

Ind 46

Filed February 1, 1967  
11:00 am

STATE OF WISCONSIN )  
DEPT. OF INDUSTRIAL COMMISSION) SS.

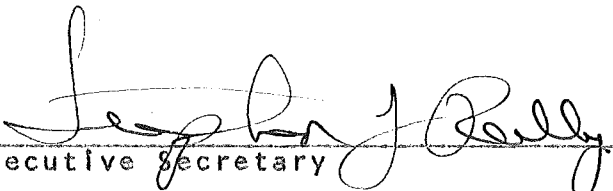
TO ALL TO WHOM THESE PRESENTS SHALL COME, GREETINGS:

I, Stephen J. Reilly, Secretary of the Industrial Commission of Wisconsin, and custodian of the official records of said Commission, do hereby certify that the attached amendments to Wisconsin Administrative Code Ind 46.01 through Ind 46.82 were adopted by the Industrial Commission on January 26, 1967.

I further certify that said copy has been compared by me with the original on file in this Commission and that the same is a true copy thereof and of the whole of such original.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the official seal of the department at the Capitol, in the city of Madison, this 30th

day of January, A. D., 1967.

  
Executive Secretary

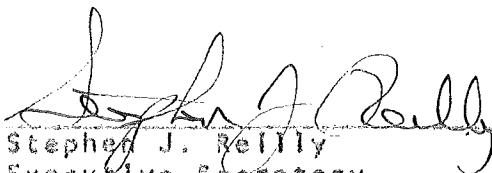
ORDER OF THE INDUSTRIAL COMMISSION  
ADOPTING RULES

Pursuant to authority vested in the Industrial Commission of Wisconsin by sections 101.01 to 101.29 Wis. Stats., the Industrial Commission on January 26, 1967 voted to adopt sections Ind 46.01 through Ind 46.82 Towing and Lifting Devices for Ski Areas.

The amendments shall become effective on April 1, 1967, following publication in the Wisconsin Administrative Code as provided in Section 227.

January 30, 1967

INDUSTRIAL COMMISSION OF WISCONSIN

  
Stephen J. Reilly  
Executive Secretary

Ind 46.01 SCOPE. The requirements of this code are to insure safe design, construction, installation and operation of every Single and Double Reversible Aerial Tramway, Chair Lift, Gondola Lift, T-Bar Lift, J-Bar Lift, Platter Lift and Fiber Rope Tows installed in public places of employment for the safety of employees and frequenters. These requirements apply to both existing installations and those hereafter installed unless otherwise specified.

Ind 46.02 DEFINITIONS. (1) Tramway. A tramway is a device used to transport passengers by any one of the following means: Single and Double Reversible Aerial Tramways, Chair Lifts, Gondola Lifts, T-Bar Lifts, J-Bar Lifts, Platter Lifts and Fiber Rope Tows.

- (a) Single and Double Reversible Aerial Tramways. A type of transportation in which passengers are carried in one or more enclosed cars and reciprocate between terminals.
- (b) Chair Lifts, Gondola Lifts. A type of transportation in which passengers are carried on chairs, on cars, or in gondola cabs attached to and suspended from a moving wire rope or attached to a moving wire rope and supported on a standing wire rope or other structure.
- (c) T-Bar Lifts, J-Bar Lifts, Platter Lifts. A type of transportation which pulls skiers riding on skis by means of devices propelled by a main overhead traveling wire rope.
- (d) Fiber Rope Tow. A type of transportation which pulls skiers riding on skis by means of a traveling fiber rope which the skier grasps by hand.
- (2) APPROVED means approved by the Industrial Commission.
- (3) CAPACITY. In computing capacity, passengers shall be based on weight of 170 pounds each.
- (4) DIAMETER. The term diameter in reference to sheaves means tread diameter.
- (5) ELECTRIC POWER LINE. Electric Power line shall mean a transmission line carrying voltage in excess of 480 volts.
- (6) FULL LOAD OR FULLY LOADED. The maximum load approved by the Industrial Commission.
- (7) HAULING ROPE (a) (Wire). A rope for propelling tramways.  
(b) (FIBER). A rope for towing skiers.
- (8) SAFETY STOP. A device used to stop the tramway as a result of passenger contact, attendant's action, cable derailment, or movement of a terminal sheave or counterweight.
- (9) SHEAVES. Pulleys or wheels grooved for rope.

- (a) Deflecting Sheave. A sheave which is used for the primary function of changing the course of direction of the hauling rope.
- (b) Drive Sheave. A sheave driving the hauling rope.
- (c) Terminal Sheave. A drive sheave or terminal return sheave.
- (d) Terminal Return Sheave. A sheave which reverses the direction of travel but does not transmit power to the hauling rope.
- (e) Roller. A rotating cylinder of small tread diameter used to guide the rope.
- (10) Tow Path. The area traversed by a skier using the tramway and extending between loading and unloading areas.
- (11) Towing Outfits. Towing outfits, rope grippers, any device other than the hands used for gripping the hauling rope of a fiber rope tramway.
- (12) Tramway. (a) Multicable. A tramway incorporating a hauling rope or ropes and a separate standing track or tracks usually of wire rope or cable.  
(b) Monocable. A tramway incorporating a hauling rope from which the carriers are suspended.
- (13) Vertical Clearance. Shall mean the distance between snow and terrain surfaces, and the lowest part of the carrier.

Ind 46.03 PLANS AND SPECIFICATIONS. (1) Plans and specifications of each new tramway installation as described in Wis. Adm. Code section Ind 46.01 shall be submitted to the Industrial Commission for review and approval.

- (2) Three copies of plans, one copy of specifications are required for approval.
- (3) Plans shall include:
  - (a) Plan and profile map showing location of towers, prime movers, counterweights and pits.
  - (b) Clearances of towers, tramway path, and counterweights.
  - (c) Details of tower construction, mountings and supports, terminal sheave assemblies and carriages.
- (4) No work shall be commenced until approval has been obtained from the Industrial Commission.

Ind 46.04 TESTS AND INSPECTIONS. (1) Every tramway shall be tested and inspected in conformance with the code requirements before the installation is placed in service.

- (a) The party erecting such an installation shall give notice to the Industrial Commission not less than 10 days prior to the time the installation is ready for inspection.

- (b) The Industrial Commission shall complete its inspection within 10 days after the installation is ready for inspection or shall issue a temporary permit to operate until such inspection is completed and installation is approved or disapproved.

Ind 46.05 INSPECTIONS, INTERVAL. Every tramway shall be subjected to a regular inspection at least once every 12 months.

#### SINGLE AND DOUBLE REVERSIBLE

#### AERIAL TRAMWAYS

Ind 46.08 TOWERS, LOCATION, CLEARANCES. (1) Tramways shall be located far enough from terrain features such as overhanging ledges and electric power lines and other structures so as to prevent injury to persons resulting from contact with or collapse of such structures and terrain features.

- (a) Trees and other objects along the tramway path shall be trimmed or cleared so as to provide a minimum running clearance on each side of five feet. Dead or weakened trees and branches near enough to fall within the path shall be removed. Such clearings shall be adequately graded and drained to avoid washouts which might endanger the tramway.
- (b) Towers shall be located to conform to the profile of the terrain and designed to provide the clearances required of the ropes and cars from all obstructions and ski or hiking trails.

##### 1. Other Than Loading and Unloading Areas.

A minimum clearance of not less than five feet shall be maintained between the lower edge of the car or hauling ropes, whichever is lower, and the terrain and snow surface.

2. A protective fence shall be provided to divert all surface transportation or persons where the vertical clearance is less than 10 feet.
  3. Towers and ropes shall be so arranged as to prevent collision of passing carriers in event of lateral swinging.
  4. The distance between two cars, if swung 10 degrees inward from the vertical, shall be at least 30 inches. The distance between cables, for purposes of this check shall be considered as equal to the gage of the line.
  5. Guards shall be provided where necessary to maintain a clearance of 18 inches between the carrier and fixed objects when the carrier is swung 10 degrees laterally from the vertical.
- (c) The tower arrangement of the multicable tramways shall be such that the track cable under the most adverse operating conditions will have a positive break-over angle at the saddle, or provision shall be made to hold the track cable in the saddle and such provision shall not interfere with the operation of any track cable brake.

