have a minimum factor of safety of 6 when new. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining the factor of safety. See ANSI B-77.1, Section 7 for additional requirements. No rotation-resistant ropes shall be used in tension systems (see section 32-1.4(bc)).

(1) Wire ropes in tension systems shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (150 mm) of the end of its travel.

(2) When wire ropes are used with pneumatic or hydraulic cylinders, they shall be adjusted so that connecting devices will not contact the reeving devices before the ram reaches the travel limits of the cylinder.

(e) Chains in tension systems. Roller, leaf, or welded link chains may be used in tension systems as specified in ANSI B-77.1 Section 7.

(1) For chain used as a tensioning component, where the chain does not pass through or around sprockets, the minimum factor of safety shall be 5.

(2) For applications of chain where any sprockets are used, the minimum factor of safety shall be 6.

(f) Cable winches or chain adjusting devices. Winches or other mechanical devices that are used for take-up and remain part of the system shall have a factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. A safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch. The diameter of the winding drum shall not be less than the specified minimum sheave diameters referenced as Condition C in section 32-4.20((c)(3) for rope.

32-4.23 Anchoring devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

(a) RESERVED

(b) RESERVED

(c) Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

(d) All connections of ropes or cables used in anchoring devices shall be in accordance with the requirements of ANSI B-77.1, Section 7.

32-4.24 Manual and automatic control devices. All control devices and switches shall conform to the requirements of section 32-4.45.

(a) Manual control devices. Manual control devices that will initiate a stop shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in proximity to all

loading and unloading areas. The control devices shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls. All start/run/stop and speed control devices shall be conspicuously and permanently marked with the proper function.

(b) Provisions for automatic stop devices. The following automatic stop devices shall be installed:

(1) automatic stopping devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the operating circuit when detached. The location of the automatic stop device shall be in accordance with the following:

(i) intermediate stations: required only when traffic is not permitted beyond the intermediate station. The device shall automatically stop the aerial lift in the event a passenger rides beyond the intended point of unloading;

(ii) terminal unloading areas - Uphill and downhill: If danger to passengers or equipment would result in the event the passenger entered or passed around a terminal at full speed, the device shall be so located that the distance from the stopping device to the first obstruction or tangent of the bull wheel, whichever is less, is 150% of the distance required to stop with the aerial lift operating at maximum speed and the most unfavorable loading condition;

(2) automatic stopping devices to stop the aerial lift if the haul rope leaves the bull wheel or departs from its normal running position;

(3) a device that will stop the aerial lift before any counterweight, other tension device or tension sheave carriage reaches either end of its travel or when the tension system exceeds its range of normal operating travel. When pneumatic or hydraulic tension systems are used, pressure-sensing devices shall also be incorporated, which will stop the aerial lift system in case the operating pressure goes above/below the design pressure range. Such pressure-sensing devices shall be located close to the actual tension system. It shall not be possible to isolate the pressure sensor from the actual tension device;

(4) a system or device that will automatically apply the service brake if the line speed exceeds the design speed by more than 10% in the forward direction on an overhauling lift.

(5) a system or device that will automatically apply the drive sheave brake if the line speed exceeds the design speed by more than 15% in the forward direction on an overhauling lift, or a reverse rotation exceeding that which normally activates the rollback device.

32-4.25 RESERVED

Subchapter C - Line Structures

32-4.26 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of section 32-4.7. Where guyed towers are used and guys intersect the ground the guys shall be marked for visibility with a blaze orange designation.

(a) Means shall be provided for ready access from the ground to all tower tops. On lifts installed after 1995, permanent ladders are required for heights above those accessible by portable

ladders. Portable ladders, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed. Portable ladders extending more than 20 feet (6.10 meters) shall not be used.

(b) On lifts installed after 1995, permanent anchor points shall be provided on all tower tops for the attachment of fall protection devices.

(c) Towers shall be identified with successive numbers at least 6 inches high and clearly visible when looking both up and down the lines.

(d) Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

32-4.27 RESERVED

32-4.28 Haul rope sheave and mounts. The diameter of a haul rope sheave shall not be less than 10 times the nominal diameter of the haul rope unless an elastomer liner is used. The requirements in this section (32-4.28), apply generally to sheaves that support or hold down the haul rope at towers on a monocable system. These requirements shall apply to both sides of each aerial lift.

(a) Maximum allowable sheave load. The maximum allowable load per sheave shall be determined by the aerial lift designer.

(b) Sheave and sheave unit design. Sheave flanges shall be as deep as possible, considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that haul ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

(1) Suitable guards, of sufficient strength to resist the lateral forces caused by an inside deropement, shall be installed.

(2) Construction of the entire sheave unit shall be such that the haul rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

(3) On each sheave unit, rope-catching devices shall be installed to reduce the risk of the rope moving excessively in the direction of the load on the sheave unit in the event of deropement. They shall be designed to permit the passage of the rope and grips after deropement. The catcher shall be independent from the sheave. On lifts installed <u>after 1995,</u> these devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of 2 rope diameters beyond the sheave flange. In addition, on lifts installed <u>after 1995</u>, when the catcher is located so that the rope cannot move in the direction of the load when it passes from the edge of the sheave to a position in the catcher, the catcher shall extend a minimum of 2 rope diameters beyond the center of the rope when the rope has reached the point where the deropement switch device initiates a stop.

(4) On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

(5) This section applies only to fixed grip aerial lifts installed after 1995. On lifts where the carrier speed exceeds 600 feet per minute (3.0 meters per second), at least one device which senses the position of the rope shall be installed on each sheave unit. The device shall initiate a stop before the rope leaves the sheave in the horizontal direction or when the rope is displaced in the vertical direction by one rope diameter plus the distance that the rope is displaced vertically from the sheave by the grip.

(6) If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

(7) Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

(8) See also section 32-4.5 for effect of tower height and location on sheave units.

(c) Haul rope retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. On lifts installed after 1995, this criterion shall be deemed to have been met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall not be less than the largest of the following values: 100 pounds (445 newtons) per sheave; or 300 pounds (1335 newtons) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length). When the haul rope elevation at the tower lies below a straight line joining haul rope elevations at the adjacent towers, the haul rope shall not leave the group of sheaves under either of the following conditions:

(i) when the haul rope tension is 1.5 times its maximum design value at the point, using unloaded carriers in adjacent spans;

(ii) when a rope is under tension of the tension system alone (bare rope) or with any arrangement or number of empty carriers on the line.

(iii) The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall not be less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to 15 times the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (1000 newtons) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

32-4.29 RESERVED

Subchapter D - Line Equipment

32-4.30 Haul rope. Wire rope design and installation shall conform to the requirements of ANSI B-77.1 Section 7.

(a) Factor of safety. When the slope length of the installation is less than 3000 feet (914 meters), the haul rope shall have a minimum static factor of safety of 5 when new. On lifts hereafter installed, for slope lengths greater than 3000 feet (914 meters), the haul rope may have a minimum static factor of safety of 4.5 when new. Static factor of safety is equal to the nominal breaking strength divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

(b) Factor of safety for spliced haul rope with an independent wire rope center. Where a spliced haul rope with an independent wire rope center (WRC) is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

32-4.31 RESERVED

32-4.32 Haul rope grip.

(a) General. The haul rope grip shall be of a type that has been approved by a Qualified Engineer. Grips shall be tested and manufactured using accepted engineering and quality practices. The manufacturer shall permanently affix a unit identification and size marking to each grip. Each grip shall be nondestructively tested before public use, and such testing shall be documented.

(1) The haul rope grip shall be designed to pass smoothly over and under line sheaves that have flanges of adequate height to discourage the haul rope from leaving the sheaves.

(2) The designer's instructions shall provide details for the proper initial setting of the grip and a method to assure an operator or inspector that the grip has not reached an operational limit of the clamping components. For grips installed after 1995, the design shall incorporate provisions to accommodate a 10% reduction in haul rope diameter.

(b) Slippage. The haul rope grip shall be designed and maintained during use so as to resist a force that tends to slide it along the haul rope, that is, a minimum of 3 times the force required to move a carrier along a properly lubricated haul rope at its steepest incline, under the most adverse conditions of carrier loading. The grip shall automatically adjust to maintain this gripping force with a 3% reduction in haul rope diameter. The grip designer shall specify the proper grip installation and testing procedures, and for clamping type grips, the minimum force below which the grip shall not slip on the rope and a maximum force above which the grip should slip on the rope.

(c) Strength. The strength of the grip shall be based upon the following criteria:

(1) A minimum factor of safety of 6 shall exist in all parts of the grip wherein stress is proportional to the dead and live load of the carrier. This factor of safety is defined as follows: With the grip in its operating condition (gripping the rope or equivalent), a load

applied in the usual direction (that is, downward when grip is in the operating position), equal to the dead load of the carrier plus 6 times the design live load, shall not cause any part of the grip to fail;

(2) on grips hereafter installed those parts whose stress is not changed by application of live load shall be designed on the basis of an allowable stress of not more than the yield point divided by 3.0. In the design of springs, hereafter installed and where used, the allowable stress may be increased if load tests are conducted by an independent nationally recognized testing laboratory to provide assurances that the fatigue life of the actual spring is more than ample for the various applied loads;

(3) for stresses caused by lateral loading, such as centrifugal force, the provisions of section 32-4.34(b) shall apply;

(4) the material of which the grip is made shall be selected or selected and treated to obtain optimum impact resistance;

(5) special attention shall be paid to fatigue considerations. A grip that has not been proved in service shall be subjected to fatigue tests;

(6) the manufacturer's quality control provision shall assure that the grips and their parts meet the designer's specifications and the foregoing criteria.

(d) Maximum loads. This section applies only to grips hereafter installed, the maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope. Where two grips are used for a single carrier, the foregoing requirement may be applied to each grip, provided that:

(1) the two grips are independent of each other (that is, articulated in such a manner that they are independently loaded);

(2) the clear length of haul rope between the two grips equals or exceeds one-half rope lay.

(e) Grip testing. The aerial lift designer or manufacturer shall develop procedures and acceptance criteria for testing hanger grips and clips for the owner to comply with section 32-4.63.

32-4.33 Carriers for fixed grip gondolas. The carrier and all components shall be designed by Qualified Engineers in accordance with accepted practices of design. If the design has not had prior successful use for passenger transportation, its adequacy shall be verified by test loadings, trial operations, and tests under repeated loadings.

(a) Hanger. The hanger shall be securely attached to the haul rope grip and to the cabin in such a manner that it cannot work loose.

(1) The hanger shall be of sufficient vertical length that, under the worst condition of longitudinal swing, the top of the cabin cannot strike the haul rope. In any event, the carrier must be able to swing longitudinally without interference to an angle of 15 degrees from the vertical at the most adverse locations.

(2) Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the aerial lift designer. Where used, they shall operate smoothly and without danger of deropement of the haul rope.

(b) Cabin. Fully enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. The minimum opening door width shall be 32 inches (815 mm). Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

(1) The horizontal gap between the cabin door opening floor edge and platform edge shall be not greater than 1 inch (25.4 mm). The height of the cabin floor to the platform edge shall be within ± ½ inch (12.7 mm). Where it is not operationally or structurally practical to meet these requirements, platform devices, vehicle devices, system devices, or bridge plates shall be provided for independent loading.
(2) All windows shall be of shatter-resistant material.
(3) Means of emergency evacuation of passengers shall be provided.
(4) The maximum capacity of each cabin, both in pounds and kilograms and number of passengers, shall be posted in a conspicuous place in each cabin.
(5) The width of cabin seats shall be at least 18 inches (460 mm) per person. If passengers are to remain standing, floor space of 2.5 square feet (0.232 square meter) per person shall be available. The minimum clear floor space in accessible cabins shall be 48 inches by 30 inches (1220 mm X 760 mm). Where special accessible cabins are used, it is recommended the waiting interval not exceed 10 minutes.
(6) All carriers shall be clearly identified with numbers located on each end of each carrier.
(7) Semi-open carriers shall meet applicable requirements for enclosed cabins and open chairs.

32-4.34 Carriers for fixed grip chair lifts.

(a) Vertical loads. With respect to vertical loads, chair lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.
(b) Horizontal loads. With respect to horizontal loads, such as centrifugal loads that stress the hangers as they pass around terminal sheaves, the parts of the assembly, including hangers and grips, shall be designed with a factor of safety of 3.6 for an empty carrier with respect to the yield point of the material(s). For this purpose, the applied load is to be taken as the computed force considered as a static load. Lift components such as chairs, hangers, grips, bull wheels, guides, and the like, shall be designed to withstand, with a factor of safety of 2 (with respect to the yield point of the materials involved), the stresses developed when a loaded carrier passes around the bull wheel at full speed. Certification of a test shall be provided by the manufacturer that a loaded carrier with twice the design load had been passed around the bull wheel at full speed of a chair of identical design and fabrication without any yielding of the chair tested.
(c) Identification. All carriers shall be clearly identified with successive numbers visible to the operator and attendant.
(d) Chair safety details. Each chair shall be equipped with a railing at each side, to a height of not less than 4 inches (100 mm) above the seat for a distance of not less than 12 inches (305 mm) from the back of the seat. Each chair shall be equipped with a restraining device referred to as a restraint bar that will not open under forward pressure. For aerial lifts operating for skiers, the thickness of the chair seat front, including padding, shall not exceed 5 inches (125 mm) from the top of the seating surface to the bottom of the curl. Tilt back angle of the seat bottom shall be a minimum of 7 degrees when loaded. Loaded shall mean an evenly distributed load using load test criteria. Provisions shall be made to keep the tails of the skis from passing through and becoming trapped in open spaces between framework, safety restraints and chair

seat underside.

(e) Hanger and carrier testing. The designer or manufacturer shall identify hanger and carrier components and critical parts that require testing and develop procedures and acceptance criteria for testing these parts (see section 32-4.63). Such information shall be made a part of the aerial lift maintenance manual (see section 32-4.37).

Subchapter E – Personnel

32-4.35 Provisions for operating personnel.

(a) General. Operator and attendant stations shall be located to provide visual surveillance of the station and the line in the vicinity of the station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:

(1) the communications and controls required of the station;

(2) the operating instructions and emergency procedures;

(3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.

(c) The aerial lift operator who operates the aerial lift shall observe the aerial lift in operation and shall have an unobstructed view of its controls, including required brake controls and communicating devices, which shall be not more than 6 feet from his/her operating position. A clear and unobstructed path to such controls shall be maintained at all times. Loading and unloading areas shall have lift stopping devices located convenient to the attendants assigned to those points. The physical appearance, operation, and location of emergency shutdown devices shall differentiate them from other operating devices or controls.

(d) Loading and unloading areas shall have lift-stopping devices located conveniently to the attendants assigned to those areas (see section 32-4.24(a)).

Subchapter F - Operational and Maintenance Manuals

32-4.36 Operational manual. The designer of each new or reinstalled aerial lift shall prepare an operational manual in English for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-4.37 Maintenance manual. The designer of each new or reinstalled aerial lift shall provide with the delivery of the installation, a maintenance manual in English for each installation. The manual shall describe recommended maintenance procedures, including:

(a) types of lubricants required and frequency of application;

(b) definitions and measurements to determine excessive wear;

(c) recommended frequency of service to specific components, including relocation of fixed grips;

(d) grip, hanger, and carrier testing procedures and acceptance criteria;

(e) brake testing and adjustment;

(f) dynamic testing procedure.

Chapter II - Electrical Design and Installation.

Subchapter A - Design and Installation testing

32-4.38 General. Prior to operation of newly installed aerial lifts or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), solenoid or relay noise at levels and frequencies that could initiate loss of control.

(a) Electrical system acceptance test. Upon the completion of the acceptance test and before public operation of the aerial lift, the design and function of software and/or replay logic shall be certified by the Qualified Engineer of record and the certification shall be included in the acceptance test report. Any modifications made to the electrical design shall be clearly marked on the on-site documentation and signed by a Qualified Engineer. (see also section 32-4.12)

(b) Software security. The “as built” documents shall include a procedure, developed by the lift manufacturer or Qualified Engineer, to ensure the security of the software logic and operating parameters that will control the aerial tramway. Upon completion of the acceptance testing, this procedure shall be implemented in a manner that will prevent unauthorized personnel from making changes to the logic or operating parameters. All programmable logic and parameters shall be documented.

32-4.39 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-4.40 Location. No aerial lift shall pass under any transmission line operating at a potential exceeding 50 volts. All electrical power transmission wiring located near or proposed to cross over aerial lifts shall comply with the applicable requirements of NES C2.

32-4.41 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

32-4.42 Voltage limitations for overhead circuits. Signal, communication, and control circuits may be supported between towers that support the aerial lift. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

32-4.43 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.

(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of NFPA 70.

(c) Insulation. All control wiring is excepted from the requirements of Article 725-27(b) of NFPA

70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the aerial lift centerline, shall be ground fault protected.

32-4.44 Grounding.

(a) Structures. All metallic structures shall be bonded to form a grounding electrode system as defined in Article 250 0f NFPA 70 for the purpose of grounding the control circuit in such a manner that an inadvertent ground, anywhere in the control circuit, would stop the aerial lift as required in section 32-4.45(a). Electrical continuity of all metal parts of the structures shall be assured by mechanical connection and shall be electrically bonded to the common bonding conductor.

(b) Drive terminal structure. The drive terminal structure shall have one point referred to as a ground electrode. If an electrical prime mover is used, the electric service grounding conductor shall terminate at this point, as well as the structure's ground referenced in section 32-4.44(a). All dc and ac electrical systems shall be referenced to this point. On lifts installed after 1995 the ground point shall be as defined in NFPA 70.

(1) Under the worst-case conditions, the resistance from the ground point to any grounded point within the aerial lift system shall not exceed 50-ohms, for the purpose of grounding the control circuit. The grounding system for the aerial lift shall not be used as a grounding system for any other system not related to the aerial lift system.