1. The tower arrangement for monocable tramways shall be such that the hauling rope cannot pull away from a group of tower sheaves. If under the most adverse loading conditions the load on a group of supporting sheaves can become less than 400 pounds, or less than 600 pounds on a group of depression sheaves, counter sheaves shall be installed to prevent the rope from leaving the grooves of the tower sheaves. The tower arrangement for monocable tramways where depression sheaves are used shall be such that the hauling rope cannot leave the sheaves when twice the normal concentration design load passes the tower while the rope is under normal design tension.
- (d) Tower heights and locations shall be so arranged that the track cables will not lift out of their saddles under any operating conditions.
- (e) The design of the towers shall be in accordance with the requirements of the Wis. Adm. Code, Building.
- (f) Where guyed towers are used and guys intersect the ground, the guys shall be fenced.
- (g) Each tower shall be effectively grounded. An 8 foot ground rod shall be provided at the tower. A No. 6 copper wire or equivalent shall connect from the tower to the ground rod.
- (h) Towers shall be clearly identified with successive numbers.

Ind 46.09 CAPACITY AND SPEED. (1) Tramways shall not be operated beyond their approved capacity and speed.

- (a) Approved capacity and rated speed of each car shall be posted in a conspicuous place in each car and at each loading platform.
- (b) The maximum car speeds shall be as outlined in these subsections:
  1. For multicable tramways; using track cable brakes on the carriage, 1,500 feet per minute.
  2. For multicable tramways; using two or more traction ropes and not using track cable brakes, 2,000 feet per minute.
  3. When there is no attendant in a car, these maximum speeds shall be reduced by 25 per cent, and speeds when passing over tower saddles shall be reduced to two-thirds of the speeds permitted elsewhere.
  4. If the track cable saddles are so designed that the carriage wheels do not ride directly on the track cables over the saddles as well as in the spans and do come in contact with or ride on any part of the saddles, or retaining clips, then the above permissible speeds for multicable tramways shall be reduced to a maximum of 800 feet per minute.
- (c) For monocable tramways; 800 feet per minute across tower rollers or sheaves, 2,000 feet per minute in clear spans.

- (d) For either multicable or monocable installations, speeds of cars entering terminals shall not exceed 300 feet per minute.

Ind 46.10 POWER SOURCE. (1) Electrical power supply shall be installed and wired in accordance with the requirements of the Wis. Adm. Code, Electrical.

- (a) All exposed electrical power lines shall be so located that in case of collapse or breakage of the power line, it will not come in contact with the cars, cables or passengers.
- (2) Liquid fuels such as gasoline and diesel fuel shall be stored and handled in accordance with the requirements of Wis. Adm. Code, Chapter Ind 8, Flammable Liquids.
- (3) Liquefied petroleum gas installation shall be made in accordance with the requirements of Wis. Adm. Code, Chapter Ind 9, Liquefied Petroleum Gases.
- (4) The engine shall always be shut down during refueling if the fuel supply tank is within 50 feet of the engine.

Ind 46.11 PRIME MOVERS. (1) Prime movers shall have sufficient power to handle the approved load.

- (a) An auxillary power unit with an independent power source shall be provided which can be used to unload the line in the event of power failure.
- (b) Speed reducers shall have ample capacity to start the tramway when fully loaded and shall be designed with a factor of safety of not less than 5.
  - 1. Bearings, couplings and shafting shall be designed with a factor of safety of not less than 5, of a size and type suitable for the function to be performed.
  - 2. Clutches shall be of ample size to carry a full load and permit controlled slippage for smooth acceleration when starting, without overheating. Clutches shall be designed with a factor of safety of not less than 5.
- (c) An automatic brake shall be provided to stop and hold the tramway system with approved load when power is shut off or the tramway is stopped for any reason. The brake shall be applied to the main drive terminal sheave or to a drive shaft so that there is no clutch, chain or belt between the brake and the main drive terminal sheave.
- (d) Brakes shall not be parallel connected with the armature or field of a direct current driving motor.
- (e) There shall be a manually operated brake on the terminal sheave. This brake shall be adequate for stopping and holding the approved load.
- (f) Each carriage on a multi-cable tramway shall be equipped with a brake that will grip the track cable. The brake shall; be capable of holding

a fully loaded car at the point of maximum slope; function automatically in case of a hauling rope failure and also shall be capable of being manually applied by the car attendant.

- (g) A positive backstop or brake to automatically prevent reverse rotation shall be applied to the drive or tension terminal sheave or to the drive gear if it is bolted directly to the drive terminal sheave.
- (2) Provisions shall be made, other than the automatic braking system, for maintaining controlled speed under overhauling loads when used for downhill transportation, not exceeding approved speed by more than 10 per cent. Electrical, mechanical, hydraulic or pneumatic means shall be provided to dissipate automatically the power developed by the overhauling load.
- (3) Squirrel cage induction electric motors shall be so designed that an overhauling load will not increase the speed of the motor beyond 5 per cent of its rated speed.
- (4) Direct current or slip ring motors shall be equipped with an overspeed switch directly connected to the motor shaft, to disconnect the power to the motor and apply the automatic brake when the motor exceeds 10 per cent of its rated speed.
- (5) Internal combustion engines shall be equipped with an automatic device that will stop the tramway when the engine exceeds 15 per cent of its rated speed.

Ind 46.12 OPERATION AND CONTROL. (1) Operating controls shall provide smooth acceleration and deceleration of the cars.

- (a) Cars shall be stopped and held immobile during loading and unloading periods. Indication shall be provided in the control room in full view of the attendant to show the location of the cars at all times.
  - (b) Electric switches to stop the tramway shall be provided at loading and unloading areas, and on the control board in each car having a capacity of more than six passengers.
  - (c) Electrical stop circuits shall be closed metallic circuits so arranged that power failure, malfunction or actuation of a safety switch causes the tramway to stop.
  - (d) Slow-down switches shall be provided at each terminal area.
  - (e) Limit switches shall be provided to interrupt power and stop the tramway before the car reaches its limits of travel.
  - (f) Constant pressure running controls shall be provided.
  - (g) Limit switches shall be installed to stop the tramway before any counterweight or terminal sheave carriage reaches either limits of travel.
- (2) By-passing of safety stop circuits is prohibited.



- (a) Passenger actuated safety stops shall be so located that they cannot be bypassed by the passenger.
  - 1. Passenger or attendant-actuated safety stops shall be tested at the beginning of each day's operation by an authorized person.
- (3) A bumper system capable of sustaining the loaded car shall be provided at each terminal of travel.
- (4) Operating controls and communicating systems shall be so located that the control operator shall have view of the tramway line without leaving his position.
- (5) At least one attendant shall be on duty at loading and unloading areas.
  - (a) An attendant having knowledge of normal and emergency duties shall be on duty in each car having a capacity of more than six passengers.
- (6) The tramway shall be started by an authorized person only.

Ind 46.13 MACHINE ROOM OR ENCLOSURE. (1) All driving units shall be enclosed or located in a manner that will prevent employees and frequenters from accidentally coming in contact with the machinery.

- (a) When an internal combustion engine is used as a prime mover, the machine room shall be ventilated to prevent any products of combustion or fuel fumes from contaminating the atmosphere in the enclosure. Engine exhaust pipes shall not pass within 2 inches of any wooden member or other flammable material.
- (b) Openings over 10 inches square shall be provided with suitable doors with locks to prevent entrance and operation by unauthorized persons.
  - 1. The machine room or enclosure shall be sign posted to the effect that unauthorized persons are not permitted therein.
- (c) Machine rooms shall be provided with uniform artificial illumination of an intensity of not less than 5 foot candles at the floor.
- (d) Approved fire extinguishers shall be installed in all machine rooms.
- (e) An exit shall be provided to permit anyone to leave rapidly in the case of an emergency.

Ind 46.14 MOVING PARTS. All moving parts shall be guarded in accordance with the requirements of the Wis. Adm. Code, Chapter Ind 1, Safety.

Ind 46.15 TERMINAL AND DRIVE SHEAVES. (1) Terminal and drive sheaves, shafts and bearings, shall be designed with a factor of safety of not less than 5.

- (a) The minimum diameter for terminal sheaves shall be 72 times the diameter of the rope.

- (b) Drive sheaves shall be designed to prevent slippage of the hauling rope in the sheave groove.
- (c) The sheave assembly shall be designed to retain the cable in the event of malfunction or breakage.
  - 1. Sheave frames shall be designed to retain the sheave in the event of shaft breakage.