(2) On lifts installed after 1995, to ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminal and line structures shall be bonded together with a common bonding conductor. The bonding conductor may be the support or messenger cable of an overhead control cable, the ground shield for an underground control cable, or some other conductor running the full length of the aerial lift system, bonded to each of the terminals and line structures and of sufficient conductance to meet the 50-ohm requirement.

(c) Haul rope grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding haul ropes, as applicable, for static electrical discharge.

(d) Lightning protection. If lightning protection is provided, it shall follow the NFPA 780.

32-4.45 Operating control circuits.

(a) Operating circuits. All aerial lift systems shall contain one or more normally de-energized circuit(s) that when energized, allow(s) the system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type. An exception to this requirement is allowed for magnetic or optically operated automatic stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit is of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All aerial lift systems shall include a normally de-energized circuit that, when energized, allows the system to run and, when interrupted, effects an emergency shutdown (see section 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the aerial lift while using the operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the aerial lift.

(1) Any one of the following conditions is considered a loss of control of an aerial lift:

(i) aerial lift will not SLOW DOWN when given the command to do so;

(ii) aerial lift will not STOP when given the command to do so;

(iii) aerial lift OVERSPEEDS beyond control settings and/or maximum design speed;

(iv) aerial lift ACCELERATES faster than normal design acceleration;

(v) aerial lift SELF-STARTS or SELF-ACCELERATES without the command to do so;

(vi) aerial lift REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and in the machine room. The shutdown device shall be conspicuously and permanently marked and shall be red in color (see section 32-4.35).

(c) Bypass circuits. A temporary bypass circuit may be installed for malfunctions in operating control circuitry (see section 32-4.58).

32-4.46 Electrical prime mover and power circuits.

(a) Electrical prime mover. All aerial lift systems equipped with electrical prime movers (electrical motors) shall have phase-loss protection on all power phases and undervoltage protection or overvoltage protection, or both, when speed regulation can be adversely affected by such voltage variations.

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:

(1) field loss (dc motors);

(2) speed feedback loss;

(3) overspeed;

(4) overcurrent.

Subchapter B - Night Operations

32-4.47 General. For nighttime operation, operating aerial lifts shall be provided with lighting systems. Lighting shall be provided at loading and unloading areas.

32-4.48 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-4.49 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp-operating characteristics.

32-4.50 Location. Lights shall be mounted on substantial poles or standards. Aerial lift tower and terminal structures may be used for supporting lights subject to the following requirements:

(a) approval shall be obtained from a Qualified Engineer;
Note: Approval of a Qualified Engineer is not required for lights installed on towers prior to 1995, and is in compliance with AV-39.

(b) the service conductors to each aerial lift tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the aerial lift;

(c) a separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure;

(d) all metallic raceways on a tower or terminal structure shall be grounded;

(e) the lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the aerial lift in any manner.

32-4.51 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(a) regular unloading of an aerial lift;

(b) emergency evacuation of carriers;

(c) operation of the auxiliary drive.

CHAPTER III - OPERATION AND MAINTENANCE

Subchapter A - Personnel Safety.

32-4.52 General and personnel safety. This subsection covers the requirements for operation and maintenance of fixed grip aerial lifts. Many requirements are listed elsewhere in Subpart 4, since they also regulate installation and design. Operating and maintenance personnel shall be familiar with applicable provisions of this Chapter and the aerial lift operational and maintenance manuals (see Chapter I, Subchapter F of this Subpart).

(a) Procedures for the operation and performance of maintenance on Fixed Grip Aerial Lifts shall include the precautionary measures necessary to reduce the risks for the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(b) Passengers and operating personnel shall be cautioned or prevented, as required, from

transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

32-4.53 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the aerial lift operations shall be adequately lighted for night operation. Additional signs, deemed necessary by the owner, may be posted but not detract from the attention from any required sign.

(1) Instructions and warnings for use of aerial lifts shall be posted at loading areas and may include the duties and obligations of the passenger, as well as the Skier's Responsibility Code (see Chapter III, Subchapter F, of this Subpart).

(2) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.

(3) The sign "Personnel Working on Lift - Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when persons are working on the lift (see section 32-4.13).

(b) Additional signs for fixed grip gondolas. The maximum capacity of each cabin in pounds and kilograms and numbers of passengers shall be posted at each loading area.

(1) A sign shall be visible at all points of downhill loading, listing downhill capacity of lift.

(2) The following information shall be prominently posted on the interior of each cabin:

(i) the maximum capacity of each cabin in pounds and kilograms and number of passengers.

(ii) instructions for procedure in emergencies.

(c) Additional signs for fixed grip chair lifts. The following signs shall be posted:

(1) A sign stating the nominal chair height ± 2 inches (50 mm). The sign shall be posted with the riding instructions;

(2) "Remove Pole Straps from Wrists - Until Unloaded" (at loading area for aerial lifts used primarily for skiers);

(3) "Check for Loose Clothing and Equipment." (two signs required one at the loading area and one in the vicinity of the "Prepare to Unload" sign);

(4) “Wait Here” (at the wait point);

(5) "Load Here" (at loading point);

(6) "Keep Ski Tips Up" (ahead of any point where skiers are carried and skis may come in contact with a platform or the snow surface);

(7) "Prepare to Unload" (ahead of unloading area);

(8) "Unload Here" (for skiers, at breakover point of unload platform);

(9) "Stop Gate" (if applicable);

(10) a sign shall be visible at all points of downhill loading, listing downhill capacity of lift.

(11) "Close Restraint Bar"

(12) "Open Restraint Bar"

(13) "Emergency Stop Switch"

(14) a sign shall be posted at or about any mid-station that is not in use and not staffed; "Loading or Unloading Here is Prohibited", see section 32-4.55(c), Note 3.

Subchapter B - Operations

32-4.54 Personnel. Fixed grip aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. Procedures for loading and unloading passengers, including passengers with common adaptive equipment, shall be included in the training. One or more persons familiar with emergency procedures shall be on the site at all times when the aerial lift is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific aerial lift.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for the operation, and shall have the authority to deny access to the aerial lift to any person who, in the supervisor's opinion, is not fit or competent to use the aerial lift without danger to that person, others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the aerial lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

(b) Operators. An operator shall be in charge of each aerial lift. This operator shall be trained and experienced in normal operational and emergency procedures and such training shall be documented. Operators shall be at least 18 years of age.

(c) Attendants. An attendant will be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view and such training shall be documented.

(d) RESERVED

(e) First aid. One or more persons trained to provide first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when an aerial lift is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

32-4.55 Minimum operating personnel. The following personnel are the minimum that shall be required:

(a) an operator who shall be in charge of each aerial lift;

(b) one attendant who shall be on duty at each loading area;

(c) one attendant who shall be on duty at each unloading area.

NOTES: (1) An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the entire aerial lift operation;

(2) A station used for both loading and unloading of a single aerial lift may be staffed by a single attendant at the loading area when both the loading and unloading can be kept under surveillance by the attendant. This note does not

apply to lifts when used primarily for foot passengers.
(3) The intermediate stations shall be staffed if there is less than 5 feet (1.53 m) of clearance for skiers or 30 inches (760 mm) for foot passengers from the chair seat to the platform surfaces when the aerial lift is open but the station is not in use.

32-4.56 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:
  (1) to determine that all aerial lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties;
  (2) to discontinue operations on any aerial lift due to physical, weather, personnel, or other reasons;
  (3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:
  (1) to assume responsible charge of the aerial lift;
  (2) to assign and supervise all attendants on his/her aerial lift;
  (3) to maintain an operational logbook as required in section 32-4.64;
  (4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant. The duties of the attendant shall be as follows:
  (1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;
  (2) to advise and assist passengers, as required;
  (3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the aerial lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-4.57 Operational procedures. The required operational procedures as set forth in sections 32-4.57 through and including 32-4.58 shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-4.36).

(a) Control of passengers. Each aerial lift shall have a definite method for marshaling passengers for loading and unloading. Fences, gates and alternate access and/or loading methods may be required to implement the system for individuals/groups.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:
  (1) a visual inspection of each terminal, station, and the entire length of the aerial lift;
  (2) assurance that the tension system is functional and that tension system devices (counterweights, cylinders, carriages, and the like) have adequate travel with appropriate clearances at both ends;
  (3) operation of all manual and automatic switches in terminals, stations, and loading and unloading areas;
  (4) operation of all braking systems;
    NOTE: The designer of the aerial lift system may specify whether this inspection is to take place while the aerial lift is not moving.

(5) operation of communication systems;
(6) operation of the aerial lift, including a visual inspection of all ropes and carriers;
(7) testing of each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis;
(8) operation of the auxiliary engine until it reaches normal operating temperature;
(9) for those aerial lifts having primary-power internal combustion engines, determining that the fuel quantity is sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the aerial lift. During refueling, power units shall be shut down. The aerial lift shall be operated using the APU at least 30 minutes per month.
(10) inspecting the loading and unloading areas and preparing them for the ingress and egress of passengers;
(11) clearing carriers of ice and snow to the extent necessary to permit operation, and inspecting and checking of all mechanical features.

(c) Access to facilities. Entrances to all machinery, operators', and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-4.58 Operational requirements.

(a) General. The supervisor and owner of each aerial lift shall review the requirements of Chapter I of this Subpart to ascertain that original design and installation conditions have not been altered in a manner such as to violate the requirements of the standard.

(b) Starting. No aerial lift shall be started except at the direction of, or following clearance by, the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation.

(c) Loading and unloading platforms. The maze or coral, loading platform surface, breakover point, and the load/unload seat height shall be reasonably maintained according to the prevailing weather conditions and established procedures.

(d) Stops. After any stop of an aerial lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) Damage to carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line as soon as feasible.

(f) Hazardous conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the aerial lift shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated. No aerial lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the aerial lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to unload all passengers. When such shutdown has been caused by an electrical storm, grounding

of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

(g) Evacuation. The owner of each aerial tramway shall submit to the Commissioner, in triplicate, a detailed written plan for evacuation of passengers from cabins or carriers in the event of a power failure or breakdown. The procedures set forth in the evacuation plan shall be tested, at any location on the lift, in the presence of the Commissioner at his request. The Commissioner, when satisfied with the evacuation plan and the results of the test, shall notify the owner in writing of such acceptance. A copy of the accepted plan shall be kept on the premises and shall be readily available to the Commissioner's representative.

(1) The written evacuation plans shall include but not be limited to the following:

(i) the definition of the line of authority in the event of an evacuation. This line of authority shall list:

(*a*) the individuals or positions responsible for determining the need for an evacuation;

(*b*) the individuals or positions responsible for ordering an evacuation;

(*c*) the individuals or positions responsible for performing the evacuation, for first aid, and for ground care of evacuated passengers.

(ii) a description of the equipment necessary for evacuation and where it will be stored;

(iii) provisions for adequate training in the functions performed in the evacuation process at least once each operating season. Such training is to include at least one evacuation drill, which is to be recorded in the operational log of each aerial lift (see section 32-4.64);

(iv) a statement that a sufficient number of experienced evacuation personnel will be readily available to evacuate the entire lift within 2 hours of the lift stoppage and any conditions which might cause this time to be exceeded;

(v) a description of unusual terrain conditions and how each of these conditions will be dealt with during an evacuation;

(vi) an estimate of when the evacuation should begin in the event the aerial lift becomes inoperable;

(vii) provisions for communications with passengers of an inoperable aerial lift, the frequency of such communication, how soon after the aerial lift becomes inoperable such communication to the passengers will start, and the frequency of communications thereafter;

(viii) the methods of evacuation to be used for the typical, incapacitated passengers, common adaptive ski equipment, and non-ambulatory passengers;

(ix) provisions for communication with the evacuation teams;

(x) provisions for suspending the evacuation in the event that the aerial lift is made operable during the evacuation;

(xi) provisions for control and assistance of evacuated persons until released;

(xii) provisions for a written post-evacuation report available for review by the Commissioner.

(2) All nonmetallic rope used for evacuation shall be of nylon or polyester (Dacron) fiber of either laid or braided construction. Laid rope of nylon shall be of a hard lay. These ropes shall be either of a static rescue type or a dynamic mountaineering type. Breaking

strength, when new, shall be at least 15 times the maximum expected operating load but in no case less than 5,000 pounds. No natural fiber or polypropylene ropes shall be used.

(3) These ropes shall be carefully stored when not in use and shall be examined after each completed aerial lift evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

(4) Carabiners, if used, shall be of the locking type.

(5) A special separate written evacuation plan shall be provided when the aerial lift is used primarily for foot passengers such as for sight seeing or amusement rides. This plan shall include a specific outline for the evacuation of the very old and/or very young, including babes in arms. All requirements of section 32-3.58(g) shall apply to this plan including the requirement for training and evacuation drills.

(h) Termination of daily operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the aerial lift after it has been shut down. Loading ramps, as required, shall be closed and so marked. When either loading or unloading portions of an intermediate station is not in operation, it shall be so signed and the loading station shall be closed to public access.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this subsection shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating circuit malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the aerial lift supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;

(5) the operator control panel shall indicate that a bypass is in use.

(6) when a required aerial lift control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the lift until the malfunction is corrected.

Subchapter C - Maintenance

32-4.59 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance and testing requirements of the designer or a Qualified Engineer (see section 32-4.37) shall be followed. Maintenance records shall be kept (see section 32-4.66).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) all wire rope, strand, and chain;

(2) line sheave units, sheaves, bearings, and liners;
(3) bull wheels, bearings, and liners;
(4) tension systems;
(5) drive system, including bearings and couplings;
(6) braking systems;
(7) electrical control systems;
(8) communication systems;
(9) carriers;
(10) structures;
(11) lift line (see section 32-3.4).

(c) A written schedule for systematic dynamic testing shall be developed and followed. The schedule shall establish specific frequencies and conditions for periodic testing. The testing shall simulate or duplicate inertial loadings. The test load shall be equivalent to the design live load. Dynamic testing shall be performed at intervals not exceeding seven (7) years. The testing shall include, but not be limited to the following:
(1) braking systems;
(2) Auxiliary power units;
(3) tension system;
(4) electrical systems.

32-4.60 Maintenance personnel. Fixed grip aerial lifts shall be maintained by trained and competent personnel, and the owner shall be responsible for their supervision and training, and such training shall be documented. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific aerial lift.

32-4.61 Rope grips. The initial installation and each relocation of a clamp-type grip shall be field-checked by a method established by the designer to provide assurance that the requirement of the first sentence of section 32-4.32(b) has been met and that the maximum slippage resistance is not exceeded.

(a) All grips shall be moved at least once every 12 calendar months. The grips shall be relocated a uniform distance of 24 inches to 36 inches each time and in the same direction. A grip shall not be installed or allowed to migrate closer than a distance of 20 haul rope diameters from a splice tuck or rope repair tuck. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see sections 32-4.62 and 32-4.63).

(b) As each grip is relocated, the haul rope shall be examined for deterioration at or near the grip location. The initial location and each subsequent relocation shall be marked by a spray paint or other marking on the rope to identify slippage. A Qualified Engineer shall supply information to the operator to enable him/her to identify excessive slippage.

Subchapter D - Inspection and Testing

32-4.62 Wire rope, strand, and chain inspection. Inspection of wire rope, strand, and chain shall comply with ANSI B77.1, Section 7, parts 7.4.1, 7.4.2, and 7.4.4. A copy of the report signed by the person performing

the inspection shall be kept at the site, available to the Commissioner.

32-4.63 Grips, clips, and carrier testing.

(a) All grips, clips, hangers, chairs, and cabins shall be tested against acceptance criteria, established by the designer or manufacturer or in the case in which the designer or manufacturer is no longer in business and the original criteria are no longer applicable, by a Qualified Engineer.

(b) Each grip, clip, hanger, chair, and cabin shall be uniquely identified by the manufacturer or the owner. The test sampling method shall identify the parts tested to assure a rotating minimum test sample on each aerial lift of 10 or 10%, whichever is greater, on each aerial lift's grips, clips, hangers, chairs, or cabins per year. Alternatively, all units may be tested every 6 years or 6,000 hours, whichever comes first. If any defects are found, the designer/manufacturer/Qualified Engineer shall be consulted to determine whether an increased sample size is warranted. Units failing to meet the acceptance criteria shall not be placed back into service until their defects are corrected.

(c) If the grips, clips, hangers, chairs, or cabins are tested by an agency other than the original equipment manufacturer, then the original aerial lift manufacturer shall receive a copy of the test procedure and results. In all cases, the owner shall receive a copy of the test procedure and the test results.

Subchapter E - Records

32-4.64 Operational log. A logbook shall be maintained for each aerial lift. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;
(e) record of compliance with daily operational inspection including loading and unloading platforms and ramps;
(f) position and condition of the tension carriage, counterweights, or other tension systems devices;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator;
(i) record of aerial lift evacuations and evacuation drills (see section 32-4.58(g)(1)(iii));
(j) record of intermediate station use (see section 32-4.58(h)).

32-4.65 Wire rope, strand, and chain log. A logbook shall be maintained for each aerial lift, giving the following information on each rope, strand, and chain:

(a) specification (in compliance with ANSI B-77.1-1999 sections 7.1.1 –7.1.1.3.2);
(b) copy of certified test report;
(c) date installed;
(d) splicing certificate for each splice or laid-in strand;
(e) record of lubrication, including type of lubricant and date applied;

(f) record of maintenance inspections;
(g) report of wire rope, strand, and chain inspection;
(h) report of accidents or injury to wire rope, strand, or chain;
(i) documentation of end attachments.

32-4.66 Maintenance log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct

32-4.67 Dexterity and ability. All passengers who use an aerial lift shall be presumed to have sufficient skiing ability, physical dexterity or personal assistance to negotiate and be evacuated from the aerial lift safely. Each passenger shall maintain control of his/her speed and course while loading or unloading the aerial lift.

32-4.68 Embarkation and disembarkation. A passenger shall get on and get off an aerial lift at designated areas. No passenger shall embark without first understanding the proper loading, riding, and unloading procedures (see section 32-4.53(c)).

32-4.69 Riding. Passengers, while riding an aerial lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the aerial lift. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

SUBPART 32-5
GENERAL PROVISIONS
Surface Lifts

Section 32-5.1 This Subpart covers the class of passenger ropeway wherein passengers or passengers on recreational devices are transported on the surface by means of devices propelled by a main overhead traveling wire rope. Surface lifts are normally monocable type, and the haul rope is usually supported on intermediate towers on both the uphill and downhill side. Either fixed or detachable grips may be used. Surface lifts include T-bars, J-bars, and platters.

(a) T-bar lifts are those surface lifts on which the device between the haul rope and passengers forms the shape of an inverted "T," propelling passengers located on both sides of the stem of the "T."
(b) J-bar lifts are those surface lifts on which the device between the haul rope and passenger is in the general form of a "J," propelling a single passenger located on the one side of the stem of the "J".
(c) Platter lifts are those surface lifts on which the device between the haul rope and passenger is a single stem with a platter (or disk) attached to the lower end of the stem, propelling the passenger astride the stem of the platter (or disk).

32-5.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-5.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the surface lift type and location:
- (1) electric power lines and their supports;
- (2) railways;
- (3) highways;
- (4) structures;
- (5) rock and earth slides, cave-ins, washouts, and the like;
- (6) snow creep and avalanches;
- (7) wind action;
- (8) icing;
- (9) ski slopes and trails;
- (10) rivers and gullies;
- (11) buried installations, including pipelines;
- (12) crossing or close proximity to other passenger tramways;
- (13) control of air space below, above, and adjacent to the installation;
- (14) passenger accessibility.

(b) Tow path gradient. No reverse grades shall be permitted except for very gradual inclines at loading and unloading areas. On lifts installed after 1995, the maximum permissible grade of the tow path shall be 100% for surface lifts using towing devices and 80% for surface lifts using towing devices for more than one passenger.

(c) Cross slope. This section applies only to lifts installed after 1995; the cross slope of a tow path shall not exceed 5% for surface lifts using towing devices for more than one passenger, except at unloading areas. For single-passenger surface lifts, the cross slope shall not exceed 5% except at towers and unloading areas. The cross slope at towers shall not exceed 10% and shall slope away from the centerline of the surface lift.

(d) Tow path crossing. No recreational device traffic shall be allowed to cross the uphill tow path (see – section 32-1.4(bu)). Skier traffic may cross at approved locations (see section 32-5.5(a)).

32-5.4 Width of clearing. The clearing shall be wide enough to prevent adjacent vegetation from interfering with the surface lift. Carriers shall not contact trees or vegetation during operational surges, or during maximum design wind conditions, or both. Trees and other vegetation shall be cleared a minimum of 5 feet (1.53 meters) from haul ropes and carriers under normal (nonsurge) operating conditions. Clearings shall be maintained to avoid washouts that might endanger the installation (see section 32-5.59).

(a) Tow path clearing width. A tow path width shall be cleared and maintained in such a manner that no rocks, stumps, or other obstructions project above the snow surface from the point where the passenger embarks on the surface lift to the point beyond the stop gate where the passenger would stop, under the most adverse conditions. The minimum tow path clearing width shall be 30 inches (760 mm) times the design number of passengers per carrier. In no case shall the track clearing width be less than 6 feet (1.83 meters).

32-5.5 Path of rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration.

(a) Vertical clearances. Terminals and towers shall be located so that, under the most adverse conditions, the towing device will not lift a passenger from the snow surface.

(1) Under the most adverse conditions, the haul rope shall be not less than 8 feet (2.44 meters) above the surface on which the passenger is towed, and high enough to keep the down-coming, empty towing devices clear of the snow. The down-coming, empty towing devices shall be a minimum of 8 feet (2.44 meters) above the snow surface at any area where the passengers cross the tow path.

(2) The towers shall be of such a height and so located that if the up-going haul rope comes off the supporting sheaves of one tower, the towers (or terminal) on either side will support the rope clear of the design tow path by a minimum of 24 inches (610 mm).

(3) When the towing device is swung longitudinally by 15 degrees from the vertical position, or when it is in its most extreme operating condition, whichever is more severe, there shall be clearance in the vertical plane between the towing device or hanger and any obstruction. Such as sheaves, guards, and the like.

(b) Horizontal clearances. A minimum clearance of 36 inches (915 mm) shall be maintained between the tower at uphill tow path surface and the vertical plane of the upward traveling haul rope cable. With respect to the downward traveling haul rope, a minimum clearance of 24 inches (610 mm) shall be provided between the towing device in its normal position and the tower. When recreational devices are used, a minimum clearance of 24 inches (610 mm) shall be maintained between the recreational device and the tower.

(c) Path of rope adjustment. When varying snow depths of the uphill ski track require changing of sheave heights, these changes shall be controlled within minimum and maximum tolerances established by the designer. This control shall be provided as prescribed below. When terminals, towers, or both contain provisions for a change in height of haul rope in order to meet normal changes in operational requirements, such provision shall be controlled as follows:

(1) the designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments;

(2) where range of adjustments allows possible operator error resulting in improper sheave loading, a system to readily verify the proper profile, without the use of tools, shall be incorporated into the installation.

32-5.6 Capacity and speed. The speed of the surface lift and the spacing of the towing devices shall be such that the minimum loading intervals designated in sections 32-5.6(a) and 32-5.6(b) are maintained. In no case shall the maximum rope speed exceed 800 feet per minute. For surface lifts with detachable grips, means shall be provided to maintain the minimum distance between successive passengers that was used in the design of the surface lift. Passengers shall not be loaded until the passenger(s) ahead has traveled this minimum distance from the loading point. Automatic launching devices shall meet these requirements when timed to release to meet the minimum loading interval.

(a) Single-passenger carriers. The minimum loading interval shall be 3 seconds plus the time required to extend the towing device to such a point that the passenger starts to move.

(b) Multiple-passenger carriers. The minimum loading interval shall be 4 seconds plus the time required to extend the towing device to such a point that the passengers start to move.

32-5.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal conditions. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) RESERVED

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the
general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost-susceptible soil or solid rock. Foundations on rock shall be firmly anchored to solid rock, unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for protection of foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus wind acting simultaneously.

32-5.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power and the communication system shall be functional and audible during a power failure. On lifts installed prior to 1995 radiophones or suitable public address system may be used.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators (e.g., LEDS) shall be visible even in bright sunlight.

NOTE: Voice communication systems are not required for those surface lifts where the

operator has clear line of sight vision of the attendant at the opposite end of the device, and the lift is 500 feet or less in length.

32-5.9 Internal combustion engine installation.

(a) Fuel tanks for combustion engines. Fuel tanks shall have adequate capacity to permit uninterrupted operation during the normal operating period. Internal combustion engines hereafter installed shall comply with NFPA 37.

(1) On internal combustion engines hereafter installed, liquid fuels shall be supplied and handled in accordance with NFPA 30. Gas fuels shall be in accordance with NFPA 58. Liquid fuels stored outside of a motor room, either above or below ground, shall be in compliance with the appropriate regulatory authority.

(2) For the purposes of interpreting NFPA 37, the auxiliary power units utilizing a combustion engine shall be considered, "used for emergency purposes". Also, "on roof of structure" shall mean "on the drive terminal structure". Structural members shall not be used as fuel tanks.

(3) An integral tank is a fuel tank furnished by the engine manufacturer. It shall be securely mounted to the engine assembly and protected against vibration, physical damage, engine heat, and the heat of exhaust piping.

EXCEPTION: The surface lift manufacturer may supply an integral or day gasoline fuel tank for mounting on a combined drive-tension carriage or an overhead fixed drive terminal. The tank shall be sized 25 gallons (94.6 liters) maximum, constructed, and installed in accordance with applicable provisions of NFPA 37.

(4) Standard portable marine fuel tanks (boat tanks) can be used in lieu of an integral fuel tank. Such tanks are limited to 7 gallons (26.5 liters) capacity and shall be secured while in use.

(5) Fill pipes located beyond the sides of the building or motor room shall have a locked fuel cap. Fill pipes shall be located to avoid toxic fumes and fire hazard during refueling.

(b) Exhaust systems. Exhaust systems shall be designed and installed to discharge to the atmosphere in a manner that does not allow precipitation to enter the exhaust system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields to the ceiling or for a distance of 8 feet (2.44 meters) above the floor or working surface, or to the ceiling if less than 8 feet (2.44 meters) and shall be insulated where they pass through combustible building materials.

(c) Ventilation. Internal combustion engine products of combustion shall be exhausted to and dispersed in the outer air. The machine room shall be ventilated so as to prevent air contamination within the room from the products of combustion which tends to injure the health of any person therein or to create a fire or explosion hazard (see section 32-5.19(c)).

32-5.10 Loading and unloading areas. Platforms, ramps, corrals, mazes, and staging areas comprising the loading and unloading areas of a surface lift are integrally related to its operation. They shall be designed and installed in accordance with the applicable criteria. Terminals, towers, and other structures or obstacles adjacent to the loading and unloading areas shall be designed or guarded to reduce the possibility of entanglement with these items.

(a) Loading areas. The loading area length, profile, and loading point shall be installed according to the surface lift's speed, terminal sheave location, and carrier type to provide a smooth transition from standing, to the towing device pulling the passenger, at full line speed. Load gates, artificial surfaces, and other loading aids when used, shall be designed and installed with regards to all passengers including adaptive. At least one point of access to the lift shall have a minimum clearance width of 36 inches (915 mm) to accommodate passengers using adaptive equipment.

(1) The loading point shall be marked as to where passengers are to stand using a loading marker located in/on the platform/snow surface.

(2) Approach paths to the loading zone shall be approximately level or slightly downgraded to facilitate passengers moving to the loading point. The approach paths shall be such that waiting passengers have a view of the loading area. The maze or coral area shall be approximately level, free of obstructions and marked, roped, or fenced in a manner to guide passengers to the “Wait Here” and “Load Here” markers. The maze or coral shall be as straight as practical.

(3) The “Wait Here” point shall be marked. This marker shall be located to provide horizontal clearance between passengers and passing carriers.

(b) Unloading areas. The unloading area, length, profile, unload point, and exit ramp shall be installed according to the surface lift's speed, terminal sheave location, and carrier type.

(1) Unloading areas shall have an approximately level area followed by a downgrade to assist the passenger in releasing the towing device and exiting the surface lift.

(2) The distance between the unload point and the terminal guides shall be sufficient to allow towing devices to become retracted and permit their oscillations to diminish before entering the terminal or the terminal shall be designed to allow a partially retracted towing device to pass in a controlled manner. This distance is further determined by the location of the stop gate and surface lift stopping distance (see section 32-5.24(b)(2)).

32-5.11 RESERVED

32-5.12 Acceptance inspection and tests.

(a) Acceptance inspection. Before a surface lift that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) Terminal and tower haul rope working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;

(ii) lubrication of all moving parts;

(iii) alignment and clearances of all open gearing;

(iv) installation and alignment of all drive components;

(v) position and freedom of movement of counterweights or other tension systems and

carriages;

(vi) haul rope alignment at entrance to bull wheels;

(vii) operation of all electrical components, including circuit protection and grounding;

(viii) brake and/or rollback device testing;

(ix) alignment of haul rope sheave units;

(x) haul rope sags;

(xi) retraction of towing outfits;

(xii) proper location of towers, bents, and terminals for correct location and installation in accordance with the plans and specifications.

(b) Acceptance tests. Before a surface lift that is new or relocated, or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel. The designer or manufacturer shall propose and submit an acceptance test procedure prior to public operation. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Any operational acceptance test shall be done in the presence of the Commissioner.

(2) The functioning of all push-button stops, automatic stops, stop gates, limit switches, deropement switches, and communication devices shall be checked. Acceleration and deceleration rates shall be satisfactory (see section 32-5.17). Braking shall be proved adequate (see sections 32-5.18(b) and 32-5.18(d)).

(3) Prior to the acceptance inspection and the above acceptance tests, the surface lift shall be operated for a period of continuous, full-speed operation, with empty carriers, of sufficient duration to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related conditions.

32-5.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the surface lift design to render the system inoperable when necessary for the protection of personnel working on the surface lift. See section 32-5.53 for placement of applicable warning signs.

Subchapter B - Terminals and Stations

32-5.14 Power units.

(a) General. All power units shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded surface lift.

(1) Where manual multispeed transmissions are used on a power unit, they shall not be shifted when the surface lift is moving.

(2) Where reverse capability is provided on a power unit for a surface lift, provisions shall also be made to prevent accidentally shifting into reverse whenever the surface lift is operating.

(b) Auxiliary power unit. An auxiliary power unit shall not be required.

32-5.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting a surface lift under the most unfavorable design loading conditions without exceeding design rating. They shall

have a service factor appropriate for the application.

32-5.16 Bearings, clutches, couplings, and shafting. Bearings, clutches, couplings, shafting and Universal joints (cardan shafts) shall be selected on the basis of the manufacturer's published data for the particular use.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.
(b) All shafting shall be designed in accordance with accepted standard practices.
(c) Guarding and containment shall be in accordance with the provisions of section 32-5.19.

32-5.17 Acceleration and speed control. Acceleration of a drive shall be regulated with regard to surface lift type, profile, speed, and use.

32-5.18 Brakes and rollback devices.

(a) General. Each surface lift shall have the brakes and devices designated in sections 32-5.18(b) and 32-5.18(d). All braking systems shall be capable of operation to comply with daily inspections and periodic testing.
(b) Service brake. Unless an unloaded surface lift operating at maximum speed will stop in 25 feet (7.62 meters) or the distance $d = V^2/18{,}000$ where d is the stopping distance in feet and V is the surface lift speed in feet per minute, ($d = 0.66V^2$ where d is stopping distance in meters and V is the surface lift speed in meters per second) whichever is greater, an automatic brake shall be provided to assure this stopping distance. This brake shall be applied by springs, weights, or other approved forms of stored energy when any stop circuit is interrupted. When the motive power is an internal combustion engine, a positive system shall be provided to stop the surface lift. If the prime mover is an internal combustion engine, the compression of the engine may serve as a brake when this unit is not declutched by activation of the stop circuit.
(c) RESERVED.
(d) Rollback device. A rollback device shall be provided to automatically prevent reverse rotation of the surface lift under maximum load.

32-5.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provisions shall be made for appropriate containment of said components. On lifts installed after 1995 guards and containment shall conform to the ASME B15.l.
    (1) Protection against static electricity shall be provided.
    (2) Fire-fighting device(s) shall be available.
(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.
(c) Machinery housed in a machine room. The machine room shall be adequately ventilated (see section 32-5.9(c)). It shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a

passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. On lifts installed after 1995, means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-5.20 Sheaves in terminals and stations.

(a) General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

(1) When unlined sheave grooves are used for wire rope, they shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

(2) When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

(b) Haul rope terminal sheaves (Bull wheel and deflection sheaves). Provisions shall be incorporated in the terminal design on lifts hereafter installed to retain the terminal sheave in its approximate normal operating position in the event of failure of the bearings, shaft, or hub.

(1) Provisions shall be incorporated in the terminal and rope retention design to control the position of the rope, including possible overhaul, to minimize the effect of its departure from its normal operating position.

(2) The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope. The sheave assembly or related structures shall be designed to minimize the probability of a deropement. A flange extension of 1-1/2 times the rope diameter (measured radially from the bottom of the rope groove) shall be one acceptable means of minimizing the probability of deropement when in full compliance with the provisions of section 32-5.20(d)4.

Table 32.5-1
Minimum diameters for counterweight rope sheaves and sheaves not specifically covered elsewhere in this rule

	SHEAVE DIAMETER		
Rope type	Condition A	Condition B	Condition C
6 x 7	72d	42d	24d
6 x 19	45d	30d	20d
6 x 37	27d	18d	12d

NOTE: d equals the nominal rope diameter.

(c) Sheaves in tension systems and sheaves not specifically covered elsewhere in this standard. The minimum diameters for these sheaves shall be as indicated in Table 32.5-1.

(1) Condition A is applicable where bending around sheaves is of major importance.

(2) Condition B is applicable where rope bending around sheaves is important, but some

sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, and the like.

(3) Condition C is applicable to sheaves that are not intended to rotate due to any tension sheave movement but are intended to rotate only due to counterweight adjustment.

(4) Provisions shall be made to assure that all counterweight sheaves rotate freely.

(d) Haul rope line sheaves.

(1) The requirements of section 32-5.28 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(i) sheaves that carry no load other than the weight of the rope and carriers;

(ii) sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means;

(iii) sheaves that are located in such a way that carriers attached to the haul rope are not passing onto the sheaves.

(2) In such cases, the design shall be modified to meet the requirements of the particular installation.

(3) Guide sheaves shall be located in order to prevent misalignment of rope entering and leaving the drive and return sheaves. Such sheaves shall be as close as practicable to the drive and return sheaves, but not farther than one diameter of the drive or return sheave from the point of tangency. Shoes, rollers, or sheaves shall be placed on the opposite side of the rope adjacent thereto, to prevent deropement in that direction.

(4) These requirements apply to all installations except floating tension sheave carriages (see section 32-5.21(d)).

32-5.21 Tension sheave carriages.

(a) General. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion produced by the most unfavorable design loading and operating conditions.

(b) Rigid mounted carriages. The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the tension system shall be supported on rigid, straight rails by means of wheels. All design loads including torsional loads due to driving torque, braking torque, or reactions of a rollback device shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations.

(c) Mechanical stops for rigid mounted carriages. Mechanical stops shall be provided to prevent overtravel of the carriage and the tension sheave. On lifts installed after 1995, these stops, and the terminal structure, shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the tension system reaction on the bull wheel.

(d) Floating tension sheave carriages. A floating tension sheave carriage may be used and operated with a lateral tilt of more than 6 degrees if it is of the type that has proved to give satisfactory service in the industry and is approved by a Qualified Engineer. Otherwise, the provisions of section 32-5.21(b) shall apply. In any event, adequate control measures shall be taken to prevent the rope from riding on the flanges or deropement from the terminal sheave and the tower sheaves on the nearest line tower.