Ind 46.16 HAULING ROPE SHEAVES, HAULING ROPE DEFLECTING SHEAVES, COUNTERWEIGHT SHEAVES AND MOUNTS. (1) Sheaves, bearings and supporting mechanisms shall be designed, constructed, and maintained to bear the static and dynamic loads.

- (a) The minimum diameter of tower sheaves shall be 10 times the rope diameter.
  - (b) The pitch diameter of hauling rope deflecting sheaves shall be as outlined in this subsection:
    - 1. for 6 x 7 rope - 72 times diameter of rope.
    - 2. for 6 x 19 rope - 45 times diameter of rope.
    - 3. for 6 x 37 rope - 27 times diameter of rope.
  - (c) The lining of sheave grooves shall satisfy the allowable bearing loads for the material used.
  - (d) Unlined sheave grooves shall have round bottoms having a radius of 55 per cent of the rope diameter.
  - (e) Single sheave units shall not be used except as terminal guide sheaves.
  - (f) Hold-down sheaves shall be installed if the load on a group of support sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
  - (g) Support sheaves shall be installed if the load on a group of hold-down sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
  - (h) Sheaves shall be connected metallically to a grounded structure.
- (2) Brackets or devices shall be provided to catch and hold the rope in the event it comes off the sheaves on the side away from the tower.

Ind 46.17 ANCHOR CONNECTIONS FOR COUNTERWEIGHT ROPES, TOWER OR STATION ANCHOR CABLES OR GUYS. (1) Cable and rope fastenings shall at least equal the strength of the cable or rope.

- (a) Anchor connections shall be above ground.
  - 1. Any part of the anchorage below ground shall be protected against loss of strength due to corrosion.

Ind 46.18 COUNTERWEIGHTS AND COUNTERWEIGHT ROPES. (1) Sufficient counterweights or a tensioning device shall be provided for proper tensioning of every:

- (a) Hauling rope.
  - (b) Track cable.
- (2) Counterweights shall be so suspended to permit free vertical movement.
  - (3) Counterweights or a tensioning device shall be so constructed or protected by enclosures to prevent ice or snow from accumulating under and around the counterweights and interfering with their free movement.
  - (4) Counterweights or a tensioning device shall be guarded to prevent accidental contact with or passage under the counterweight.
  - (5) Counterweights or a tensioning device shall have sufficient travel to provide for all normal operating changes in loading and temperature.
  - (6) Counterweight ropes shall have a factor of safety of not less than 6.
    - (a) Counterweight ropes shall be coated with lubricant or some other approved coating to prevent rusting, unless manufactured of corrosion resistant material.
    - (b) Splices in counterweight ropes are prohibited.

Ind 46.19 Structures and foundations shall be installed in accordance with the requirements of Wis. Adm. Code, Building.

Ind 46.20 LOADING AND UNLOADING AREAS. (1) Platforms and areas shall be level.

- (a) Platforms shall be provided with car guide rails with curved ends to permit easy entrance and exit of cars to and from platforms when the cars are within 10 degrees from vertical.
- (b) Guard rails shall be provided to guide passengers safely to and from the cars.
- (c) Illumination at loading and unloading areas when a tramway is in operation shall be of an intensity of not less than 5 foot candles at the surface.

Ind 46.22 TRACK CABLE SADDLES AND MOUNTS. (1) The radius of a track cable saddle shall be:

- (a) Large enough to reduce bearing pressure to a value that will permit the cable to slide in the saddle groove, and provide smooth transition of the carrier from span to span.

- (b) 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.
- (c) Saddles shall be designed so that the track cable brake, if any, may function at the time the carrier is passing the saddle without derailment of the trucks.
- (d) Saddles shall permit free passage of the carriage even when the carrier is swinging laterally as it approaches or passes the tower.
- (e) If the gage of the tramway is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum so that the carriage cannot become derailed as it passes over the saddle.

Ind 46.23 HAULING ROPES. (1) There shall be posted for permanent record in a conspicuous place on the tramway a metal sign bearing the following data:

Diameter of Rope - - - - -  
Material and Type of Rope - - - - -  
Rated Ultimate Strength - - - - -  
Date of Installation - - - - -

- (a) The minimum size of hauling ropes shall be 1 inch in diameter for monocable lift tramways.
    - 1. The factor of safety shall be not less than 6 when new.
  - (b) Hauling wire rope attachments shall be of the approved type.
  - (c) Stationary wire rope and hangers on the hauling rope must be relocated at least once in every 12 months. The attachments must be moved a distance of at least 3 feet ahead for each relocation.
  - (d) Any splice shall be at least 1,200 times the diameter of the rope and shall withstand its rated ultimate strength.
  - (e) Rope links with swaged end fittings, the end fittings shall be so designed and applied that, in a test of a complete link, the rope will break without slippage of the fittings.
- (2) Ropes shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has been decreased more than 25 per cent of the rated ultimate strength of the rope.
- (3) Hauling ropes shall be connected metallically to a grounded structure.

Ind 46.24 CAR. (1) Car assemblies shall conform with the requirements as outlined in this subsection.

- (a) Passenger cars shall be enclosed.

- (b) If glass is used it shall be of Safety or Wire Glass.
  - (c) Cars shall be equipped with doors that fill the entire opening.
  - (d) Car doors shall be locked while in motion and so arranged to be unlocked by key only, by the conductor or attendant.
    - 1. The key shall be kept in a receptacle having a transparent breakable cover clearly marked, "For Emergency Use Only," and so located to be accessible for emergency use.
  - (e) There shall be a metal plate which shall be located in a conspicuous place in each car, the letters and figures in each plate to be not less than 1/4 inch in height and to be stamped in, etched, or raised on the surface of the plate and shall bear the following information:
    - 1. The approved load of the car in pounds.
    - 2. The number of persons allowed in the car.
  - (f) Passenger cars shall be ventilated.
- (2) The car frame members of every cabin shall be securely welded, bolted and/or riveted and braced.
- (a) The frame hanger shall be of sufficient length vertically so that under the worst condition of longitudinal sway the top of the car cannot strike the hauling rope or the bottom of a tower saddle. The hanger may be shorter if sway dampers are used.
  - (b) Sway dampers provided to reduce longitudinal sway of the car, shall be designed to operate smoothly and without danger of derailment of trucks.
- (3) On multi-cable tramways the weight of the unit shall be so distributed over all wheels that the load per wheel does not exceed that approved.
- (a) Diameter of the wheels shall be selected on the basis of that one of the following criteria which requires the greater diameter:
    - (1) Allowable bearing pressure on the material, if any, with which the wheels are lined.
    - (2) As approved.
  - (b) Wheels shall be designed to prevent them from leaving the track cable under all operating conditions.

Ind 46.25 TRACK CABLES. (1) There shall be posted for permanent record in a conspicuous place on the tramway a metal sign bearing the following data:

Diameter of Cable - - - - -  
Material and Type of Cable - - - - -  
Rated Ultimate Strength - - - - -  
Date of Installation - - - - -

- (a) The factor of safety shall not be less than 6 when new.
  - (b) Track cables shall be connected metallically to a grounded structure.
  - (c) Cable sockets shall be of such strength that the cable will break before the socket is deformed.
  - (d) Track cable couplings shall not be used.
- (2) Cables shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has been decreased more than 25 per cent of the rated ultimate strength of the cable.

Ind 46.26 COMMUNICATION. A voice communication system shall be provided so that operators at each loading and unloading area will be in communication with each other at all times.

Ind 46.27 EVACUATION. Provisions shall be made for the evacuation of passengers from the tramway in case of emergency.

## TRAMWAYS

### CHAIR LIFTS - GONDOLA LIFTS

Ind 46.28 LOCATION, TOWERS, CLEARANCES. (1) Tramways shall be located far enough from terrain features, such as overhanging ledges and electric power lines and other structures so as to prevent injury to persons resulting from contact with or collapse of such structures and terrain features.

- (a) Trees and other objects along the tramway path shall be trimmed or cleared so as to provide a minimum running clearance on each side of three feet. Dead or weakened trees and branches near enough to fall within the path shall be removed. Such clearings shall be adequately graded and drained to avoid washouts which might endanger the tramway.
- (b) Towers shall be located to conform to the profile of the terrain and designed to provide the clearances required of the ropes, chairs and cars from all obstructions on ski or hiking trails.
- (c) Where ski runs cross under the tramway line, the towers shall be of sufficient height to maintain a vertical clearance of not less than 10 feet from the lowest part of the carrier to the snow surface.
- (d) A vertical clearance of not less than 5 feet shall be maintained between snow surface and the bottom of the chair or car, other than at loading and unloading areas.
- (e) Tower heights and locations shall be so arranged that the track cables will not lift out of their saddles under any operating conditions.