32-5.22 Tension systems.

(a) General. Counterweights, hydraulic and pneumatic cylinders, or other suitable devices shall be used to provide the tensioning requirements of the particular installation. All devices used to provide the tension shall have sufficient travel to adjust to all normal operating changes in loading and temperature.

(1) The tension for haul ropes for all modes of operation shall be determined by the design engineer. Tension systems may be automatic or manual; however, all systems shall have monitoring equipment that will automatically prevent operation outside of design limits (see section 32-5.24(b)(2)).

(2) Tension systems may be adjustable to provide proper tensions for different modes of tramway operation.

(3) The tension system design shall consider changes, for each mode of operation, in tensions due to rope elongation, friction, and other forces affecting traction on driving, braking, or holding sheaves, tower and sheave loading, and maximum vertical loads on grips to assure that tensions remain within design limits.

(b) Hydraulic and pneumatic systems. Hydraulic and pneumatic cylinders, when used, shall have sufficient ram travel to accommodate all normal operating changes in loading and temperature. Provisions shall be made to keep the cylinder free from climatic induced conditions and contaminants that may interfere with free movement.

(1) Cylinders and their attachments shall each have a minimum factor of safety of 5. The factor of safety is equal to the ultimate tensile strength of the cylinder divided by the maximum steady state design tension.

(2) The systems providing operating pressure for the cylinder shall have a minimum factor of safety of 5 unless a high-velocity check valve or flow control device is used where the pressure line is connected to the cylinder. The check valve shall be rated to hold twice the normal operating pressure. The remainder of the system shall not exceed the manufacturer's published working pressure. Provisions shall be made to restrict the movement of pressure lines or hoses should they become severed under pressures. When pneumatic storage cylinders, accumulators, or other similar devices are used, they shall be located so that they cannot be knocked over or damaged.

(c) Counterweights. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow, ice, water, and other materials from accumulating under and around the counterweights and interfering with their free movement. Visual access shall be provided to areas beneath and above all counterweights contained in enclosures or pits. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

(d) Wire ropes in tension systems. Wire ropes in tension systems shall have a minimum factor of safety of 6 when new. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of safety. See ANSI B77.1, Section 7 for additional requirements. No rotation-resistant ropes shall be used as counterweight ropes (see section 32-1.4(bc)).

(1) Wire ropes in tension systems shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (150 mm) of the end of its travel.

(2) When wire ropes are used with pneumatic or hydraulic cylinders, they shall be adjusted so that connecting devices will not contact the reeving devices before the ram reaches the travel limits of the cylinder.

(e) Chains in tension systems. Roller, leaf, or welded link chains may be used in tension systems as specified in ANSI B77.1 Section 7.

(1) For chain used as a tensioning component, where the chain does not pass through or around sprockets, the minimum factor of safety shall be 5.

(2) For applications of chain where any sprockets are used, the minimum factor of safety shall be 6.

(f) Cable winches or chain adjusting devices. Winches that are used for counterweight system take-up and remain a permanent part of the system shall have a minimum factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. Where this safety factor cannot be established by the manufacturer's endorsement, a safety device shall be installed on the tension system rope or chain ahead of the winch/mechanical device that will keep the tensioning system intact in the event of failure or release of the device. The diameter of the winding drum shall not be less than the specified minimum sheave diameters referenced as Condition C in section 32-5.20(c)(3).

32-5.23 Anchoring devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

(a) RESERVED

(b) RESERVED

(c) Wire ropes or strands and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

All connections of ropes or cables used in anchoring devices shall be in accordance with the requirements of ANSI B77.1 Section 7.

32-5.24 Manual and automatic control devices. All control devices and switches shall conform to the requirements of section 32-5.45.

(a) Manual control devices. Manual control devices that will initiate a stop shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in proximity to all loading and unloading areas. The control devices shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls. All start/run/stop and speed control devices shall be conspicuously and permanently marked with the proper function.

(b) Provisions for automatic stop devices. The following automatic stop devices shall be installed:

(1) automatic stopping devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the operating circuit when detached. The location of the device shall be in accordance with the following:

(i) Intermediate unloading stations. Required only when passengers are not permitted beyond the intermediate unloading station. The device shall automatically stop the surface lift in the event a passenger or an unretracted towing device passes beyond the intended point of unloading;

(ii) Terminal unloading areas. Always required. The device shall automatically stop the surface lift in the event a passenger or an unretracted towing device passes beyond the stop gate. The stop gate shall be so located that the distance from the stopping device to the first obstruction or point of reversal of direction of the towing devices is 150% of the distance required to stop the empty surface lift operating at maximum speed.

(iii) In no case may the grip travel more than two-thirds (2/3) of the distance from its position at the time the stop gate is tripped to the point where it would begin to pull a passenger in the reverse direction.

(iv) A device shall be installed on the down side of surface lifts to stop the lift in the event a towing outfit fails to retract. This device shall be located as near to the upper terminal as practical, but in no event be further downhill than opposite to the unloading area;

(2) a device(s) that will stop the lift if any component in the tension system exceeds its normal operating range;

(3) suitable deropement switch devices on each sheave assembly which will stop the lift in case of deropement.

32-5.25 RESERVED

Subchapter C - Line Structures

32-5.26 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of section 32-5.7. Where guyed towers are used and guys intersect the ground the guys shall be marked for visibility with a blaze orange designation.

(a) Means shall be provided for ready access from the ground to all tower tops. This requirement will be fulfilled if the tower structure is readily climbable. On lifts installed after 1995, permanent ladders are required for heights above those accessible by portable ladders. Portable ladders, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed. Portable ladders extending more than 20 feet (6.10 meters) shall not be used.

(b) On lifts installed after 1995, permanent anchor points shall be provided on all tower tops for the attachment of fall protection devices.

(c) Towers shall be identified with successive numbers at least 6 inches high and clearly visible when looking both up and down the lines.

(d) Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

32-5.27 Tower guards and clearances. If unloading is permitted ahead of any intermediate tower, the layout of the unloading area shall satisfy the requirements of section 32-5.10, and the tower shall be so guarded as to prevent the released towing devices from becoming entangled with it.

32-5.28 Haul rope sheaves and mounts. The tread diameter of a haul rope sheave shall not be less than 10 times the nominal diameter of the haul rope unless an elastomer liner is used. The requirements in this section (32-5.28) apply generally to sheaves that support or hold down the haul rope at towers on a monocable system. These requirements shall apply to both sides of each surface lift.

(a) Maximum allowable sheave load. The maximum allowable load per sheave shall be determined by the surface lift designer.

(b) Sheave and sheave unit design. Sheave flanges shall be as deep as possible, considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that haul ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

(1) Suitable guards, of sufficient strength to resist the lateral forces caused by an inside deropement, shall be installed.

(2) Construction of the entire sheave unit shall be such that the haul rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

(3) On each sheave unit, rope-catching devices shall be installed to reduce the risk of the rope moving excessively in the direction of the load on the sheave unit in the event of deropement. They shall be designed to permit the passage of the rope and grips after deropement. On lifts installed after 1995 these devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of 2 rope diameters beyond the sheave flange.

(4) On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the surface lift in case of deropement.

(5) If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

(6) Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

(7) See also section 32-5.5 for the effect of tower height and location on sheave units.

(c) Haul rope retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. On lifts installed after 1995 this criterion shall be met if any of the following conditions is fulfilled:

(1) Condition A. Under the most adverse design loading conditions (excluding dynamic

effects), the minimum load of the haul rope on a group of support sheaves at a tower shall not be less than the largest of the following values: 100 pounds (445 newtons) per sheave; or 300 pounds (1335 newtons) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to 10 times the sum of the adjacent span lengths expressed in meters of slope length). When haul rope elevation at a tower lies below a straight line joining haul rope elevations at the adjacent tower, the haul rope shall not leave the group of sheaves under either of the following conditions:

(i) when the haul rope tension is 1.5 times its maximum design value at the tower working point, using unloaded carriers in adjacent spans or, in the case of detachable systems, no carriers in adjacent spans;

(ii) when a rope is under tension of the tension system alone (bare rope) or with any arrangement or number of empty towing devices on the line.

(iii) The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall not be less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in newtons equal to 15 times the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (1000 newtons) per passenger.

(2) Condition B. Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

(d) Additional requirements. When single sheaves are used for other than guide sheaves, which normally carry no load other than the weight of the rope and carriers, the sheave diameter shall not be less than 20 times the nominal rope diameter. The sheaves for the return rope shall be installed in a manner to prevent a passenger from contacting the rope or being hit by one of the returning towing devices. All line sheaves shall be so guarded that towing devices cannot become entangled in the sheaves or sheave supports while traveling in either a forward or reverse direction.

32-5.29 RESERVED

Subchapter D - Line Equipment.

32-5.30 Haul rope. Wire rope design and installation shall conform to the requirements of ANSI B77.1 Section 7.

(a) Factor of safety. When the slope length of the installation is less than 3000 feet (914 meters), the haul rope shall have a minimum static factor of safety of 5 when new. On tows hereafter installed, for slope lengths greater than 3000 feet (914 meters), the haul rope may have a minimum static factor of safety of 4.5 when new. Static factor of safety is equal to the nominal breaking strength divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

(b) Factor of safety for spliced haul rope with an independent wire rope center. Where a spliced haul rope with an independent wire rope center (IWRC) is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

32-5.31 RESERVED

32-5.32 Fixed and detachable haul rope grips.

(a) General. The haul rope grip shall be of a type that has been approved by a Qualified Engineer. Grips shall be tested and manufactured using accepted engineering and quality practices. The manufacturer shall permanently affix a unit identification and size marking to each grip. Each grip shall be nondestructively tested before public use, and such testing shall be documented.

(1) The rope grip shall be designed to pass smoothly over and under line sheaves that have flanges of adequate height to discourage the haul rope from leaving the sheaves.

(2) The designer's instructions shall provide details for the proper initial setting of the grip and a method to assure an operator or inspector that the grip has not reached an operational limit of the clamping components. For grips installed after 1995 the design shall incorporate provisions to accommodate a 10% reduction in haul rope diameter.

(b) Slippage. This section applies only to grips hereafter installed; the rope grip shall be designed and maintained during use so as to resist a force that tends to slide it along the haul rope, that is, a minimum of 2 times the force required to move a carrier along a properly lubricated haul rope at its steepest incline, under the most adverse conditions of carrier loading. The grip shall automatically adjust to maintain this gripping force with a 3% reduction in haul rope diameter. The grip designer shall specify the proper grip installation and testing procedures, and for clamping type grips, the minimum force below which the grip shall not slip on the rope and a maximum force above which the grip should slip on the rope.

(c) Strength. The strength of the grip shall be based upon the following criteria:

(1) a minimum factor of safety of 6 shall exist in all parts of the grip wherein stress is proportional to the dead and live load of the carrier. This factor of safety is defined as follows: With the grip in its operating position (gripping the rope or equivalent), a downward load, equal to the dead load of the carrier plus 6 times of the design live load, shall not cause any part of the grip to fail;

(2) for grips hereafter installed those parts whose stress is not changed by application of live load shall be designed on the basis of an allowable stress of not more than the yield point divided by 3.0. In the design of springs, hereafter installed and where used, the allowable stress may be increased if load tests are conducted by an independent nationally recognized testing laboratory to provide assurances that the fatigue life of the actual spring is more than ample for the various applied loads;

(3) the material of which the grip is made shall be selected or selected and treated to obtain optimum impact resistance;
(4) special attention shall be paid to fatigue considerations. A grip that has not been proved in service shall be subjected to fatigue tests;
(5) the manufacturer's quality control provision shall assure that the grips and their parts meet the designer's specifications and the foregoing criteria.

(d) Maximum loads. On grips hereafter installed, the maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope.

(e) RESERVED

(f) Positive attachment of detachable grips. A detachable grip shall be designed and constructed in such a manner that it grips the haul rope positively without damaging the haul rope and in such a manner that it cannot become accidentally uncoupled, even by haul rope vibrations. Provision shall be made to preclude a grip attaching to the haul rope at the splice unless the designer stipulates that the grip will function properly at that point and gives maximum and minimum permissible rope diameter variations through the splice length including the point of splice tucks.

32-5.33 Carriers.

(a) General. The bar, platter, or other device in contact with the skier shall be so designed that the passenger can embark and disembark. Devices that envelop the passenger, such as a strap, are prohibited. The length of the towing outfit shall permit the shortest passenger to remain in firm contact with the uphill track and to satisfy the requirements of section 32-5.5.

(b) Loads. With respect to vertical loads, the surface lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.

(c) Additional requirements for retractable towing devices. Retraction of a towing device shall be so controlled that it may be released from a fully extended position without causing injury to passengers or damage to the towing device, or causing such violent oscillations as to expose any part of the towing device to entanglement with the haul rope, sheaves, other structures, or equipment.

32-5.34 RESERVED

Subchapter E - Personnel

32-5.35 Provisions for operating personnel.

(a) General. Operator and attendant stations shall be located to provide visual surveillance of the station and the line in the vicinity of the station. When enclosed, they shall be heated, ventilated,
and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:
(1) the communications and controls required of the station;
(2) the operating instructions and emergency procedures;
(3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.

(c) The lift operator who operates the lift shall observe the lift in operation and shall have an unobstructed view of its controls, including required brake controls and communicating devices, which shall be not more than 6 feet from his/her operating position. A clear and unobstructed path to such controls shall be maintained at all times. Loading and unloading areas shall have lift stopping devices located convenient to the attendants assigned to those points. The physical appearance, operation, and location of emergency shutdown devices shall differentiate them from other operating devices or controls.

(d) Loading and unloading areas shall have stopping devices located conveniently to the attendants assigned to those areas (see section 32-5.24(a)).

Subchapter F - Operational and Maintenance Manuals

32-5.36 Operational manual. The designer of each new or reinstalled surface lift shall prepare an operational manual in English for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-5.37 Maintenance Manual. The designer of each new or reinstalled surface lift shall provide with delivery of the installation, a maintenance manual in English for that installation. The manual shall describe recommended maintenance procedures, including:

(a) types of lubricants required and frequency of application;

(b) definitions and measurements to determine excessive wear;

(c) recommended frequency of service to specific components, including relocation of fixed grips, if applicable;

(d) brake testing and adjustment.

CHAPTER II - ELECTRICAL DESIGN AND INSTALLATION

Subchapter A - Design and Installation Testing

32-5.38 General. Prior to operation of newly installed surface lifts or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

(a) Electrical system acceptance test. Upon the completion of the acceptance test and before public operation of the aerial lift, the design and function of software and/or replay logic shall be certified by the Qualified Engineer of record and the certification shall be included in the acceptance test report. Any modifications made to the electrical design shall be clearly marked on the on-site documentation and signed by a Qualified Engineer. (see also section 32-4.12)

(b) Software security. The “as built” documents shall include a procedure, developed by the lift manufacturer or Qualified Engineer, to ensure the security of the software logic and operating parameters that will control the aerial tramway. Upon completion of the acceptance testing, this procedure shall be implemented in a manner that will prevent unauthorized personnel from making changes to the logic or operating parameters. All programmable logic and parameters shall be documented.

32-5.39 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-5.40 Location. No lift shall pass under any transmission line operating at a potential exceeding 50 volts. All electrical power transmission wiring located near or proposed to cross over surface lifts shall comply with the applicable requirements of NES C2.

32-5.41 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

32-5.42 Voltage limitations for overhead circuits. Signal, communication, and control circuits may be supported between towers that support the surface lift. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

32-5.43 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.

(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of the NFPA 70.

(c) Insulation. All control wiring is excepted from the requirements of Article 725-27(b) of the NFPA 70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the surface lift centerline, shall be ground fault protected.

32-5.44 Grounding.

(a) Structures. All metallic structures shall be bonded to form grounding electrode system as defined in Article 250 of NFPA 70 for the purpose of grounding the control circuit in such a manner that an inadvertent ground, anywhere in the control circuit, would stop the surface lift as required in section 32-5.45(a). Electrical continuity of all metal parts of the structures shall be assured by mechanical connection and shall be electrically bonded to the common bonding conductor.

(b) Drive terminal structure. The drive terminal structure shall have one point referred to as a grounding electrode as defined in NFPA 70. If an electrical prime mover is used, the electrical service grounding conductor shall terminate at this point as well as the structure's ground

referenced in section 32-5.44(a). All dc and ac electrical systems shall be referenced to this point. On lifts installed after 1995 the ground point shall be as defined in NFPA 70.

(1) Under the worst-case conditions, the resistance from the ground point to any grounded point within the surface lift system shall not exceed 50-ohms, for the purpose of grounding the control circuit. The grounding system for the surface lift shall not be used as a grounding system for any other system not related to the surface lift system.

(2) On lifts installed after 1995, to ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminal and line structures shall be bonded together with a common bonding conductor. The bonding conductor may be the support or messenger cable of overhead control cable, the ground shield for underground control cable, or some other conductor running the full length of the surface lift system, bonded to each of the terminals and line structures and of sufficient conductance to meet the 50-ohm requirement.

(c) Haul rope grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding haul ropes, as applicable, for static electrical discharge.

(d) Lightning protection. If lightning protection is provided, it shall follow the NFPA 780.

32-5.45 Operating control circuits.

(a) Operating circuits. All surface lift systems shall contain one or more normally de-energized circuit(s) that, when energized, allow(s) system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type. An exception to this requirement is allowed for magnetic or optically operated automatic stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit is of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All surface lift systems shall include a normally de-energized circuit that, when energized, allows the system to run and, when interrupted, effects an emergency shutdown (see section 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the surface lift while using the operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the surface lift.

(1) Any one of the following conditions is considered a loss of control of a surface lift:

(i) surface lift will not SLOW DOWN when given the command to do so;

(ii) surface lift will not STOP when given the command to do so;

(iii) surface lift OVERSPEEDS beyond control settings and/or maximum design speed;

(iv) surface lift ACCELERATES faster than normal design acceleration;
(v) surface lift SELF-STARTS or SELF-ACCELERATES without the command to do so;
(vi) surface lift REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and in the machine room. The shutdown device shall be conspicuously and permanently marked and shall be red in color (see section 32-5.35). If there is only one circuit, it shall be called the Emergency shutdown circuit.

(c) Bypass circuits. A temporary bypass device may be installed for malfunctions in operating control circuitry (see section 32-5.58).

32-5.46 Electrical prime mover and power circuits.

(a) Electrical prime mover. All surface lift systems equipped with electrical prime movers (electrical motors) shall have phase-loss protection on all power phases and undervoltage protection or overvoltage protection, or both, when speed regulation can be adversely affected by such voltage variations.

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:

(1) field loss (dc motors);
(2) speed feedback loss;
(3) overspeed;
(4) overcurrent.

Subchapter B - Night Operations

32-5.47 General. For nighttime operation, operating surface lifts shall be provided with lighting systems. The entire tow path, including the loading and unloading areas, shall be lighted.

32-5.48 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-5.49 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp-operating characteristics.

32-5.50 Location. Lights shall be mounted on substantial poles or standards. Surface lift towers and terminal structures may be used for supporting lights subject to the following requirements:

(a) approval shall be obtained from a Qualified Engineer;
Note: Approval of a Qualified Engineer is not required for lights installed on towers prior to 1995, and are in compliance with AV-39.

(b) the service conductors to each surface lift tower or terminal structure shall be underground or

in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the surface lift;

(c) a separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure;

(d) all metallic raceways on a tower or terminal structure shall be grounded;

(e) the lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the surface lift in any manner.

32-5.51 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit regular unloading of surface lift

CHAPTER III - OPERATION AND MAINTENANCE

Subchapter A - Personnel Safety

32-5.52 General and personnel safety. This subsection covers the requirements for operation and maintenance of all types of surface lifts. All passenger ropeways covered by this Subpart regardless of the date of installation shall be in compliance with this Chapter. Operating and maintenance personnel shall be familiar with applicable provisions of this section and the surface lift operational and maintenance manuals (see Chapter I, Subchapter F of this Subpart).

(a) Procedures for the operation and performance of maintenance on surface lifts shall include the precautionary measures necessary to reduce the risks for the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(b) Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

32-5.53 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the surface lift operations shall be adequately lighted for night operation. Signs shall be visible to passengers facing downhill while riding recreational devices. Additional signs deemed necessary by the owner, may be posted but not detract attention from any required sign.

(1) Instructions and warnings for use of surface lifts shall be posted at loading areas and may include the duties and obligations of the passenger, as well as the Skier's Responsibility Code (see Chapter III, Subchapter F, of this Subpart).

(2) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.

(3) The sign "Personnel Working on Surface Lift -- Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the prime mover when persons are working on the surface lift (see section 32-5.13).

(b) The following signs shall be posted:

(1) "Remove Pole Straps from Wrists -- Until Unloaded" (at loading area);

(2) "Check for Loose Clothing and Equipment" (two signs required -- one at the loading area and one in the vicinity of the "Prepare to Unload" sign);
(3) "Load Here" (at loading point);
(4) "Stay in tow path";
(5) "Prepare to Unload" (not less than 50 feet (15.2 meters) ahead of unloading area);
(6) "Unload Here";
(7) "Stop Gate".
(8) "Emergency Stop Switch"

Subchapter B - Operations

32-5.54 Personnel. Surface lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. Procedures for loading and unloading passengers, including passengers with common adaptive equipment, shall be included in the training. One or more persons familiar with emergency procedures shall be on the site at all times when the surface lift is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific surface lift.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for the operation, and shall have the authority to deny access to the surface lift to any person who, in the supervisor's opinion, is not fit or competent to use the surface lift without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the surface lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.
(b) Operators. An operator shall be in charge of each surface lift. This operator shall be trained and experienced in normal operational and emergency procedures and such training shall be documented. Operators shall be at least 18 years of age.
(c) Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view and such training shall be documented.
(d) RESERVED
(e) First aid. One or more persons trained to administer first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when a surface lift is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

32-5.55 Minimum operating personnel.

(a) The following personnel are the minimum that shall be required:
(1) an operator who shall be in charge of each surface lift;
(2) one attendant who shall be on duty at each loading area;

(3) one attendant who shall be on duty at each unloading area.

NOTE: An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the of the entire surface lift operation.

(b) The above regulations for minimum operating personnel may be modified in the following cases:

(1) Surface lifts may be operated with a single operator at the loading station provided the following conditions are met:

(i) the length of the surface lift, measured from the loading area to the stop gate, shall not exceed 800 feet (244 meters);

(ii) the entire tow path and the entire haul rope system shall be visible to the operator;

(iii) the surface lift shall have a clearly identified stop switch located at the unloading area, in addition to the required stop gate (see 32-5.24);

(iv) the operator shall have all surface lift controls immediately available;

(v) the restarting of the surface lift following actuation of an automatic or manual stopping device shall be impossible until clearance is assured and the automatic or manual stopping device(s) has been reset by an authorized person;

(vi) there shall be no obstructions at the top bull wheel area that could come into contact with a passenger who might fail to unload.

32-5.56 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:

(1) to determine that all surface lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties;

(2) to discontinue operations on any surface lift due to physical, weather, personnel, or other reasons;

(3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:

(1) to assume responsible charge of the surface lift;

(2) to assign and supervise all attendants on his/her surface lift;

(3) to maintain an operational logbook as required in section 32-5.64;

(4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant. The duties of the attendant shall be as follows:

(1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;

(2) to advise and assist passengers, as required;

(3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the surface lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-5.57 Operational procedures. The required operational procedures as set forth in sections 32-5.57 through and including 32-5.58 shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-5.36).

(a) Control of passengers. Each surface lift shall have a definite method for marshaling passengers for loading and unloading. Fences, gates, and alternate access and/or loading methods may be required to implement the system. Passengers shall not attach or detach recreational devices from the towing device.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) a visual inspection of each terminal, station, and the entire length of the surface lift;

(2) assurance that the tension system is functional and that tension system devices (counterweights, cylinders, carriages, and the like) have adequate travel with appropriate clearance at both ends;

(3) operation of all manual and automatic switches in terminals, stations, and loading and unloading area;

(4) operation of all braking systems;

NOTE: The designer of the surface lift system may specify that this inspection is to take place while the surface lift is not moving.

(5) operation of communication systems;

(6) operation of the surface lift, including a visual inspection of all ropes and carriers;

(7) checking each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis;

(8) for those surface lifts having internal combustion engines, determining that the fuel quantity is sufficient to conduct the anticipated period of operation without refueling. During refueling, power units shall be shut down.

(9) inspecting the loading and unloading areas and preparing them for the ingress and egress of passengers. The surface lift shall be inspected and, if necessary, tracks shall be established. Tracks shall be established beyond the stop gate for a distance necessary for passengers to stop should the passenger pass through the stop gate (see section 32-5.24(b)(1)). The towing devices shall be cleared of ice to the extent necessary to permit operation (see section 32-5.4(a)).

(c) Access to facilities. Entrances to all machinery, operators' and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-5.58 Operational requirements.

(a) General. The owner and operator of each surface lift shall review the requirements of Chapter I of this Subpart and to ascertain that original design and installation conditions have not been altered in a manner such as to violate the requirements of the standard.

(b) Starting. No surface lift shall be started except at the direction of, or following clearance by, the operator.

(c) Tow path maintenance. A minimum tow path surface width of 30 inches (760 mm) times the design number of passengers per carrier, but not less than 4 feet (1.22 meters), shall be

maintained through the length of the tow path. The tow path, including the loading and unloading areas shall be maintained to the range of contours specified by the designer or a Qualified Engineer.

(d) Stops. After any stop of a surface lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) Damage to towing devices. Should any towing device become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line as soon as feasible.

(f) Hazardous conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the surface lift shall be unloaded and the operation discontinued. No surface lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the surface lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

(g) RESERVED.

(h) Termination of daily operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the surface lift after it has been shut down. Loading ramps, as required, shall be closed during off-hours and so marked.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this subsection shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating circuit malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the surface lift supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;

(5) the operator control panel shall indicate that a bypass is in use.

(6) When a required surface lift control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the lift until the malfunction is corrected.

Subchapter C - Maintenance

32-5.59 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see section 32-5.37) shall be followed. Maintenance records shall be kept (see section 32-5.66).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) all wire ropes, strand, and chain;
(2) line sheave units, sheaves, bearings, and liners;
(3) bull wheels, bearings, and liners;
(4) tension systems;
(5) drive system, including bearings and couplings;
(6) braking systems;
(7) electrical control systems;
(8) communication systems;
(9) towing devices;
(10) structures;
(11) tow path (see section 32-5.4).

32-5.60 Maintenance personnel. Surface lifts shall be maintained by trained and competent personnel, and the owner shall be responsible for their supervision and training and such training shall be documented. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific surface lift.

32-5.61 Rope grips.

(a) Fixed rope grips - additional requirements. All grips shall be moved at least once every 12 calendar months. The grips shall be relocated a uniform distance of 24 inches to 36 inches each time and in the same direction. A fixed grip shall not be installed or allowed to migrate closer than a distance of 20 haul rope diameters from a splice tuck or rope repair tuck. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see sections 32-5.65 and 32-5.66).

(b) As each grip is relocated, the haul rope shall be examined for deterioration at or near the grip location. A Qualified Engineer shall supply information to the owner to enable him/her to identify excessive slippage.

(d) Detachable rope grips - additional requirements. Detachable rope grips shall be disassembled for inspection, adjustment, and replacement of worn parts at intervals not to exceed those recommended by the designer.

Subchapter D - Inspections and Testing

32-5.62 Wire rope Inspection. Inspection of wire rope, strand, and chain shall comply with ANSI B77.1 parts 7.4.1, 7.4.2, and 7.4.3. A copy of the report signed by the person performing the inspection shall be kept at the site, available to the Commissioner.

32-5.63 RESERVED

Subchapter E - Records

32-5.64 Operational log. A logbook shall be maintained for each surface lift. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;
(e) record of compliance with daily operational inspection including loading and unloading platforms, tow path and signs;
(f) position and condition of the tension carriage; counterweights, or other tension devices;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator.

32-5.65 Wire rope, strand, and chain log. A logbook shall be maintained for each surface lift giving the following information on each rope, strand, and chain;

(a) specification;
(b) copy of certified test report;
(c) date installed;
(d) splicing certificate for each splice or laid in strand;
(e) record of lubrication, including type of lubricant and date applied;
(f) record of maintenance inspections;
(g) report of wire rope, strand, and chain inspection;
(h) report of accidents or injury to wire rope, strand, or chain;
(i) documentation of end attachment.

32-5.66 Maintenance log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct

32-5.67 Dexterity and ability. All passengers who use a surface lift shall be presumed to have sufficient ability and physical dexterity or provide personal assistance to negotiate the surface lift. Each passenger shall maintain control of speed and course while loading, riding or unloading the surface lift.

32-5.68 Embarkation and disembarkation. A passenger shall get on and get off a surface lift at designated areas. No passenger shall embark without first understanding the proper loading, riding, and unloading procedures (see section 32-5.53).

32-5.69 Riding. Passengers, while riding a surface lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the surface lift. Passengers shall not

willfully engage in any type of conduct that may contribute to, or cause, injury to any other person. Skiers, when using a surface lift, shall not willfully place in an uphill track any object that can cause another skier to fall.

SUBPART 32-6
GENERAL PROVISIONS
Tows

Section 32-6.1 This Subpart covers that class of passenger ropeways wherein passengers grasp the circulating fiber hauling rope or a towing device attached to the circulating wire or fiber hauling rope and are propelled uphill. Passengers riding on recreational devices are also propelled uphill. On a tow, the uphill rope spans without intermediate support from the loading to the unloading area. The downhill rope may have intermediate supports.

CHAPTER I - DESIGN AND INSTALLATION
Subchapter A - General

32-6.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-6.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the tow type and location:
- (1) electric power lines and their supports;
- (2) highways;
- (3) structures;
- (4) rock and earth slides, cave-ins, washouts, and the like;
- (5) snow creep and avalanches;
- (6) wind action;
- (7) icing;
- (8) ski slopes and trails;
- (9) rivers and gullies;
- (10) buried installations, including pipelines;
- (11) crossing or close proximity to other passenger ropeways;
- (12) control of air space below, above, and adjacent to the installation;
- (13) passenger accessibility.

(b) Tow path gradient. The maximum grade of a tow path shall be regulated for the use intended. In no case shall the grade exceed that recommended by the tow design engineer or the manufacturer. No reverse grades shall be permitted except for very gradual inclines at loading and unloading areas.

(c) Tow path cross slope. On lifts installed after 1995, the cross slope of a tow path shall not exceed 5% except at unloading areas, and on wire rope tows, any cross slope shall be away from the tow.

32-6.4 Width of clearing. The clearing shall be wide enough to prevent adjacent vegetation from interfering with the tow. Such clearings shall be maintained to avoid washouts that might endanger the installation.

(a) Tow path clearing width. A minimum tow path clearing width shall be cleared on each side of the centerline of the tow path and maintained in such a manner that no rocks, stumps, or other obstructions project above the surface from the point where the passenger embarks on the tow to the point beyond the stop gate where the passenger would stop, under the most adverse conditions as follows:
   (1) 3 feet (915 mm) for skiers only;
   (2) 18 inches (460 mm) plus one-half the width of the recreational device.

(b) Tow path width. A minimum skiable track width of 4 feet (1.22 meters) shall be maintained free of obstructions through the length of the tow path clearing described in section 32-6.4(a).

32-6.5 Path of rope. Terminals and supports shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that towing devices will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.53 meters) of any portion of a wire haul rope or towing device under normal (nonsurge) operating conditions. Vegetation may extend over the rope provided it does not obscure the operator's and/or attendant's view of the tow.

(a) Vertical clearances. At no point between the loading and discharge areas shall the rope exert a downward force greater than 35 pounds (156 newtons), or an upward force greater than 30 pounds (133 newtons), when held at a height of 24 inches (610 mm) above the snow surface by a single passenger.
   EXCEPTION: For tows used to transport recreational devices, the upward force of 30 pounds (133 newtons) may be increased at the unloading area for a distance not exceeding 20 feet (6.1 meters) (see section 32-6.10).
   (1) Fiber rope tows: When the down-coming rope is less than 7 feet (2.14 meters) above the tow path, protective fencing or other approved means shall be provided to prevent persons from coming in contact with the down-coming rope.
   (2) Wire rope tows: Tow devices shall not contact the ground or snow surface at any point along the tow.

(b) Horizontal clearances. The following minimum distances shall be maintained along the tow path:
   (1) 36 inches (915 mm) between the up-going rope and any support;
   (2) 18 inches (460 mm) from a recreational device and any support.

(c) Other clearances. The clearances for up-going and down-coming ropes shall be:
   (1) Tows without towing devices: There shall be a minimum distance of 5 feet (1.53 meters) between the up-going rope and the downhill intermediate supports for 50 feet (15.24 meters) uphill of the loading area.
   (2) Tows with towing devices: At all points, the distance between the up-going and down-coming ropes shall exceed twice the projection of any towing device attached to the haul rope. In no event, shall the distance be less than 4 feet 6 inches (1.38 meters). The uphill tow path shall be so located that a passenger cannot be struck by a down-coming towing device (see section 32-6.27).

32-6.6 Capacity and speed.

(a) Capacity. The loading interval and capacity shall be stated by the manufacturer and regulated to suit the design limitations of the equipment as well as the slope gradient and the ability of the passengers to load and leave the tow.

(b) Fiber rope tows. The rope speed shall not exceed 1500 feet per minute (7.6 meters per second) when skiers grasp the circulating hauling rope. The speed shall not exceed 400 feet per minute (2.0 meters per second) when towing devices are attached to the hauling rope or passengers are riding in the recreational devices.

(c) Wire rope tows. The rope speed shall not exceed 400 feet per minute (2.0 meters per second) with a loading interval of not less than 5 seconds.

Note: With tows installed prior to 1995, the maximum speed shall not exceed 450 feet per minute.

32-6.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal operations. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) RESERVED

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost-susceptible soil or solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for protection of the foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus wind acting simultaneously.

(d) Anchorages. All structures shall be supported on sills or other supports that, however temporary, are capable of carrying the loads imposed by structural and machine elements under static or operating conditions without shifting or settlement that will impair the operation of the tow.

(1) Anchors may be natural objects or devices installed in a manner capable of withstanding tensions and uplift imposed by tow installation (see section 32-6.23). Above ground anchorages, including but not limited to trees, rocks or a deadman packed in snow or ice, are prohibited.

(2) The design shall have a factor of safety of 2 in resisting overturning, sliding, or

withdrawal under dead and live load.

32-6.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover control point, drive machinery building if any, loading stations, and unloading stations. The communication system shall be functional and audible during a power failure. On tows installed prior to 1995, radiophones or suitable public address systems may be used.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

NOTE: Voice communication systems are not required for those tows qualifying for operation by a single operator, as defined in section 32-6.55.

32-6.9 Internal combustion engine installation.

(a) Fuel tanks for combustion engines. Fuel tanks shall have adequate capacity to permit uninterrupted operation during the normal operating period. Internal combustion engines hereafter installed shall comply with NFPA 37.

(1) On internal combustion engines hereafter installed liquid fuels shall be supplied and handled in accordance with NFPA 30. Gas fuels shall be in accordance with NFPA 58. Liquid fuels stored outside of a motor room, either above ground or below ground, must be in compliance with the appropriate regulatory authority.

(2) For the purposes of interpreting ANSI/NFPA 37-1998, the auxiliary power units utilizing a combustion engine shall be considered, "used for emergency purposes". Also, "on roof of structure" shall mean "on the drive terminal structure". Structural members shall not be used as fuel tanks.