- (f) Towers and ropes shall be so arranged as to prevent collision of passing carriers in event of lateral swinging.
    - 1. The distance between two carriers, if swung 10 degrees inward from the vertical, shall be at least 30 inches. The distance between cables, for purposes of this check, shall be considered as equal to the gage of the line.
    - 2. Guards shall be provided where necessary to maintain a clearance of 18 inches between the carrier and fixed objects when the carrier is swung 10 degrees laterally from the vertical.
  - (g) Guards shall be placed on open frame towers in a manner that will prevent skis from catching in the tower framing if the clearance between the tower and the inside edge of the chair in its normal position is less than 36 inches. Guards shall be at least 48 inches in height, extending 24 inches above and 24 inches below foot level. Clearance shall not be less than 24 inches.
  - (h) The design of the towers shall be in accordance with the requirements of the Wis. Adm. Code, Building.
  - (i) Guyed towers shall not be used for intermediate supports.
  - (j) Guyed towers where the guys intersect the ground, the guys shall be fenced.
  - (k) Each tower shall be effectively grounded. An 8 foot ground rod shall be provided at the tower. A No. 6 copper wire or equivalent shall connect the tower to the ground rod.
  - (l) Towers shall be clearly identified with successive numbers.
- (2) Trestles and Monorails. (a) The design of trestles and monorails shall satisfy the requirements of section Ind 46.19 and further portions of section Ind 46.28 that may be relevant to the particular design.
- (b) Provisions shall be made for expansion and contraction of the actual track or rail.
  - (c) Provisions shall be made for maintenance and emergency access to the trestle track deck from the ground at intervals not exceeding 800 feet, and to the monorail at any point.
  - (d) Supports shall be clearly identified with successive numbers.

Ind 46.29 CAPACITY AND SPEED. (1) Tramways shall not be operated beyond their approved capacity and speed.

- (a) Single chair tramways shall not be operated for use of skiers at speeds in excess of 600 feet per minute, nor with chair spacings less than would produce a loading interval of 6 seconds.

1. Outside of the skiing season or where there is no skiing, the tramway shall be operated at a speed not to exceed 350 feet per minute except where the tramway is stopped for loading and unloading.
  - (b) Multiple passenger tramways and Monorail tramways shall not be operated for use of skiers at speeds in excess of 550 feet per minute, nor with spacing less than would produce a loading interval of 6 seconds.
    1. Outside of the skiing season, or where there is no skiing, the tramway shall be operated at a speed not to exceed 350 feet per minute except where the tramway is stopped for loading and unloading.
- (2) On detachable chair tramways and Gondola tramways the approved capacity of each carrier shall be posted in a conspicuous place.
  - (a) Carriers shall be spaced as required by section Ind 46.29 (1)(a) and (b).
  - (b) Smooth acceleration and deceleration of the carrier shall be provided.
  - (c) Rope speed shall not exceed 600 feet per minute.
- (3) Tramways shall be arranged to be operated at slow speed for inspection.

Ind 46.30 POWER SOURCE. (1) Electrical power supply shall be installed and wired in accordance with the requirements of the Wis. Adm. Code, Electrical.

- (a) All exposed electrical power lines shall be so located that in case of collapse or breakage of the power line, it will not come in contact with the cars, cables or passengers.
- (2) Liquid fuels such as gasoline and diesel fuel shall be stored and handled in accordance with the requirements of Wis. Adm. Code, Chapter Ind 8, Flammable Liquids.
- (3) Liquefied petroleum gas installation shall be made in accordance with the requirements of Wis. Adm. Code, Chapter Ind 9, Liquefied Petroleum Gases.
- (4) The engine shall always be shut down during refueling if the fuel supply tank is within 50 feet of the engine.

Ind 46.31 PRIME MOVERS. (1) Prime movers shall have sufficient power to handle the approved load.

- (a) An auxiliary power unit with an independent power source shall be provided which can be used to unload the line in the event of power failure.
- (b) Speed reducers shall have ample capacity to start the tramway when fully loaded, and shall be designed with a factor of safety of not less than 5.
  1. Bearings, couplings and shafting shall be designed with a factor of safety of not less than 5, of a size and type suitable for the function to be performed.



2. Clutches shall be of ample size to carry a full load and permit controlled slippage for smooth acceleration when starting, without overheating. Clutches shall be designed with a factor of safety of not less than 5.
  - (c) An automatic brake shall be provided to stop and hold the tramway system with approved load when power is shut off or the tramway is stopped for any reason. The brake shall be applied to the main drive terminal sheave or to a drive shaft so that there is no clutch, chain or belt between the brake and the main drive terminal sheave.
  - (d) Chair tramways using hydraulic motors which are geared direct to terminal sheave and which have two or more check valves in the high pressure oil line will not be required to use an automatic brake. Check valves shall be so located that a broken hose line shall not make them ineffective. A by-pass oil line with two hand valves or an equivalent device shall be installed around the check valves to allow the lift to be operated by gravity in cases of emergency.
  - (e) Brakes shall not be parallel connected with the armature or field of a direct current driving motor.
  - (f) There shall be a manually operated brake on the terminal sheave. This brake shall be adequate for stopping and holding the approved load.
  - (g) A positive backstop or brake to automatically prevent reverse rotation shall be applied to the drive or tension terminal sheave or to the drive gear if it is bolted directly to the drive terminal sheave.
- (2) Provisions shall be made, other than the automatic braking system, for maintaining controlled speed under overhauling loads when used for downhill transportation, not exceeding approved speed by more than 10 per cent. Electrical, mechanical, hydraulic or pneumatic means shall be provided to dissipate automatically the power developed by the overhauling load.
- (3) Squirrel cage induction electric motors shall be so designed that an overhauling load will not increase the speed of the motor beyond 5 per cent of its rated speed.
- (4) Direct current or slip ring motors shall be equipped with an overspeed switch directly connected to the motor shaft, to disconnect the power to the motor and apply the automatic brake when the motor exceeds 10 per cent of its rated speed.
- (5) Internal combustion engines shall be equipped with an automatic device that will stop the tramway when the engine exceeds 15 per cent of its rated speed.
- (6) Detachable carrier unbalancing loads shall be controlled by automatic car counters or other means.

Ind 46.32 OPERATION AND CONTROL. (1) Electric switches to stop the tramway shall be provided at all loading and unloading areas and in the machine room.

- (a) Electrical stop circuits shall be closed metallic circuits so arranged that power failure, malfunction or actuation of a safety switch causes the tramway to stop.
  - (b) Limit switches shall be installed to stop the tramway before any counter-weight or terminal wheel carriage reaches either limits of travel.
  - (c) Towers shall be equipped with electric disconnects or switches which will stop the tramway in case of rope derailment.
- (2) Bypassing of safety stop circuits is prohibited.
- (a) Passenger actuated safety stops shall be so located that they cannot be bypassed by the passenger.
    - 1. Passenger or attendant-actuated safety stops shall be tested at the beginning of each day's operation by an authorized person.
- (3) Operating controls and communicating systems shall be so located that the control operator shall have view of the tramway line without leaving his position.
- (4) At least one attendant shall be on duty at loading and unloading areas.
- (a) Where carriers of the detachable type are not mechanically controlled in the stations, one additional attendant shall be required to handle incoming carriers.
- (5) The tramway shall be started by an authorized person only.
- (6) A safety stop shall be provided at each terminal of detachable chair and gondola tramways to stop the tramway should a carrier fail to properly disengage from, or reattach to the hauling rope.
- (a) A safety stop shall be provided at each terminal of chair, gondola and monorail tramways to stop the tramway before the passenger or equipment becomes exposed to danger due to overtravel or attachment and detachment failure of a grip. The distance from this safety stop to such exposure shall not be less than 1 1/2 times the distance traveled by the unloaded tramway, operating at maximum speed after activation of such a stop.
- (7) Switches in the track system of detachable chair and gondola tramways shall be provided with safety stops to stop the prime mover in the event of switch malfunction.
- (8) Gondolas shall be stopped and held immobile during loading and unloading.

Ind 46.33 MACHINE ROOM OR ENCLOSURE. (1) All driving units shall be enclosed or located in a manner that will prevent employees and frequenters from accidentally coming in contact with the machinery.