(3) An integral tank is a fuel tank furnished by the engine manufacturer. It shall be securely mounted to the engine assembly, protected against vibration, physical damage, engine heat, and the heat of exhaust piping.

EXCEPTION: The tow manufacturer may supply an integral or day gasoline fuel tank for mounting on a combined drive-tension carriage or an overhead fixed drive terminal. The tank shall be sized 25 gallons (94.6 liters) maximum, constructed, and installed in accordance with applicable provisions of NFPA 37.

(4) Standard portable marine fuel tanks (boat tanks) can be used in lieu of an integral fuel tank. Such tanks are limited to 7 gallons (26.5 liters) capacity and shall be secured while in use.

(5) Fill pipes located beyond the sides of the building or motor room shall have a locked fuel cap and shall be located to avoid toxic fumes and fire hazard during refueling.

(b) Exhaust systems. Exhaust systems shall be designed and installed to discharge to the atmosphere in a manner that does not allow precipitation to enter the exhaust system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields for a distance of 8 feet (2.44 meters) above the floor or other walking or working surface, or to the ceiling if less than 8 feet (2.44 meters) and shall be insulated where they pass through combustible building

materials.

(c) Ventilation. Internal combustion engine products of combustion shall be exhausted to and dispersed in the outer air and the machine room shall be ventilated so as to prevent air contamination within the room from the products of combustion or otherwise which tends to injure the health of any person therein or to create a fire or explosion hazard (see section 32-6.19).

32-6.10 Loading and unloading areas. Platforms, ramps, and related units comprising the loading and unloading areas of tows are integrally related to their operation. They shall be designed and installed in conformance with applicable criteria.

(a) Loading areas. Loading areas shall be approximately level. The area shall be free of obstructions and fenced in a manner to guide passengers to the loading point. Load gates, artificial surfaces and other loading aids when used shall be designed and installed with regards to all passengers. At least one point of access to the lift shall have a minimum clearance width of 36 inches (915 mm) to accommodate passengers using adaptive equipment.

(b) Unloading areas. The unloading areas' length, profile, and exit pathway shall be installed in accordance with the tow's speed, usage and manufacturer's recommendations. The exit pathway shall be level or be inclined downward in the direction of travel and outward from the line of the uphill tow path to provide passenger movement away from the tow.

32-6.11 RESERVED

32-6.12 Acceptance inspection and tests.

(a) Acceptance inspection. Before a tow that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) RESERVED

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;

(ii) lubrication of all moving parts;

(iii) alignment and clearances of all open gearing;

(iv) installation and alignment of all drive components;

(v) position and freedom of movement of counterweights or other tension systems and carriages;

(vi) haul rope alignment at entrance to bull wheels;

(vii) operation of all electrical components, including circuit protection and grounding;

(viii) horizontal and vertical clearances (see sections 32-6.5(a) through 32-6.5(c));

(ix) terminals for correct location and installation in accordance with plans and specifications;

(x) condition of haul rope splice.

(b) Acceptance tests. Before a tow that is new or relocated or that has not been operated for

routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel. The designer or manufacturer shall propose and submit an acceptance test procedure. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Any operational acceptance test shall be done in the presence of the Commissioner.

(2) The functioning of all push-button stops, stop gates, etc., shall be checked. Braking shall be proved adequate (see sections 32-6.18(b) and 32-6.18(d)). The tests shall include full-speed operation for as long as required to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, rope twist or spiraling verified to conform with section 32-6.30(c), and other related conditions.

32-6.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the tow design to render the system inoperable when necessary for the protection of personnel working on the tow. See section 32-6.53 for placement of applicable warning signs.

Subchapter B - Terminals and Stations

32-6.14 Power units.

(a) General. All power units shall have the capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded tow.

(1) Where manual multispeed transmissions are used on a power unit, they shall not be shifted when the tow is moving.

(2) Where reverse capability is provided on a power unit for a tow, provisions shall also be made to prevent accidentally shifting into reverse whenever the tow is operating.

(3) The tow is to be started at its lowest point of speed range after any type of stop.

(b) Auxiliary power unit. An auxiliary power unit shall not be required.

32-6.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting a tow under the most unfavorable design loading conditions without exceeding design rating. They shall have a service factor appropriate for the application.

32-6.16 Bearings, clutches, couplings, and shafting. Bearings, clutches, couplings, shafting and Universal joint shafts (cardan shafts) shall be selected on the basis of the manufacturer's published data for the particular use.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

(b) All shafting shall be designed in accordance with accepted standard practices.

(c) Guarding and containment shall be in accordance with the provisions of section 32-6.19.

32-6.17 Acceleration and speed control. Acceleration of a drive shall be regulated with regard to tow type, profile, speed, and use.

32-6.18 Brakes and rollback device.

(a) General. Each tow shall have the brakes and devices designated in sections 32-6.18(b) and 32-6.18(d). All braking systems shall be capable of operation to comply with daily inspections and periodic testing.

(b) Service brake. Unless an unloaded tow operating at maximum speed will stop in 25 feet (7.62 meters) or less, an automatic brake shall be provided to assure this stopping distance. This brake shall be applied by springs, weights, or other approved forms of stored energy when any stop circuit is interrupted. When the motive power is an internal combustion engine, a positive system shall be provided to stop the tow.

(c) RESERVED

(d) Rollback device. A device to automatically prevent reverse rotation of the tow shall be on all tows having an average grade in excess of 15%. If it can be demonstrated that the tow will not roll back (if declutched) under the most adverse loading, a rollback device shall not be necessary.

32-6.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provisions shall be made for appropriate containment of said components. On tows installed after 1995 guards and containment shall conform to the ASME B15.l.

(1) Protection against static electricity shall be provided.

(2) Fire-fighting device(s) shall be available.

(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.

(c) Machinery housed in a machine room. The machine room shall be adequately ventilated (see section 32-6.9(c)). It shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. On lifts installed after 1995, means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-6.20 Sheaves in terminals and stations.

(a) General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

(1) When unlined sheave grooves are used for wire rope, they shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

(2) When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

(b) Haul rope terminal sheaves.

(1) Wire rope tows (Bull wheels and deflection sheaves). Haul rope terminal sheave frames

shall be designed to retain the rope in the event of the failure of the shaft or mounting. In instances where the sheave is cantilevered, the design working stresses shall not be more than 60% of those otherwise allowable.

(i) The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope, provided that no towing device passes around the sheave. The minimum diameter shall be 80 times the nominal haul rope diameter in cases where towing devices pass around the sheave. In the latter case, means shall be provided to guide towing devices into, around, and out of terminal sheaves and to prevent the towing devices from swinging excessively while passing around the sheave. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave.

(ii) Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove.

(iii) Provisions shall be made to permit adjustment of the terminal sheaves to control the rotation of the haul rope and towing devices.

(2) Fiber rope tows (Bull wheel and deflection sheaves). Sheaves shall be designed and arranged to prevent unnecessary stress, wear, or disfigurement of the fiber haul rope. They shall be of sufficient strength and properly balanced to prevent excessive vibration at any operating speed. A suitable method shall be provided to retain the rope in the terminal in the event of a deropement from the sheave.

(c) Haul rope line sheaves. The requirements of 32-6.28 are applicable to haul rope line sheaves used in terminals and stations, except sheaves that carry no load other than the weight of the rope and towing devices. In the event auxiliary terminal guide sheaves are required, they shall be sized and located, have sufficient guides, and be otherwise designed to present no operational hazard to passengers, operating personnel, or mechanical elements of the tow.

32-6.21 Tension sheave carriages. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation. The idler terminal sheave may be supported by a rigid structure or carried in a floating manner. The assembly shall not be subject to collapse in the event of deropement and the subsequent retaining of the haul rope by the structure or sheave mounting.

32-6.22 Tensioning systems.

(a) General. Counterweights, hydraulic and pneumatic cylinders, or other suitable devices shall be used to provide the tensioning requirements of the particular installation.

(b) Tensioning devices for wire rope tows. A mechanical or hydraulic tensioning system shall be provided to ensure that the haul rope tension does not exceed a value of one-fifth its nominal breaking strength under the most unfavorable accumulation of stress due to loading, operating, temperature, and like considerations. A visual means of verifying this restriction shall be provided.

(c) Tensioning devices for fiber rope tows. All installations shall have provisions for adjusting and maintaining proper rope tension.

(d) Wire ropes in tension systems. Wire ropes in tension systems shall have a minimum factor of safety of 6, when new. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of

safety. See ANSI B-77.1 Section 7 for additional requirements. No rotation-resistant ropes shall be used in tension systems (see section 32-1.4(bc)).

(e) RESERVED

(f) Cable winches or chain adjusting devices. Winches or other mechanical devices that are used for take up and remain a part of the system shall have a factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. Where this factor cannot be established by the manufacturer's endorsement, a safety device shall be installed on the tension system rope or chain ahead of the winch/mechanical device that will keep the tensioning system intact in the event of failure or release of the device.

32-6.23 Anchoring devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

(a) RESERVED

(b) RESERVED

(c) Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

(d) All connections of ropes or cables used in anchoring devices shall be in accordance with the requirements of ANSI B-77.1 Section 7.

32-6.24 Manual and automatic control devices. All control devices and switches shall conform to the requirements of section 32-6.45.

(a) Manual control devices. Manual control devices that will initiate a stop shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in proximity to all loading and unloading areas. The control devices shall not be located in a position that would require the operator or attendant to reach across the haul rope in order to operate the controls. All start/run/stop and speed control devices shall be conspicuously and permanently marked with the proper function.

(b) Provisions for automatic stop devices. The following automatic stop devices shall be installed:

(1) automatic stopping devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the operating circuit when detached. The location of the device shall be in accordance with the following:

(i) Intermediate Unloading Stations. Required only when skiers are not permitted beyond the intermediate unloading station. The device shall automatically stop the tow in the event a skier passes beyond the intended point of unloading;

(ii) Terminal Unloading Areas. The device shall automatically stop the tow in the event a skier passes beyond the stop gate. The stop gate shall be so located that the distance from the stopping device to the first obstruction or point of reversal of direction of the towing device is 150% of the distance required to stop the empty tow operating at maximum speed;

(3) for fiber rope tows, a device (stop gate) that actuates the automatic stop and encircles the

up-going haul rope.

32-6.25 RESERVED

Subchapter C - Line Structures

32-6.26 Supports.

(a) Fiber rope tows. Line supports will be permitted between the unloading and loading areas to carry the return rope only; in accordance with the requirements of section 32-6.5. Where guyed towers are used the guys shall be marked for visibility with a blaze orange designation, and conform to the clearance requirements of sections 32-6.5(b) and 32-6.5(c).

(1) There shall be no spikes, hooks or other projections on a tower for a distance of 7 feet (2.14 meters) above the snow surface. A means of holding the idle rope up off the snow may be provided by fiber or other materials secured to the upper side of the pole.

(2) Towers shall be identified with successive numbers at least 6 inches high and clearly visible when looking both up and down the lines.

(b) Wire rope tows. There shall be no intermediate line structures on a wire rope tows.

32-6.27 Guards and clearances. Moving parts (other than the up-going haul rope) that are less than 7 feet (2.14 meters) above the snow surface shall be guarded in such a manner as to prevent accidental contact by the public or skiers using the tow. Adequate clearance or guards shall be provided between opposing haul ropes and towing devices to prevent accidental contact by the public or passengers. Persons shall be prevented from passing under the counterweight or tensioning system, or contacting any attachments thereto, by fences or guards.

32-6.28 Haul rope sheaves and mounts. The diameter of a haul rope sheave shall not be less than 10 times the nominal diameter of the haul rope unless an elastomer liner is used.

(a) The sheave mountings shall be sufficiently strong to prevent failure under the most adverse design load conditions.

(b) If the vertical component of the rope tension is not sufficient to hold the rope in the sheave groove at all times, then a device shall be used to catch and hold the rope in the event of deropement from the sheave. This applies to both sheaves supporting the rope and those holding it down. See section 32-6.26(b) for limitations for wire rope tows.

32-6.29 RESERVED

Subchapter D - Line Equipment

32-6.30 Haul rope. Wire rope design and installation shall conform to the requirements of ANSI B-77.1 Section 7.

(a) Factor of safety for wire ropes. Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

(b) Factor of safety for spliced haul rope with an independent wire rope center. Where a spliced haul rope with an (IWRC) is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

(c) Requirements for haul ropes for fiber rope tows. The haul rope shall be natural- or synthetic-fiber rope having a special lay or braid to minimize twist and manufactured for use with a ski tow. Fiber ropes shall be reeled in a manner that minimizes twist, and the manufacturer's instructions for unreeling and installation shall be followed.

(1) Splices shall be made by qualified personnel in accordance with the manufacturer's recommendations. All splices shall be long or transmission splices.

(2) Sheave adjustment or other means shall be provided to regulate rotation of the up-going rope and limit spiraling to one complete revolution in 200 feet (61.0 meters) of travel not to exceed 3 revolutions in the total uphill length of any tow.

(3) The minimum factor of safety shall be 5, based upon the manufacturer's catalog breaking strength of the new rope divided by the maximum full-load static tension in the haul rope.

32-6.31 RESERVED

32-6.32 Tow devices.

(a) Rope grippers shall not be permitted. Towing devices shall be allowed on tows operating at 400 feet per minute (2.0 meters per second) or less.

(b) Towing devices shall be designed to prevent sliding along the haul rope when subject to twice the pull required to move a passenger along the tow path at the steepest point.

(1) The towing device shall be designed to preclude entangling gloves or clothing, or pinching fingers between the towing device and the haul rope.

(2) Attaching the towing device to the haul rope shall in no way impair the strength of the haul rope

(3) The towing devices shall be relocated on the haul rope in accordance with the manufacturer's recommendations, but in no case, less frequently than once annually.

32-6.33 RESERVED

32-6.34 RESERVED

Subchapter E - Personnel

32-6.35 Provision for operating personnel.

(a) General. Operator and attendant stations shall be located to provide visual surveillance of the station and the line in the vicinity of the station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:

(1) the communications and controls required of the station;

(2) the operating instructions and emergency procedures;

(3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.
(c) The tow operator who operates the tow shall observe the tow in operation and shall have an unobstructed view of its controls, including required brakes and communicating devices, which shall not be more than 6 feet from his operating position. A clear and unobstructed path to such controls and communications shall be maintained at all times.
(d) When attendants are on duty on a tow, loading and unloading areas shall have tow-stopping devices located convenient to the attendants assigned to those areas.

Subchapter F - Operational and Maintenance Manuals

32-6.36 Operational manual. The designer of each new or reinstalled tow shall prepare an operational manual in English for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-6.37 Maintenance manual. The designer of each new or reinstalled tow shall provide with the delivery of the installation, a maintenance manual in English for each installation. The manual shall describe recommended maintenance procedures, including:
(a) types of lubricants required and frequency of application;
(b) definitions and measurements to determine excessive wear;
(c) recommended frequency of service to specific components, including relocation of fixed grips, if applicable.

CHAPTER II - ELECTRICAL DESIGN AND INSTALLATION
Subchapter A - Design and Installation Testing

32-6.38 General. Prior to operation of newly installed tows, or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

32-6.39 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-6.40 Location. No lift shall pass under any transmission line operating at a potential exceeding 50 volts. All electrical power transmission wiring located near or proposed to cross over tows shall comply with the applicable requirements of NES C2.

32-6.41 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected

against overloads by circuit breakers or fuses.

32-6.42 Voltage limitations for overhead circuits. Signal, communication, and control circuits may be supported between towers that support the tow. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

32-6.43 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.

(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of NFPA 70.

(c) Insulation. All control wiring is excepted from the requirements of Article 725-27(b) of NFPA 70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the tow centerline, shall be ground fault protected.

32-6.44 Grounding.

(a) RESERVED

(b) Terminal structure. The drive terminal structure shall have one point referred to as the grounding electrode as defined in NFPA 70. If an electrical prime mover is used, the electrical service grounding conductor shall terminate at this point. All dc and ac electrical systems shall be referenced to this point. Under the worst-case conditions, the resistance from the ground point to any part of the tow control shall not exceed 50-ohms for the purpose of grounding the tow control circuit. The grounding system for the particular tow shall not be used as a grounding system for any other system not related to the tow system. On lifts installed after 1995 the ground point shall be as defined in NFPA 70.

(c) Haul rope grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding metallic haul ropes, as applicable, for static electrical discharge.

(d) Lightning protection. If lightning protection is provided, it shall follow the NFPA 780.

32-6.45 Operating control circuits.

(a) Operating circuits. All tow systems shall contain one or more normally de-energized circuit(s) that, when energized, allow(s) the system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type.

An exception to this requirement is allowed for magnetic or optically operated stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit is of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All tow systems shall include a normally de-engergized circuit that, when energized, allows the system to run and when interrupted, effects an emergency shutdown (see 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the tow while using the normal operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the tow.

(1) Any one of the following conditions is considered a loss of control of a tow:

(i) tow will not SLOW DOWN when given the command to do so;

(ii) tow will not STOP when given the command to do so;

(iii) tow OVERSPEEDS beyond control settings and/or maximum design speed;

(iv) tow ACCELERATES faster than normal design acceleration;

(v) tow SELF-STARTS or SELF-ACCELERATES without the command to do so;

(vi) tow REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and the machine room. The shut down device shall be conspicuously and permanently marked and shall be red in color (see section 32-6.35). If there is only one circuit, it shall be called the Emergency Shutdown Circuit.

(c) Bypass circuits. A temporary bypass device may be installed for malfunctions in operating control circuitry (see section 32-6.58(i)).

32-6.46 Electric prime mover and power circuits.

(a) RESERVED

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:

(1) field loss (dc motors);

(2) speed feedback loss;

(3) overspeed;

(4) overcurrent.

Subchapter B - Night Operations

32-6.47 General. For nighttime operation, operating tows shall be provided with lighting systems. The entire tow path, including the loading, unloading, and operational areas shall be lighted.