- (a) When an internal combustion engine is used as a prime mover, the machine room shall be ventilated to prevent any products of combustion or fuel

fumes from contaminating the atmosphere in the enclosure. Engine exhaust pipes shall not pass within 2 inches of any wooden member or other flammable material.

- (b) Openings over 10 inches square shall be provided with suitable doors with locks to prevent entrance and operation by unauthorized persons.
  - 1. The machine room or enclosure shall be sign posted to the effect that unauthorized persons are not permitted therein.
- (c) Machine rooms shall be provided with uniform artificial illumination of an intensity of not less than 5 foot candles at the floor.
- (d) Approved fire extinguishers shall be installed in all machine rooms.
- (e) An exit shall be provided to permit anyone to leave rapidly in the case of an emergency.

Ind 46.34 MOVING PARTS, Moving parts shall be guarded in accordance with the requirements of the Wis. Adm. Code, Chapter Ind 1, Safety.

Ind 46.35 TERMINAL AND DRIVE SHEAVES. (1) Terminal and drive sheaves, shafts and bearings, shall be designed with a factor of safety of not less than 5.

- (a) The minimum diameter for terminal sheaves shall be 72 times the diameter of the rope provided that no device which attaches the carrier to the rope passes around the terminal sheave.
- (b) The minimum diameter for terminal sheaves shall be 96 times the diameter of the rope in cases where the devices which attach the carriers to the rope travel around the terminal sheaves.
  - 1. Means shall be provided to control the carriers from swinging excessively while passing around the sheave.
- (c) Drive sheaves shall be designed to prevent slippage of the hauling rope in the sheave groove.
- (d) The sheave assembly shall be designed to retain the rope in the event of malfunction or breakage.
  - 1. Sheave frames shall be designed to retain the sheave in the event of shaft breakage.

Ind 46.36 HAULING ROPE SHEAVES, HAULING ROPE DEFLECTING SHEAVES, COUNTERWEIGHT ROPE SHEAVES AND MOUNTS. (1) Sheaves, bearings and supporting mechanisms shall be designed, constructed, and maintained to bear the static and dynamic loads.

- (a) The minimum diameter of tower sheaves shall be 10 times the rope diameter.

- (b) The pitch diameter of hauling rope deflecting sheaves shall be as outlined in this subsection:
    - 1. for 6 x 7 rope - 72 times diameter of rope.
    - 2. for 6 x 19 rope - 45 times diameter of rope.
    - 3. for 6 x 37 rope - 27 times diameter of rope.
  - (c) The lining of sheave grooves shall satisfy the allowable bearing loads for the material used.
  - (d) Unlined sheave grooves shall have round bottoms having a radius of 55 per cent of the rope diameter.
  - (e) Single sheave units shall not be used except as terminal guide sheaves.
  - (f) Hold-down sheaves shall be installed if the load on a group of support sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
  - (g) Support sheaves shall be installed if the load on a group of hold-down sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
  - (h) Sheaves shall be connected metallically to a grounded structure.
- (2) Brackets or devices shall be provided to catch and hold the rope in the event it comes off the sheaves on the side away from the tower.
  - (3) The design of sheave and sheave supports shall be such as to prevent the rope from leaving the sheave on the side toward the tower.

Ind 46.37 ANCHOR CONNECTIONS FOR COUNTERWEIGHT ROPES, TOWER OR STATION ANCHOR CABLES OR GUYS. (1) Cable and rope fastenings shall at least equal the strength of the cable or rope.

- (a) Anchor connections shall be above ground.
  - 1. Any part of the anchorage below ground shall be protected against loss of strength due to corrosion.

Ind 46.38 COUNTERWEIGHTS AND COUNTERWEIGHT ROPES. (1) Sufficient counterweights or a tensioning device shall be provided for proper tensioning of every:

- (a) Hauling Rope.
  - (b) Track Cable.
- (2) Counterweights shall be so suspended to permit free vertical movement.
  - (3) Counterweights or tensioning device shall be so constructed and maintained as to have free movement at all times.

- (4) Counterweights or tensioning device shall be properly guarded to prevent accidental contact with or passage under the counterweight.
- (5) Counterweights or tensioning device shall have sufficient travel to provide for all normal operating changes in loading and temperature.
- (6) Counterweight ropes shall have a factor of safety of not less than 6.
  - (a) Counterweight ropes shall be coated with lubricant or some other approved coating to prevent rusting, unless manufactured of corrosion resistant material.
  - (b) Splices in counterweight ropes are prohibited.

Ind 46.39 STRUCTURES AND FOUNDATIONS. Structures and foundations shall be installed in accordance with the requirements of Wis. Adm. Code, Building.

Ind 46.40 LOADING AND UNLOADING AREAS. (1) Loading and unloading areas for chair and monorail tramways shall have sufficient length and width to load and unload passengers safely.

- (a) The unloading area shall be graded to permit passengers to ski away from the tramway.
- (b) Elevated loading and unloading platforms shall be protected on all sides by guard rails, safety nets or ramps.
- (c) Outer ends of unloading platforms shall be provided with inclined guards to prevent ski tips from catching under the edges of the platform.
- (d) Illumination at loading and unloading areas when a tramway is in operation shall be of an intensity of not less than 5 foot candles at the surface.
- (e) Towers adjacent to loading points shall be properly guarded to prevent ski tips from becoming entangled in the towers.

Ind 46.41 TRACK CABLE SADDLES AND MOUNTS. (1) The radius of a track cable saddle shall be:

- (a) Large enough to reduce bearing pressure to a value that will permit the cable to slide in the saddle groove, and provide smooth transition of the carrier from span to span.
- (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 derailment of the trucks.
- (4) Saddles shall permit free passage of the carriage even when the carrier is swinging laterally as it approaches or passes the tower.

- (5) If the gage of the tramway is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum so that the carriage cannot become derailed as it passes over the saddle.

Ind 46.42 HAULING ROPES. (1) There shall be posted for permanent record in a conspicuous place on the tramway a metal sign bearing the following data:

Diameter of Rope - - - - -  
Material and Type of Rope - - - - -  
Rated Ultimate Strength - - - - -  
Date of Installation - - - - -

- (a) The minimum size of hauling ropes shall be 1 inch in diameter for mono-cable tramways.
    - 1. The factor of safety shall be not less than 6 when new.
  - (b) Hauling wire rope attachments shall be of the approved type.
  - (c) Stationary wire rope and hangers on the hauling rope must be relocated at least once in every 12 months. The attachments must be moved a distance of at least 3 feet ahead for each relocation.
  - (d) Any splice shall be at least 1,200 times the diameter of the rope and shall withstand its rated ultimate strength.
  - (e) If rope links with swaged end fittings are used the end fittings shall be so designed and applied that, in a test of a complete link, the rope will break without slippage of the fittings.
- (2) Ropes shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has been decreased more than 25 per cent of the rated ultimate strength of the rope.
  - (3) Hauling ropes shall be connected metallicly to a grounded structure.

Ind 46.43 CARRIERS; CHAIR TRAMWAYS, GONDOLA TRAMWAYS AND APPURTENANCES. (1) Chairs and hangers shall be designed with a factor of safety of not less than 6.

- (a) Carriers shall be clearly identified with numbers.
- (b) A rope grip, whether detachable or fixed shall be of the approved type.
- (c) A factor of safety of not less than 6 shall exist in component parts and the fastening of grips.
- (d) Detachable and fixed grips shall be designed to pass smoothly over and under line sheaves.
- (e) The detachable grips shall be designed and constructed to grip the hauling rope positively and without damage to the rope.

- 1. At least two springs shall be required for holding detachable grip jaws. Each spring shall be capable of holding the grip safely closed against the design load.
- (f) Each terminal shall be equipped with devices to prevent the start of detachable grips that are incorrectly coupled to the rope.
- (2) On multi-cable tramways the weight of the unit shall be so distributed over all wheels that the load per wheel does not exceed that approved.
  - (a) Diameter of the wheels shall be selected on the basis of that one of the following criteria which requires the greater diameter:
    - 1. Allowable bearing pressure on the material, if any, with which the wheels are lined.
    - 2. As approved.
  - (b) Wheels shall be designed to prevent them from leaving the track cable under all operating conditions.