32-6.48 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-6.49 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

32-6.50 Location. Lights shall be mounted on substantial poles or standards. Tow towers and terminal structures may be used for supporting lights subject to the following requirements:

(a) approval shall be obtained from a Qualified Engineer;
Note: Approval of a Qualified Engineer is not required for lights installed on towers prior to 1995, and is in compliance with AV-39.

(b) the service conductors to each tow tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tow;

(c) a separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure;

(d) all metallic raceways on a tower or terminal structure shall be grounded;

(e) the lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tow in any manner.

32-6.51 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit regular unloading of the tow.

CHAPTER III - OPERATION AND MAINTENANCE
Subchapter A - Personnel Safety

32-6.52 General and personnel safety. This subsection covers the requirements for operation and maintenance of all types of tows. All tows covered by this Subpart regardless of the date of installation shall be in compliance with this Chapter. Operating and maintenance personnel shall be familiar with applicable provisions of this section and the tow operational and maintenance manuals (see Chapter I, Subchapter F of this Subpart).

(a) Procedures for the operation and performance of maintenance on tows shall include the precautionary measures necessary to reduce the risks of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(c) Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials which may encroach upon limitations of clearances or design live loads.

32-6.53 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the tow operations shall be adequately lighted for night operation. Signs shall be visible to passengers facing downhill while riding recreational devices. Additional signs, deemed necessary by the owner, may be posted but not detract attention from any required sign.
   (1) Instructions and warnings for the use of tows shall be posted at loading areas and may include the duties and obligations of the passenger, as well as the Skier's Responsibility Code (see Chapter III, Subchapter F, of this Subpart).
   (2) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.
   (3) The sign "Personnel Working on Tow - Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when persons are working on the tow (see section 32-6.13).

(b) The following Signs shall be posted:
   (1) "No Loose Scarves" (at the loading area)
   "No Loose Clothing"
   "No Long Hair Exposed"
   (2) "Stay in tow path"
   (3) "Unload Here"
   (4) "Stop Gate"
   (5) "Emergency Stop Switch"

Subchapter B - Operations

32-6.54 Personnel. Tows shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. Procedures for loading and unloading passengers including passengers with common adaptive equipment shall be included in the training. One or more persons familiar with emergency procedures shall be on the site at all times when the tow is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific tow.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for operation, and shall have the authority to deny access to the tow to any person who in the supervisor's opinion is not fit or competent to use the tow without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the tow under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

(b) Operators. An operator shall be in charge of each tow. This operator shall be trained and experienced in normal operational and emergency procedures and such training shall be documented. Operators shall be at least 18 years of age.

(c) Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view and such training shall be documented.

(d) RESERVED

(e) First aid. One or more persons trained to administer first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when a tow is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if necessary, heated shelter.

32-6.55 Minimum operating personnel.

(a) A single operator may operate a tow provided the following conditions are met:
   (1) the length of the tow, measured from the loading area to the stop gate, shall not exceed 800 feet (244 meters);
   (2) the entire tow is clearly visible to the operator from the loading area to the stop gate at top;
   (3) the operator can start the tow while maintaining the surveillance required in condition (b) above;
   (4) the restarting of the tow following actuation of an automatic or manual stopping device(s) shall be impossible until clearance is assured and the automatic or manual stopping device(s) has been reset by an authorized person;
   (5) no recreational device is attached to or being conveyed by the tow.

(b) If the above conditions are not met, an additional attendant(s) is required. Each attendant shall be furnished with a stopping device and shall be able to communicate with operator.

32-6.56 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:
   (1) to determine that all tows are operational and that all operating personnel are trained, equipped, and fit to perform their duties;
   (2) to discontinue operations on any tow due to physical, weather, personnel, or other reasons;
   (3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:
   (1) to assume responsible charge of the tow;
   (2) to assign and supervise all attendants on his/her tow;
   (3) to maintain an operational logbook as required in section 32-6.64;
   (4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant. The duties of the attendant shall be as follows:
   (1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;
   (2) to advise and assist passengers, as required;
   (3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the tow immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-6.57 Operational procedures. The required operational procedures as set forth in sections 32-6.57 through and including 32-6.58 of this rule shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-6.36).

(a) Control of passengers. Each tow shall have a definite method for marshaling passengers for loading and unloading. Fences and gates may be required to implement the system. Passengers shall not attach or detach the recreational device from the towing device and shall be loaded according to the capacity stated by the lift manufacturer.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) a visual inspection of each terminal, station, and the entire length of the tow;

(2) assurance that the tension system is functional and that tension system devices (counterweights, cylinders, carriages, and the like) have adequate travel with appropriate clearances at both ends;

(3) operation of all manual and automatic switches in terminals, stations, and loading and unloading areas;

(4) operation of all braking systems. The designer of the tow system may specify whether the inspection is to take place while the tow is not moving;

(5) operation of communication systems;

(6) operation of the tow, including a visual inspection of all ropes and carriers;

(7) checking each control circuit for circuit continuity and integrity at its most remote location, on a daily basis;

(8) for those tows having internal combustion engines, determining that the fuel quantity is sufficient to conduct the anticipated period of operation without refueling. During refueling, power units shall be shut down;

(9) inspecting the loading and unloading areas and preparing them for ingress and egress of passengers. The tow path shall be inspected and, if necessary, tracks shall be established. Tracks shall be established beyond the stop gate for a distance necessary for passengers to stop should the passenger pass through the stop gate (see section 32-6.4(a));

(10) the rope twist shall be verified daily prior to operation for the public and shall comply with that specified in section 32-6.30. Verification shall be noted in the daily operational log.

(c) Access to facilities. Entrances to all machinery, operators' and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-6.58 Operational requirements.

(a) General. The supervisor and operator of each tow shall review the requirements of Chapter I of this Subpart to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

(b) Starting. The tow shall not be started by any person other than the operator. The starting mechanism shall be located at the drive station only.

(c) Tow path maintenance. The following minimum tow path width shall be maintained and free of obstructions for the length of the tow path:

(1) 4 feet (1.22 meters) for skiers;

(2) 24 inches (610 mm) plus the width of the recreational device for passengers on recreational devices.

(d) Stops. After any stop of a tow, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) Damage to wire rope towing devices. Should any towing device become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked, and not used for passengers until repaired or replaced. It shall be removed from the line as soon as feasible.

(f) Hazardous conditions. No tow shall operate when wind or icing conditions may endanger passengers or equipment or when there is an electrical storm in the immediate vicinity. Should such conditions develop while the tow is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers.

(g) RESERVED

(h) Termination of daily operations. Procedures shall be established for terminating daily operations.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this subsection shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the tow supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;

(5) the operator control panel shall indicate that a bypass is in use;

(6) when a required tow control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the tow until the malfunction is corrected.

Subchapter C - Maintenance

32-6.59 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see section 32-6.37) shall be followed. Maintenance records shall be kept (see section 32-6.66).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) all fiber ropes, wire ropes, strand and chain;
(2) line sheave units, sheaves, bearings, and liners;
(3) bull wheels, bearings, and liners;
(4) counterweight or tensioning systems;
(5) drive system, including bearings and couplings;
(6) braking systems;
(7) electrical control systems;
(8) communication systems;
(9) towing devices;
(10) structures;
(11) tow path (see section 32-6.4).

32-6.60 RESERVED

32-6.61 Additional requirements for wire rope towing devices. All wire rope towing devices shall be moved at least once annually. The towing device shall be moved a uniform distance each time and in the same direction. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see section 32-6.66). As each towing device is relocated, the haul rope shall be examined for deterioration at or near the towing device location.

Subchapter D - Inspection and Testing

32-6.62 Fiber rope. Operation and replacement of fiber ropes shall be in accordance with section 32-6.30(c).

32-6.63 Wire rope. No haul rope shall be permitted to remain in service when broken wires are visible on the exterior portions of the strands.

Subchapter E - Records

32-6.64 Operational log. A logbook shall be maintained for each tow. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;

(e) record of compliance with daily operational inspection including loading and unloading platforms, ramps, tow path, rope twist and signs;
(f) position and condition of the tension carriage, counterweights, or other tension systems;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator.

32-6.65 Wire Rope Log. A log shall be maintained for each tow using a wire rope giving the following information on the haul rope:

(a) copy of certified test report;
(b) date installed;
(c) splicing certificate for each long splice or laid-in strand or , record of installation of mechanical splice (splice grip or pressed sleeve connector);
(d) record of maintenance inspections per ANSI B77.1 section 7;
(e) report of wire rope inspections per ANSI B77.1 section 7;
(f) report of accidents or injury to wire rope.

32-6.66 Maintenance log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct

32-6.67 Dexterity and ability. All passengers who use a tow shall be presumed to have sufficient ability and physical dexterity or provide personal assistance to negotiate the tow. Each passenger should maintain control of their speed and course while loading, riding, and unloading the tow.

32-6.68 Embarkation and disembarkation. A passenger shall get on and get off a tow at designated areas

32-6.69 Riding. Passengers, while riding a tow, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the tow. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person. Passengers, when using a tow, shall not willfully place in an uphill path any object that can cause another skier to fall.

SUBPART 32-7
RESERVED

SUBPART 32-8
GENERAL PROVISIONS
Conveyors

Section 32-8.1 This Subpart covers that class of outdoor transportation wherein skiers, or passengers on recreational devices, are transported uphill on a flexible moving element. The circulating, flexible moving element (conveyor belt) travels uphill on one path and generally returns underneath the uphill portion.

CHAPTER I - DESIGN AND INSTALLATION
Subchapter A - General

32-8.2 Design passenger weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77.1 kg).

32-8.3 Location.

(a) General. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the conveyor type and location:
- (1) electric power lines and their supports;
- (2) highways;
- (3) structures;
- (4) rock and earth slides, cave-ins, washouts, and the like;
- (5) snow creep and avalanches;
- (6) wind action;
- (7) icing;
- (8) ski slopes and trails;
- (9) rivers and gullies;
- (10) buried installations, including pipelines;
- (11) crossing or close proximity to other passenger ropeways;
- (12) control of air space below, above, and adjacent to the installation;
- (13) passenger accessibility.

(b) Conveyor gradient. The maximum grade of a conveyor shall be regulated for the use intended. In no case shall the conveyor belt grade exceed 40 percent.

(c) Cross slope. The cross slope of the conveyor shall not exceed 5%.

32-8.4 Conveyor belt length/width. The conveyor system length shall be the exposed conveyor belt surface to the next whole inch or centimeter measured from the outgoing transition point to the incoming transition point.

(a) The conveyor system travel length shall be the exposed conveyor belt surface as follows:
   (1) For end loading – from the load point to the unload transition point.
   (2) For side loading – From the load point to a point 5 feet (1.53 meters) plus 150% of the distance required to stop the empty conveyor operating at maximum speed beyond the stopping device.

(b) The width of the conveyor shall be the width of the exposed conveyor belt to the next whole inch or centimeter. The minimum conveyor belt width shall be 22 inches (560 mm).

(c) Path width. A minimum clear walking surface, of snow for skiers along both sides of the conveyor, shall be 18 inches (460 mm) wide as a minimum measured from the exposed edge of the belt. The surface shall approximate the horizontal plane of the uphill conveyor belt surface.
   (1) The surface from 18 inches (460 mm) to 72 inches (1830 mm) horizontally from the exposed edge of the belt shall not exceed a 1:2 slope. A fence or other structure can be used in lieu of the grading.

(d) Clearing width. The conveyor clearing shall be maintained so trees or vegetation do not extend within 5 feet (1.53 meters) horizontally and 10 feet (3.05 meters) vertically of the conveyor belting. Vegetation may extend over the conveyor belting provided it does not obscure the operator's and/or attendant's view of the conveyor. Such clearings shall be maintained to avoid washouts that might endanger the installation (see section 32-8.53 Maintenance).

32-8.5 Clearances

(a) Vertical clearances. The minimum headroom shall be 7 feet (2.14 meters) measured vertically from the conveyor belt surface.

(b) Horizontal clearances. There shall be a minimum distance of 24 inches (610 mm) between the exposed edge of the belt and any obstruction located between the loading and discharge zones.

32-8.6 Capacity and speed.

(a) Capacity. The loading interval and capacity shall be stated by the manufacturer and regulated to suit the design limitations of the equipment as well as the slope gradient and the ability of the passengers to load and leave the conveyor.

32-8.7 Structures and foundations.

(a) General. All structures and foundations shall be designed and constructed in conformance with applicable criteria and shall be appropriate for the site. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal conditions and for foreseeable abnormal operations. A minimum live load of 100 lb/ft^2 (488 kg/m^2) shall be used. Structures and foundations located in snow creep areas shall be designed for such conditions and loads, or protective structures shall be provided as required by the conditions.

(b) RESERVED

(c) Foundations. In determining the resistance of the soil to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage shall be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on non-frost-susceptible soil or solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

(1) The top of concrete foundations shall not be less than 6 inches (150 mm) above finished grade unless specific direction for protection of the foundation and structural steel below grade is specified by the designer.

(2) The design shall have a minimum factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead-load and live-load conditions; the minimum factors shall be 1.5 under these loadings plus wind acting simultaneously.

(d) Anchorages. All structures shall be supported on sills or other supports that, however temporary, are capable of carrying the loads imposed by structural and machine elements under static or operating conditions without shifting or settlement that will impair the operation of the conveyor.

(1) Anchors may be natural objects or devices installed in a manner capable of withstanding tensions and uplift imposed by conveyor installation.

(2) The design shall have a factor of safety of 2 in resisting overturning, sliding, or withdrawal under dead and live load.

32-8.8 Communications.

(a) General. A permanently installed two-way voice communication system shall be provided between the prime mover control point, drive machinery building if any, loading stations, and unloading stations. The communication system shall be functional and audible during operation and a power failure.

(b) Audio indicators shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

NOTE: Voice communication systems are not required for those conveyors qualifying for operation by a single operator, as defined in section 32-8.49.

32-8.9 Internal combustion engine installation.

(a) Internal combustion engines, fuel tanks, and exhaust systems, if used on conveyors, shall comply with section 32-5.9.

32-8.10 Loading and unloading areas. Platforms, ramps, corals and mazes comprising the loading and unloading areas of conveyors are integrally related to their operation. They shall be designed and installed in conformance with applicable criteria.

(a) Loading areas. Loading areas shall provide a pathway free of obstructions and fenced in a manner to guide passengers to the loading point.

(b) Unloading areas. The unloading area have a pathway to provide passenger movement away from the conveyor.

(c) The minimum length of the load and unload area shall be not less than twice the belt width (see section 32-8.4) measured from the transition point of the conveyor belt.

32-8.11 RESERVED

32-8.12 Acceptance inspection and tests.

(a) Acceptance inspection. Before a conveyor that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given a thorough inspection by the Commissioner to verify compliance with the plans and specifications of the designer.

(1) RESERVED

(2) It shall be the responsibility of the owner to see that the following conditions have been met:

(i) tightness of all structural connections;

(ii) lubrication of all moving parts;

(iii) installation and alignment of all drive components;

(iv) proper function of belt tensioning components;

(v) conveyor belt alignment;

(vi) conveyor belt splice;

(vii) operation of all electrical components, including circuit protection, ground fault circuit breakers, and grounding;

(ix) path width and clearances (see sections 32-8.4 and 32-8.5);

(ix) conveyor in correct location and installation in accordance with plans and specifications;

(b) Acceptance tests. Before a conveyor that is new or relocated or that has not been operated for routine maintenance within the previous 2 years is opened to the public, it shall be given thorough tests by qualified personnel. The designer or manufacturer shall propose and submit an acceptance test procedure. The Commissioner shall be advised by the owner 10 days prior to the date of the test.

(1) Any operational acceptance test shall be done in the presence of the Commissioner.

(2) The functioning of all push-button stops, stop gates, etc., shall be checked. Braking shall be proved adequate (see section 32-8.18). The tests shall include full-speed operation for as long as required to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components.

32-8.13 Safety of operating and maintenance personnel. Provision shall be incorporated in the conveyor design to render the system inoperable when necessary for the protection of personnel working on the conveyor. See section 32-8.47 for placement of applicable warning signs.

Subchapter B – Drive machinery

32-8.14 Power units.

(a) General. All power units shall have the capacity to handle the most unfavorable design loading

conditions, including the starting of a fully loaded conveyor at minimum passenger spacing specified by the manufacturer.

(1) Where manual multispeed transmissions are used on a power unit, they shall not be shifted when the conveyor is moving.

(2) Where reverse capability is provided on a power unit for a conveyor, provisions shall also be made to prevent accidental reversal whenever the conveyor is moving.

(3) The conveyor is to be started at its lowest point of speed range after any type of stop.

(b) Auxiliary power unit. An auxiliary power unit shall not be required.

32-8.15 Speed reducers and gearing. All speed reducers and gearing shall have the capacity for starting a conveyor under the most unfavorable design loading conditions without exceeding design rating. They shall have a service factor appropriate for the application. They shall be located such that no belt, friction clutch or similar friction-type device is between the speed reducer and drive drum.

32-8.16 Bearings, clutches, couplings, and shafting. Bearings, clutches, couplings, shafting and Universal joint shafts (cardan shafts) shall be selected on the basis of the manufacturer's published data for the particular use.

(a) Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

(b) All shafting shall be designed in accordance with accepted standard practices.

(c) Guarding and containment shall be in accordance with the provisions of section 32-8.19.

32-8.17 Acceleration and speed control. Acceleration of a drive shall be regulated with regard to conveyor type, profile, speed, and use.

32-8.18 Brakes and rollback device.

(a) Service brake. The service brake can be located at any point in the drive train such that there is no belt, friction clutch, or similar friction-type device between the brake and the drive drum.

(b) RESERVED

(c) Rollback device. If it can be demonstrated that the conveyor will not roll back (if declutched) under the most adverse loading, a rollback device shall not be necessary. This device shall be located on the drive drum.

32-8.19 Location of machinery.