Ind 46.44 TRACK CABLES. (1) There shall be posted for permanent record in a conspicuous place on the tramway a metal sign bearing the following data:

Diameter of Cable - - - - -  
 Material and Type of Cable - - - - -  
 Rated Ultimate Strength - - - - -  
 Date Installed - - - - -

- (a) The factor of safety shall be not less than 6 when new.
- (b) Track cables shall be connected metallicly to a grounded structure.
- (c) Cable sockets shall be of such strength that the cable will break before the socket is deformed.
- (d) Track cable couplings shall not be used.
- (2) Cables shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has been decreased more than 25 per cent of the rated ultimate strength of the cable.

Ind 46.45 COMMUNICATION. Voice communication system shall be provided so that operators at each loading and unloading area will be in communication with each other at all times.

Ind 46.46 SIGNS. (1) Signs shall be provided as outlined in the following subsection:

- (a) "If not familiar with use of lift, ask for instructions."
  - 1. This shall be placed at the loading areas.

- (b) "Do not unload except at designated unloading areas."
  - 1. This shall be placed near loading areas.
- (c) "Prepare to Unload."
  - "Open Safety Bar." Where Safety Bars are used.
  - "Keep Ski Tips Up."
  - 1. These shall be placed at a distance of not less than 50 feet ahead of unloading areas.
- (d) "Get Off Here."
  - 1. This shall be placed at the unloading points.
- (e) "Keep Clear of Unloading Area."
  - 1. This shall be placed at the unloading areas.

Ind 46.47 EVACUATION. Provisions shall be made for the evacuation of passengers from the tramway in case of emergency.

#### TRAMWAYS

##### T-BAR LIFTS -- J-BAR LIFTS -- PLATTER LIFTS

Ind 46.48 LOCATION, TOWERS, CLEARANCES. (1) Tramways shall be located far enough from terrain features, such as overhanging ledges and electric power lines and other structures so as to prevent injury to skiers resulting from contact with or collapse of such structures and terrain features.

- (a) The tramway line path shall be cleared of all obstructions to a minimum distance of 3 feet on both sides of the ascending rope line. Dead or weakened trees and branches near enough to fall within the path shall be removed. Clearings shall be adequately graded and drained to avoid wash-outs which would endanger the tramway.
- (b) The tramway path shall have a level or upward slope at all points. No reverse slopes shall be permitted, except that a decline of not more than 20 per cent shall be permitted at the unloading areas.
- (c) The maximum permissible slope of ski track for single towing outfits shall be not more than a grade of 100 per cent, not more than 80 per cent for double towing outfits.
- (d) Distance between ropes of adjacent tramways shall be at least 10 feet.
- (e) Ski trails shall not intersect or cross the tramway line.



- (f) Ski tow path shall be centered under the up-hauling rope with no obstruction within 3 feet of the center line of the path. The side slope of the tow path shall not exceed 5 per cent.
- (g) Path width of cuts or fills shall be as follows:
  - 1. Single towing outfits shall be not less than 6 feet.
  - 2. Double towing outfits shall be not less than 10 feet.
- (2) The design of the towers shall be in accordance with the requirements of the Wis. Adm. Code, Building.
  - (a) Towers shall be located and arranged so that:
    - 1. The towing device cannot lift passengers off the snow.
    - 2. Down-coming empty towing outfits will be clear of the snow.
    - 3. The hauling rope shall clear the passenger's head by at least 2 feet under the most adverse conditions.
    - 4. The distance between the uphill rope and the downhill rope shall be not less than 6 feet except between the terminal sheaves and adjacent towers.
  - (b) Changes in variable height towers shall be made to avoid overloading or underloading of tower sheave units.
  - (c) Guyed towers where the guys intersect the ground, the guys shall be fenced.
  - (d) Each tower shall be effectively grounded. An 8 foot ground rod shall be provided at the tower. A No. 6 copper wire or equivalent shall connect the tower to the ground rod.
  - (e) Towers shall be clearly identified with successive numbers.

Ind 46.49 CAPACITY AND SPEED. (1) Tramways shall not be operated beyond their approved capacity and speed.

- (a) Multi-passenger tramways shall not be operated at speeds in excess of 600 feet per minute. The loading interval shall be not less than 4 seconds plus the time required to extend the towing outfit to a point where skiers start to move.
- (b) Single-passenger tramways shall not be operated at speeds in excess of 800 feet per minute. The loading interval shall be not less than 3 seconds plus the time required to extend the towing outfit to a point where skiers start to move.
- (c) Smooth acceleration of the rope shall be provided and shall be effective when starting with one skier to full load.

- (d) Speed of an internal combustion engine prime mover shall be controlled by a mechanical governor.

Ind 46.50 POWER SOURCE. (1) Electrical power supply shall be installed and wired in accordance with the requirements of the Wis. Adm. Code, Electrical.

- (a) All exposed electrical transmission wiring shall be so located that in case of collapse or breakage of the power line, it will not come in contact with the cars, cables or passengers.
- (2) Liquid fuels such as gasoline and diesel fuel shall be stored and handled in accordance with the requirements of Wis. Adm. Code, Chapter Ind 8, Flammable Liquids.
- (3) Liquefied petroleum gas installation shall be made in accordance with the requirements of Wis. Adm. Code, Chapter Ind 9, Liquefied Petroleum Gases.
- (4) The engine shall always be shut down during refueling if the fuel supply tank is within 50 feet of the engine.

Ind 46.51 PRIME MOVERS. (1) Prime movers shall have sufficient power to handle the approved load.

- (a) Speed reducers and gears shall have ample capacity to start the tramway when fully loaded and shall be designed with a factor of safety of not less than 5.
  - 1. Bearings, couplings and shafting shall be designed with a factor of safety of not less than 5, of a size and type suitable for the function to be performed.
  - 2. Clutches shall be of ample size to carry a full load and permit controlled slippage for smooth acceleration when starting, without overheating. Clutches shall be designed with a factor of safety of not less than 5.
- (b) A positive backstop or brake to automatically prevent reverse rotation shall be applied to the drive or tension terminal sheave or to the gear.
- (c) Brakes shall not be parallel connected with the armature or field of a direct current driving motor.
- (2) Direct current or slip ring motors shall be equipped with an overspeed switch directly connected to the motor shaft to disconnect the power to the motor and apply the automatic brake when the motor exceeds 10 per cent of its rated speed.
- (3) Internal combustion engines shall be equipped with an automatic device that will stop the tramway when the engine exceeds 15 per cent of its rated speed.

Ind 46.52 OPERATION AND CONTROL. (1) Electric switches to stop the tramway shall be provided at all loading and unloading areas and in the machine room.

- (a) Electrical stop circuits shall be closed metallic circuits so arranged that power failure, malfunction or actuation of a safety switch causes the tramway to stop.
  - (b) Limit switches shall be installed to stop the tramway before any counter-weight or terminal wheel carriage reaches either limits of travel.
  - (c) Towers shall be equipped with electric disconnects or switches which will stop the lift in case of rope derailment.
- (2) Bypassing of safety stop circuits is prohibited.
- (a) Passenger actuated safety stops shall be so located that they cannot be bypassed by a skier.
    - 1. Passenger or attendant-actuated safety stops shall be tested at the beginning of each day's operation by an authorized person.
- (3) Operating controls and communicating systems shall be so located that the control operator shall have view of the tramway line without leaving his position.
- (4) At least one attendant shall be on duty at loading areas.
- (5) The tramway shall be started by an authorized person only.

Ind 46.53 MACHINE ROOM OR ENCLOSURE. (1) Driving units shall be enclosed or located in a manner that will prevent employees or frequenters from accidentally coming in contact with the machinery.

- (a) When an internal combustion engine is used as a prime mover, the machine room shall be ventilated to prevent any products of combustion or fuel fumes from contaminating the atmosphere in the enclosure. Engine exhaust pipes shall not pass within 2 inches of any wooden member or other flammable material.
- (b) Openings over 10 inches square shall be provided with suitable doors with locks to prevent entrance and operation by unauthorized persons.
  - 1. The machine room or enclosure shall be sign posted to the effect that unauthorized persons are not permitted therein.
- (c) Machine rooms shall be provided with uniform artificial illumination of an intensity of not less than 5 foot candles at the floor.
- (d) Approved fire extinguishers shall be installed in all machine rooms.
- (e) An exit shall be provided to permit anyone to leave rapidly in the case of an emergency.

Ind 46.54 MOVING PARTS. Moving parts shall be guarded in accordance with the requirements of the Wis. Adm. Code, Chapter Ind 1, Safety.

Ind 46.55 TERMINAL AND DRIVE SHEAVES. (1) Terminal and drive sheaves, shafts and bearings, shall be designed with a factor of safety of not less than 5.

- (a) The minimum diameter for terminal sheaves shall be 72 times the diameter of the rope.
- (b) Drive sheaves shall be designed to prevent slippage of the hauling rope in the sheave groove.
- (c) The sheave assembly shall be designed to retain the cable in the event of malfunction or breakage.
  - 1. Sheave frames shall be designed to retain the sheave in the event of shaft breakage.

Ind 46.56 HAULING ROPE SHEAVES, HAULING ROPE DEFLECTING SHEAVES, COUNTERWEIGHT ROPE SHEAVES AND MOUNTS. (1) Sheaves, bearings, and supporting mechanisms shall be designed, constructed, and maintained to bear the static and dynamic loads.

- (a) The minimum diameter of guide sheaves shall be 10 times the rope diameter.
- (b) The pitch diameter of hauling rope deflecting sheaves shall be as outlined in this subsection:
  - 1. for 6 x 7 rope - 72 times diameter of rope.
  - 2. for 6 x 19 rope - 45 times diameter of rope.
  - 3. for 6 x 37 rope - 27 times diameter of rope.
- (c) The lining of sheave grooves shall satisfy the allowable bearing loads for the material used.
- (d) Unlined sheave grooves shall have round bottoms having a radius of 55 per cent of the rope diameter.
- (e) Single sheave units shall not be used except as terminal guide sheaves.
- (f) Hold-down sheaves shall be installed if the load on a group of support sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
- (g) Support sheaves shall be installed if the load on a group of hold-down sheaves on a tower can become less than one-half the permissible load on one sheave under the most adverse loading conditions.
- (h) Sheaves shall be connected metallically to a grounded structure.
- (i) Return rope sheaves shall be located to prevent passengers from contacting the rope.

- (j) Line sheaves shall be guarded to prevent towing devices or attachments from becoming entangled in the sheaves or sheave supports.
- (2) Brackets or devices shall be provided to catch and hold the rope in the event it comes off the sheaves on the side away from the tower.
- (3) The design of sheave and sheave supports shall be such as to prevent the rope from leaving the sheave on the side toward the tower.

Ind 46.57 ANCHOR CONNECTIONS FOR COUNTERWEIGHT ROPES, TOWER OR STATION ANCHOR CABLES OR GUYS. (1) Cable and rope fastenings shall at least equal the strength of the cable or rope.

- (a) Anchor connections shall be above ground.
  - 1. Any part of the anchorage below ground shall be protected against loss of strength due to corrosion.

Ind 46.58 COUNTERWEIGHTS AND COUNTERWEIGHT ROPES. (1) Sufficient counterweights or a tensioning device shall be provided for proper tensioning of every:

- (a) Hauling Rope.
  - (2) Counterweights shall be so suspended to permit free vertical movement.
  - (3) Counterweights or tensioning devices shall be so constructed and maintained as to have free movement at all times.
  - (4) Counterweights or tensioning devices shall be guarded to prevent accidental contact with or passage under the counterweights.
  - (5) Counterweights or tensioning devices shall have sufficient travel to provide for all normal operating changes in loading and temperature.
  - (6) Counterweight ropes shall have a factor of safety of not less than 6.
    - (a) Counterweight ropes shall be coated with lubricant or some other approved coating to prevent rusting, unless manufactured of corrosion resistant material.
    - (b) Splices in counterweight ropes are prohibited.

Ind 46.59 STRUCTURES AND FOUNDATIONS. Structures and foundations shall be installed in accordance with the requirements of Wis. Adm. Code, Building.

Ind 46.60 LOADING AND UNLOADING AREAS. (1) Loading areas shall be of sufficient length, width to provide proper starting for the skier.

- (a) Loading areas shall be level, free of obstructions and fenced to guide skiers for loading.

- (b) Unloading areas shall be of sufficient length, width and grade to provide the skier clearances to move away from the tramway line.
- (c) Illumination at loading and unloading areas, and the entire ski path, when the tramway is in operation, shall be of an intensity of not less than 5 foot candles at the surface.

Ind 46.61 HAULING ROPES. (1) There shall be posted for permanent record in a conspicuous place on the tramway a metal sign bearing the following data:

Diameter of Rope - - - - -  
Material and Type of Rope - - - - -  
Rated Ultimate Strength - - - - -  
Date of Installation - - - - -

- (a) The hauling rope shall have a factor of safety of not less than 6 when new.
- (2) Stationary wire rope and hangers on the hauling rope must be relocated at least once in every 12 months. The attachments must be moved a distance of at least 3 feet ahead for each relocation.
- (3) Any splice shall be at least 1,200 times the diameter of the rope and shall withstand its rated ultimate strength.
- (4) If rope links with swaged end fittings are used, the end fittings shall be so designed and applied that, in a test of a complete link, the rope will break without slippage of the fittings.
- (5) Ropes shall be renewed when through broken wires, wear, rust, undue strain, or other deterioration, the strength has been decreased more than 25 per cent of the rated ultimate strength of the rope.
- (6) Hauling ropes shall be connected metallicly to a grounded structure.

Ind 46.62 TOWING OUTFITS. (1) Bars or platters. (a) The use of straps or other devices to fasten a person to the towing outfit is prohibited.

- (b) Towing outfits and components shall be designed with a factor of safety of not less than 5.
- (c) Retraction of the telescoping and spring box type towing outfits shall be controlled so it may be released from a fully extended position without causing injury to itself or the passengers, or causing any part of the towing outfit to become entangled with the hauling rope, sheaves, or other structures or equipment.
- (d) Detachable and fixed grips shall be designed to pass smoothly over and under line sheaves.
- (e) Detachable grips shall be designed and constructed to grip the hauling rope positively and without damage to the rope.

Ind 46.63 COMMUNICATION. Voice communication system shall be provided so that operators at each loading and unloading area will be in communication with each other at all times.

Ind 46.64 SIGNS. (1) Signs shall be provided as outlined in the following subsection:

- (a) "If not familiar with use of lift, ask for instructions."
  - 1. This shall be placed at loading areas.
- (b) "Stay in Ski Track."
  - "Do not unload except at designated unloading areas."
    - 1. These shall be placed on the first tower uphill from loading areas.
- (c) "Release Bar Gently When Unloading."
  - 1. This shall be placed at a distance of not less than 25 feet ahead of unloading areas.
- (d) "Keep Clear of Unloading Area."
  - 1. This shall be placed at the unloading areas.
- (e) "Safety Gate."
  - 1. This shall be placed at the safety gates.

#### FIBER ROPE TOWS

Ind 46.66 LOCATION, CLEARANCES, PATH OF ROPE. (1) Tramways shall be located far enough from terrain features, such as overhanging ledges and electric power lines and other structures so as to prevent injury to skiers resulting from contact with, or collapse of such structures and terrain features.

- (a) The tramway line path shall be cleared of all obstructions to a minimum distance of 3 feet on both sides of the ascending rope line. Dead or weakened trees and branches near enough to fall within the path shall be removed.
- (b) The distance between the uphill rope and the return rope shall be not less than 5 feet at the loading area.
  - 1. The distance between the uphill rope and any pole located between the loading and unloading areas shall be not less than 3 feet.
  - 2. The distance between uphill ropes of adjacent tramways shall be not less than 6 feet.

- (c) Ski tow path shall be centered under the uphill rope with no obstructions within 3 feet of the center line of the path. The side slope of the tow path shall not exceed 5 per cent.
- (d) Tow path width in cuts or fills shall be as follows:
  - 1. Single tows not less than 6 feet.
  - 2. Double tows not less than 10 feet.
- (2) Provisions shall be made to prevent skiers from loading on the downhill side of the rope.

Ind 46.67 CAPACITY AND SPEED, (1) The rope speed shall be not more than 1,500 feet per minute.

- (a) Speed of an internal combustion engine prime mover shall be controlled by a mechanical governor.
- (2) Loading intervals for skiers shall be not less than 10 feet.

Ind 46.68 POWER SOURCE. (1) Electrical power supply shall be installed and wired in accordance with the requirements of the Wis. Adm. Code, Electrical.

- (a) All exposed electrical power lines shall be so located that in case of collapse or breakage of the power line, it will not come in contact with the cars, cables or passengers.
- (2) Liquid fuels such as gasoline and diesel fuel shall be stored and handled in accordance with the requirements of Wis. Adm. Code, Chapter Ind 8, Flammable Liquids.
- (3) Liquefied petroleum gas installation shall be made in accordance with the requirements of Wis. Adm. Code, Chapter Ind 9, Liquefied Petroleum Gases.
- (4) The engine shall always be shut down during refueling if the fuel supply tank is in the immediate vicinity.