(a) General. Moving machine parts that normally may be in reach of personnel shall be fitted with guards. Where breakage of a power transmission component can result in injury, provisions shall be made for appropriate containment of said components. Guards and containment shall conform to ASME B15.l.

(1) Protection against static electricity shall be provided.

(2) Fire-fighting device(s) shall be available.

(b) Machinery not housed in a machine room. Provisions shall be made to keep the public away from the machinery. All machinery and controls shall be rated for use in their intended environment.

(c) Machinery housed in a machine room. The machine room shall be adequately ventilated. It

shall have a permanently installed lighting system, adequate for proper machinery maintenance and to reduce the risk of injury to operating personnel. The arrangement of machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (460 mm) shall be maintained. Means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

32-8.20 Drums and rollers. All drums, sprocket drums, and conveyor belt support rollers, including their mountings and frames, shall be designed to withstand static and dynamic loads. Drums, roller bearings and their mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers.

32-8.21 Tension drums or rollers. The available travel of tensioning drums or rollers shall be adequate to properly tension the conveyor belt during normal operations.

32-8.22 Tension systems. The system providing tension to the conveyor belt shall provide adequate belt tensioning for normal operations taking into consideration changing load and weather conditions.

32-8.23 RESERVED

32-8.24 Manual and automatic control devices. All control devices shall conform to the requirements of section 32-8.39.

(a) Manual control devices. Manual control devices that will initiate a stop shall be installed in all attendants' and operators' stations, in machine rooms, machine compartments, access points to crawl spaces, and out-of-doors in proximity to all loading and unloading areas. The control devices shall not be located in a position that would require the operator or attendant to cross the path of the conveyor belt to operate the controls. All start/run/stop and speed control devices shall be conspicuously and permanently marked with the proper function.

(b) Provisions for automatic stop devices. A belt transition entry stop device shall be provided at the unloading area. It shall be initiate an emergency shutdown of the conveyor and be of the manually reset type. It shall operate in either of two ways:

(1) If an object becomes entangled between the conveyor belt and the belt guard, the guard shall move to relieve the pinch point and initiate the stop. The guard shall be capable of moving the lesser of 5 inches (127 mm) or 150% of the distance required to stop the empty conveyor belt operating at full speed.

(2) An object on the belt initiates the stop as it approaches the pinch point. The stop gate shall be located 5 feet (1.53 meters) plus 150% of the distance required to stop the empty conveyor operating at maximum speed from the first obstruction or pinch point.

32-8.25 RESERVED

Subchapter C - Line Structures

32-8.26 Line structure(s). The design of structures supporting conveyor belting, the drive roller, idler roller and intermediate conveyor belt guide rollers shall be in accordance with the requirements of 32-8.7.

Subchapter D - Line Equipment

32-8.27 Conveyor belt. Conveyor belting and its splice(s) shall be based on the material rating of the manufacturer considering the most adverse design loading conditions. Splices and alternate treads on the adjacent surfaces shall intermesh so that there is no continuous transverse gap between the surfaces. Splicing of the conveyor belt shall be in such a manner as to result in a continuous conveyor belt surface.

32-8.28 Supports. Where the conveyor belt load side is supported on a series of load carrying rollers, the combination of roller spacing, belt tension, and belt stiffness shall be such that the deflection of the conveyor belt surface, midway between load carrying rollers, shall not exceed the quantity 0.094 inches (2.4mm) plus 0.004 times the center-to-center distance of the rollers in inches (millimeters) when measured as follows:

(a) The conveyor belt surface shall be loaded midway between rollers with a 25 pound (11.3 kg) weight concentrated on a cylindrical foot piece 2 inches (51mm) long by 1 inch (25 mm) in diameter placed with its long axis across the belt. Deflection of this foot piece from its unloaded position shall not exceed the figure obtained above.

Subchapter E - Personnel

32-8.29 Provision for operating personnel.

(a) General. Operator and attendant stations, if provided, shall be located to provide visual surveillance of the station and the conveyor in the vicinity of the station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed:
   (1) the communications and controls required of the station;
   (2) the operating instructions and emergency procedures;
   (3) a fire extinguisher.

(b) This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry when unattended.

(c) When the conveyor is operated by an operator without the use of attendants, the operator shall be located where he/she can observe the full length of the conveyor including the loading and unloading areas. All primary controls and communications shall be available to him/her.

(d) Loading and unloading areas shall have conveyor-stopping devices located convenient to the operator or attendants assigned to those areas.

Subchapter F - Operational and Maintenance Manuals

32-8.30 Operational manual. The designer of each new or reinstalled conveyor shall prepare an operational manual in English for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

32-8.31 Maintenance manual. The designer of each new or reinstalled conveyor shall prepare a maintenance manual in English for each installation. The manual shall describe recommended maintenance procedures, including:

(a) types of lubricants required and frequency of application;
(b) definitions and measurements to determine excessive wear;
(c) recommended frequency of service to specific components, including relocation of fixed grips, if applicable.

CHAPTER II - ELECTRICAL DESIGN AND INSTALLATION
Subchapter A - Design and Installation Testing

32-8.32 General. Prior to operation of newly installed conveyors, or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electrical controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

32-8.33 Applicable codes. All electrical systems hereafter installed shall comply with NFPA 70, and NES C2.

32-8.34 Location. No conveyor shall pass under any transmission line operating at a potential exceeding 50 volts. All electrical power transmission wiring located near or proposed to cross over tows shall comply with the applicable requirements of NES C2.

32-8.35 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

32-8.36 Voltage limitations. Signal, communication, and control circuits may be supported by the structure supporting the conveyor belt. Voltage on control or communications wiring shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

32-8.37 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

(a) Control wiring classification. All control wiring hereafter installed shall be Class 1 in accordance with Article 725 Parts A and B of NFPA 70.
(b) Communication wiring. All communication wiring and systems are excluded from the requirements in Article 800 of NFPA 70.
(c) Insulation. All control wiring is excepted from the requirements of Article 725-27(b) of NFPA

70. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

(d) Exterior lighting and snowmaking circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18.3 meters) of the conveyor centerline, shall be ground fault protected.

(e) Power supply cords. Placement of wires shall take into consideration, snow grooming, skiers, and other equipment that may pass over temporary power supply cords. The power supply cords shall be protected by ground fault circuit breaker.

32-8.38 Grounding.

(a) RESERVED

(b) Conveyor structure. The conveyor structure shall have one point referred to as the grounding electrode as defined in NFPA 70. If an electrical prime mover is used, the electrical service grounding conductor shall terminate at this point. All dc and ac electrical systems shall be referenced to this point. Under the worst-case conditions, the resistance from the ground point to any part of the conveyor control shall not exceed 50-ohms for the purpose of grounding the conveyor control circuit. The grounding system for the particular conveyor shall not be used as a grounding system for any other system not related to the conveyor system.

(c) RESERVED

(d) Lightning protection. If lightning protection is provided, it shall follow NFPA 780.

32-8.39 Operating control circuits.

(a) Operating circuits. All conveyor systems shall contain one or more normally de-energized circuit(s) that, when energized, allow(s) the system to start, accelerate to and run at designated speeds, and when interrupted or de-energized by manual stop switches, automatic stop devices, inadvertent ground or a power failure, cause(s) the system to stop.

(1) Operating circuits shall not have anything across or parallel with the contacts of switches, relays, or automatic stopping devices (including solid state devices monitoring the circuits or devices), unless it can be shown that any failure mode of the device placed across the contacts does not defeat the purpose of the operating circuit devices.

(2) All start/run/stop and speed control switches shall be conspicuously and permanently marked with the proper function.

(3) All automatic and manual stop and shutdown devices shall be of the manually reset type. An exception to this requirement is allowed for magnetic or optically operated stop devices, if the operating circuit is such that it indicates that such devices initiated the stop and the circuit is of the manually reset type.

(4) Manual stop switches (push button) shall be positively opened mechanically and their opening shall not be dependent upon springs.

(b) Emergency shutdown circuit. All conveyor systems shall include a normally de-engergized circuit that, when energized, allows the system to run and when interrupted, effects an emergency shutdown (see 32-1.4(aa)). The shutdown shall have priority over all other control stops or commands. If, for any reason, the operator has lost control of the conveyor while using the normal operating control circuitry, the controls shall include an emergency shutdown circuit allowing the operator/attendant to stop the conveyor.

(1) Any one of the following conditions is considered a loss of control of a conveyor:
  (i) conveyor will not SLOW DOWN when given the command to do so;
  (ii) conveyor will not STOP when given the command to do so;
  (iii) conveyor OVERSPEEDS beyond control settings and/or maximum design speed;
  (iv) conveyor ACCELERATES faster than normal design acceleration;
  (v) conveyor SELF-STARTS or SELF-ACCELERATES without the command to do so;
  (vi) conveyor REVERSES direction unintentionally and without the command to do so.

(2) The shutdown circuit shall not have anything across or parallel with the contacts of switches, relays, or other devices in this circuit, but can have such devices as solid state monitoring devices and microprocessors in series with the manual shutdown device and main control contactor (main control disconnect coil).

(3) This circuit shall include a manual shutdown device at each station and the machine room. The shut down device shall be conspicuously and permanently marked and shall be red in color (see section 32-8.29). If there is only one circuit, it shall be called the Emergency Shutdown Circuit.

(c) Bypass circuits. A temporary bypass device may be installed for malfunctions in operating control circuitry (see section 32-8.52(i)).

32-8.40 Electric prime mover and power circuits.

(a) RESERVED

(b) Electronic speed-regulated drives. All electronic speed-regulated drives and electric motors shall shut down in the event of:
  (1) field loss (dc motors);
  (2) speed feedback loss;
  (3) overspeed;
  (4) overcurrent.
  (5) phase loss

Subchapter B - Night Operations

32-8.41 General. For nighttime operation, operating conveyors shall be provided with lighting systems. The entire conveyor belt surface including the loading and unloading areas shall be lighted.

32-8.42 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

32-8.43 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

32-8.44 Location. Lights shall be mounted on substantial poles or standards.

32-8.45 Emergency lighting. Emergency lighting shall be provided in the event of electric power failure to permit regular unloading of the conveyor.

CHAPTER III - OPERATION AND MAINTENANCE
Subchapter A - Personnel Safety

32-8.46 General and personnel safety. This subsection covers the requirements for operation and maintenance of all types of conveyors. All conveyors covered by this Subpart regardless of the date of installation shall be in compliance with this Chapter. Operating and maintenance personnel shall be familiar with applicable provisions of this section and the conveyor operational and maintenance manuals (see Chapter I, Subchapter F of this Subpart).

(a) Procedures for the operation and performance of maintenance on conveyors shall include the precautionary measures necessary to reduce the risks of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

(b) Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials which may encroach upon limitations of clearances or design live loads.

32-8.47 Signs.

(a) General. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point. All such signs shall be prominently placed, and those pertaining to the conveyor operations shall be adequately lighted for night operation. Additional signs, deemed necessary by the owner, may be posted but not detract attention from any required sign.

(1) Instructions and warnings for the use of conveyors shall be posted at loading areas and may include the duties and obligations of the passenger.

(2) Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons.

(3) The sign "Personnel Working on Conveyor - Do Not Start" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when persons are working on the conveyor (see section 32-8.13).

(b) The following Signs shall be posted:

(1) "No Loose Scarves" (at the loading area)
"No Loose Clothing"
"No Long Hair Exposed"

(2) “Please Remain Standing” (at the loading area)

(3) "Load Here”

(4) "Unload Here"

(5) "Stop Gate" (if applicable)

(6) "Emergency Stop Switch"

Subchapter B - Operations

32-8.48 Personnel. Conveyors shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the conveyor is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific conveyor.

(a) Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for operation, and shall have the authority to deny access to the conveyor to any person who in the supervisor's opinion is not fit or competent to use the conveyor without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the conveyor under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

(b) Operators. An operator shall be in charge of each conveyor. This operator shall be trained and experienced in normal operational and emergency procedures and such training shall be documented. Operators shall be at least 18 years of age.

(c) Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view and such training shall be documented.

(d) RESERVED

(e) First aid. One or more persons trained to administer first aid/emergency care at the Basic Life Support (BLS) level, including CPR, shall be available at all times when a conveyor is operating and transporting passengers. There shall be ready access to first aid/emergency care supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

32-8.49 Minimum operating personnel.

(a) A single operator may operate a conveyor provided the following conditions are met:

(1) the travel length of the conveyor shall not exceed 400 feet (122 meters);

(2) the travel length of the conveyor is clearly visible to the operator during operation, including the exit transition belt pinch point, if applicable;

(3) the operator can start the conveyor while maintaining the surveillance required in condition (b) above;

(4) the restarting of the conveyor following actuation of an automatic or manual stopping device(s) shall be impossible until clearance is assured and the automatic or manual stopping device(s) has been reset by an authorized person;

(5) if the above conditions (1), (2), and (3) are met, one operator may operate two (2) conveyors providing both conveyors stop when any stopping device is activated on either conveyor, and the stopping and staring controls for each conveyor are clearly marked and within his/her reach.

(b) If the above conditions are not met, an additional attendant(s) is required. Each attendant shall be furnished with a stopping device and shall be able to communicate with operator.

32-8.50 Duties of operating personnel.

(a) Supervisor. The duties of the supervisor shall be as follows:
  (1) to determine that all conveyors are operational and that all operating personnel are trained, equipped, and fit to perform their duties;
  (2) to discontinue operations on any conveyor due to physical, weather, personnel, or other reasons;
  (3) to enforce operational, maintenance, and safety rules.

(b) Operator. The duties of the operator shall be as follows:
  (1) to assume responsible charge of the conveyor;
  (2) to assign and supervise all attendants on his/her conveyor;
  (3) to maintain an operational logbook as required in section 32-8.55;
  (4) to advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

(c) Attendant. The duties of the attendant shall be as follows:
  (1) to maintain orderly passenger traffic conditions within his/her area of jurisdiction;
  (2) to advise and assist passengers, as required;
  (3) to maintain surveillance of his/her area of jurisdiction.

(d) The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the conveyor immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

32-8.51 Operational procedures. The required operational procedures as set forth in sections 32-8.51 through and including 32-8.52 of this rule shall be supplemented by specific requirements as specified in the designer's operational manual (see section 32-8.30).

(a) Control of passengers. Each conveyor shall have a definite method for marshaling passengers for loading and unloading. Fences and gates may be required to implement the system.

(b) Daily preoperational inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:
  (1) a visual inspection of each end, and the entire length of the conveyor belt;
  (2) assurance that the conveyor belt is properly tensioned and operates smoothly;
  (3) operation of all manual and automatic switches;
  (4) operation of all braking systems. The designer of the conveyor system may specify whether the inspection is to take place while the conveyor is moving;
  (5) operation of communication systems;
  (6) operation of the conveyor;
  (7) inspecting the loading and unloading areas and preparing them for ingress and egress of passengers.
  (8) condition and preparation of the clear surface beyond each exposed edge (see 32-8.4(c))

(c) Access to facilities. Entrances to all machinery, operators' and attendants' rooms shall be locked when not in use. Unattended entrances accessible to the public, which may be left open, shall be equipped with barriers to entry.

32-8.52 Operational requirements.

(a) General. The supervisor and operator of each conveyor shall review the requirements of Chapter I of this Subpart to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

(b) Starting. The conveyor shall not be started by any person other than the operator. The starting mechanism shall be located at the drive station only.

(c) RESERVED

(d) Stops. After any stop of a conveyor, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

(e) RESERVED

(f) Hazardous conditions. No conveyor shall operate when wind or icing conditions may endanger passengers or equipment or when there is an electrical storm in the immediate vicinity. Should such conditions develop while the conveyor is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers.

(g) RESERVED

(h) Termination of daily operations. Procedures shall be established for terminating daily operations.

(i) Bypass requirements. Prior to and during the operation of a bypass circuit that has been installed for the purpose of bypassing normal operating control circuits, the conditions listed in this subsection shall be met in the following order:

(1) the condition that the circuit indicated is in default shall be thoroughly inspected to ensure an electrical operating malfunction, rather than the indicated condition, actually exists;

(2) the bypass shall be authorized only by the conveyor supervisor or his/her designated representative;

(3) when a bypass is in operation, the function bypassed shall be under constant, close visual observation;

(4) the use of a bypass circuit shall be logged and shall indicate when, who authorized, and for what duration a bypass was used;

(5) the operator control panel shall indicate that a bypass is in use;

(6) when a required conveyor control circuit is bypassed, all passengers shall be off loaded and no passengers other than maintenance personnel being transported to the repair site shall be allowed to board the conveyor until the malfunction is corrected.

Subchapter C - Maintenance

32-8.53 General.

(a) Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see section 32-8.31) shall be followed. Maintenance records shall be kept (see section 32-8.57).

(b) A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:
   (1) conveyor belting;
   (2) drums and rollers;
   (3) conveyor belt tensioning system;
   (4) braking systems;
   (5) electrical control systems;
   (6) communication systems;
   (7) structures;

Subchapter D - Inspection and Testing

32-8.54 RESERVED

Subchapter E - Records

32-8.55 Operational log. A logbook shall be maintained for each conveyor. Daily entries shall be made giving the following minimum information:

(a) date;
(b) names and duty stations of operating personnel;
(c) operating hours and purpose of operations;
(d) temperature, wind, and weather conditions;
(e) record of compliance with daily operational inspection including loading and unloading zones and signs;
(f) position and condition of the tension carriage, counterweights, or other tension systems;
(g) accidents, malfunctions, or abnormal occurrences during operation;
(h) signature of operator

32-8.56 RESERVED

32-8.57 Maintenance log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

Subchapter F - Passenger Conduct

32-8.58 Dexterity and ability. A passenger who uses a conveyor shall be presumed to have sufficient ability and physical dexterity or provide personal assistance to negotiate the conveyor. Each passenger should maintain control of their speed and course while loading, riding, and unloading the conveyor.

32-8.59 Embarkation and disembarkation. A passenger shall get on and get off a conveyor at designated areas.

32-8.60 Riding. Passengers, while riding a conveyor, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the conveyor. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.