Ind 46.69 PRIME MOVER. (1) Prime movers shall have sufficient power to handle the approved load.

- (a) Speed reducers and gears shall have ample capacity to start the tramway when fully loaded, and shall be designed with a factor of safety of not less than 5.
  - 1. Bearings, couplings and shaftings shall be of a size and type suitable for the function to be performed and shall be designed with a factor of safety of not less than 5.



2. Clutches shall be of ample size to carry a full load and permit controlled slippage for smooth acceleration when starting, without overheating. Clutches shall be designed with a factor of safety of not less than 5.

- (b) An automatic brake shall be provided to stop and hold the tramway system with approved load when power is shut off or the tramway is stopped for any reason. The brake shall be applied to the main drive sheave or to a drive shaft so that there is no clutch, chain or belt between the brake and the main drive sheave.

Ind 46.70 OPERATION AND CONTROL. (1) There shall be a safety gate or safety stop so constructed and installed that no passenger, in contact with or being pulled by the rope, can come in contact with sheaves, machinery, building or other obstruction. The safety stop shall be so designed and constructed that it can only be reset manually.

- (a) The distance from the safety gate to the first sheave or other obstruction shall be not less than the distance the rope travels, plus a 30 per cent safety factor after the safety gate has been tripped. This distance shall be determined while the tramway is operating at maximum speed with only one passenger riding on the tramway.
- (b) Electrical stop circuits shall be closed metallic circuits so arranged that power failure, malfunction or actuation of a safety switch causes the tramway to stop.

(2) Bypassing of safety stop circuits is prohibited.

- (a) Passenger actuated safety stops shall be so located that they cannot be bypassed by the skier.

1. Passenger or attendant-actuated safety stops shall be tested at the beginning of each day's operation by an authorized person.

(3) The tramway operator shall maintain a position to have view of the tramway or tramways, and shall have controls to stop the tramway readily available.

(4) The tramway shall be started by an authorized employee or authorized ski patrol member only.

Ind 46.71 MACHINE ROOM OR ENCLOSURE. (1) Driving units shall be enclosed or located in a manner that will prevent employees and frequenters from accidentally coming in contact with the machinery.

- (a) When an internal combustion engine is used as a prime mover, the machine room shall be ventilated to prevent any products of combustion or fuel fumes from contaminating the atmosphere in the enclosure. Engine exhaust pipes shall not pass within 2 inches of any wooden member or other flammable material.

- (b) Openings over 10 inches square shall be provided with suitable doors with locks to prevent entrance and operation by unauthorized persons.
  - 1. The machine room or enclosure shall be sign posted to the effect that authorized persons are not permitted therein.
- (c) Machine rooms shall be provided with uniform artificial illumination of an intensity of not less than 5 foot candles at the floor.
- (d) Approved fire extinguishers shall be installed in all machine rooms.
- (e) An exit shall be near enough to permit anyone to leave rapidly in the case of an emergency.

Ind 46.72 MOVING PARTS. All moving parts shall be guarded in accordance with the requirements of the Wis. Adm. Code, Chapter Ind 1, Safety.

Ind 46.73 ROPE DRIVE SHEAVES, IDLER SHEAVES AND SUPPORTS. (1) Sheaves and supports shall be of a design, type and sufficient strength to withstand stresses imposed by full load operation.

- (a) Grooved sheaves shall be installed to hold the uphill rope not more than 3 feet above the snow at the loading area so arranged to prevent the rope from being pulled out of the groove by skiers.
- (b) There shall be no intermediate sheaves on the uphill rope between the loading and unloading areas.
- (c) Terminal sheaves shall be grooved and arranged to retain the rope in the groove.
  - 1. Terminal sheaves shall be installed to prevent their falling to the ground in the event of rope breakage.
- (d) Return rope sheaves shall be mounted high enough on the intermediate towers to hold the rope at least 7 feet above the snow level.
  - 1. Return rope sheave mountings shall be of sufficient strength to prevent failure under full load.
- (e) The vertical component of the rope tension shall be sufficient to hold the rope in the sheave groove, or an approved device shall be provided to retain the rope in the groove.

Ind 46.74 COUNTERWEIGHT OR TENSIONING DEVICE ROPE. (1) Connection between the counterweight or tensioning device sheave and the securing point shall be made with rope with a factor of safety of not less than 6.

- (a) Wire rope shall be coated with lubricant or some other approved coating to prevent rusting unless manufactured of corrosion-resistant material.

- (b) Splices in counterweight ropes are prohibited.

Ind 46.75 COUNTERWEIGHT OR TENSIONING DEVICE. (1) The counterweight or tensioning device shall be of sufficient type and size to prevent slippage of the hauling rope on the drive sheave under full load.

- (a) Counterweight or tensioning device sheaves shall be grooved and arranged to retain the rope in the groove.
- (b) Counterweights shall be so suspended to permit free vertical movement.
- (c) Counterweights or tensioning devices shall be so constructed and maintained as to have free movement at all times.
- (d) Counterweights or tensioning devices shall be guarded to prevent accidental contact with or passage under the counterweights.
- (e) Counterweights or tensioning devices shall have sufficient travel to provide for all normal operating changes in loading and temperatures.

Ind 46.76 FOUNDATIONS. Foundations or anchors used to restrain the driving mechanism and the terminal sheave shall be of sufficient size and type to prevent movement under full load.

Ind 46.77 LOADING AND UNLOADING AREAS. (1) Loading areas shall be level, free of obstructions and fenced to guide skiers for loading.

- (2) Unloading areas shall be of sufficient length, width and grade to provide the skier clearances to move away from the tramway line.
- (3) A ladder or other suitable means of elevation for facilitating release of skiers entangled in the tramway rope shall be available and visible at all times in the immediate vicinity of the safety-stop at the unloading area.
- (4) Illumination at loading and unloading areas and the entire ski-path, when the tramway is in operation, shall be of an intensity of not less than 5 foot candles at the surface.

Ind 46.78 HAULING ROPE. (1) Hauling rope shall be a type manufactured for ski-tow use.

- (a) Splices shall be of the transmission or long type.
- (2) The use of towing outfits or rope grippers attached to a skier or his equipment is prohibited.

Ind 46.79 INTERMEDIATE TOWERS AND SUPPORTS. (1) Return rope sheave supports shall be of sufficient strength to prevent failure under full load.

- (a) Guy wires or braces shall be located to provide the minimum clearances as required by section Ind 46.66 (1)(a), (b), and (c).
  - (b) Guy wires or braces shall be fenced.
  - (c) There shall be no projections lower than 7 feet above the surface of the tow path on towers and supports.
- (2) Foundations for intermediate towers shall be constructed, located and of sufficient strength to support the stresses imposed under full load operation.

Ind 46.80 SIGNS. (1) Signs shall be provided as outlined in the following subsection:

- (a) "Towing outfits or rope grippers attached to a skier or his equipment are prohibited."

"Beware" -- "Dangerous" -- "Loose Clothing - Long Hair."

"Stay in Ski-Track."

- 1. These shall be placed at loading areas.

- (b) "Safety Gate."

- 1. This shall be placed at the safety gate.

Ind 46.81 GENERAL REQUIREMENTS. (1) New and existing installations.

- (a) Voltage through any passenger activated safety stop shall not exceed 120 volts.
- (2) CONSTRUCTION AND LOCATION OF SIGNS. Required signs shall be of substantial construction, firmly and appropriately mounted or positioned. They shall be provided in such numbers and at such locations as to be clearly visible under normal operating conditions to all persons to whom their respective legends may relate. Design, lettering and background coloring shall be such to provide easy legibility.
- (3) ACCIDENTS. (1) Provision shall be made to render first aid in the event persons are injured on the tramway. This shall include provision for transporting an injured person off the tramway or slope.
- (a) Accidents resulting in personal injury on a tramway shall be reported to the Industrial Commission within 10 days from date of accident.

Ind 46.82 MAINTENANCE. (1) Tramways shall be kept in safe operating condition, properly lubricated and clean, including counterweight areas and pits, machine rooms or areas.

- (a) Permanent records must be kept of all inspections and major repairs made. These records shall be made available to the Industrial Commission upon request.