4-006 Temperature limitations (see Appendix B)

1) Where equipment is marked with a maximum conductor termination temperature, the minimum size of conductor used shall be based on the allowable ampacity in the temperature column in Table 1, 2, 3, or 4, with all relevant correction factors being applied as required by Rule 4-004, corresponding to the maximum termination temperature marked on the equipment.

2) For the purpose of Subrule 1), and except as provided for by other Rules of this Code, where the maximum conductor termination temperature for equipment is not marked, the maximum conductor termination temperature shall be considered to be

   a) 60 °C for equipment

      i) rated not more than 100 A; or

      ii) marked for use with No. 1 AWG or smaller conductors; and

   b) 75 °C for equipment

      i) rated more than 100 A; or

      ii) marked for use with conductors larger than No. 1 AWG.

3) Notwithstanding Subrule 2), for high-voltage equipment where conductor termination temperatures are not marked, it shall be permitted to consult the manufacturer to establish the permitted termination temperature.

4) Subrules 1) and 2) shall apply only to the first 1.2 m of conductor length measured from the point of termination on the equipment.

5) Where a cable transition is made to meet the requirements of Subrule 1) or 2), the length of a conductor terminating on equipment shall be not less than 1.2 m.

6) Where the conductor ampacity is selected from Tables D8A to D11B, Tables D17A to D17N, or Table 12E, Subrules 1) and 2) shall apply.

APPENDIX B - Rule 4-006

In accordance with CSA product Standards (e.g., CSA C22.2 No. 4 or CSA C22.2 No. 5), when equipment of 600 V or less is evaluated relative to the appropriate temperature characteristics of the terminations, conductors sized similar to those in the 75 °C column of Table 2 or 4 are used.

It is intended by this Rule that the size of conductors terminating on equipment described in Subrules 1), 2), 3), and 4) be not less than the conductor size selected for the maximum insulated conductor ampacity in the corresponding temperature column of Table 1, 2, 3, or 4.

This Rule is not intended to address conductor allowable ampacity (see Rule 4-004).

Regardless of conductor allowable ampacities determined by other Rules in this Code (for underground conductors, cables, flexible cords, portable power cables, DLO cables, and conductors with higher temperature ratings, etc.), it is intended that the minimum conductor size be based on the requirements of this Rule.

APPENDIX B - Rule 4-006 3)

High-voltage equipment may be tested and rated for termination temperature at 90°C. For high-voltage installations rated up to 5 kV, where conductors are selected in accordance with Tables 1 to 4, 12E, or D8A to D11B, or for high-voltage installations rated 5 kV to 46 kV, where insulated conductors or cables are selected in accordance with Tables D17A to D17N, the equipment manufacturer should be consulted when insulated conductors or cables are intended for termination on each specific type of high-voltage equipment.

APPENDIX B - Rules 4-006 4) and 5)

The 1.2 m length is based on test requirements from equipment Standards.

Where the ends of a conductor terminate, we must consider the temperature rating of the equipment it is connected on. In the case of breakers and fused equipment, the termination temperatures of the equipment determine the column to be used for maximum conductor ampacity, based on Table 2 and 4. For example, if a conductor is terminated on a circuit breaker with 75°C terminations on one end and a device with 90°C terminations on the other end, the lower termination temperature is used. However, circuit breakers are factory-tested at 60°C and 75°C. This means that in any situation where we have circuit breakers and we are determining conductor sizing, we must use the 75°C column from the ampacity tables, even if we are using 90°C rated conductors.

Where equipment termination temperatures are not indicated, the default temperatures are noted as 60 degrees for equipment rated at 100 A maximum and #1/0 maximum, and 75 degrees for above 100 A and larger than #1/0.

This is not intended to address the actual ampacity of the conductor, that is determined in 4-004. For a 90°C conductor we use the 90°C ampacity to derate and then we check to see if it stills corresponds with the 75°C ampacity.

4-008 Induced voltages and currents in metal armour or sheaths of single-conductor cables (see Appendix B)

1) Where sheath currents in single-conductor cables having continuous sheaths of lead, aluminum, stainless steel, or copper are likely to cause the insulation of the conductors to be subjected to temperatures in excess of the insulation ratings, the cables shall be

Total length of service run inside of a building may be reduced by running part of it in a concrete wall or concrete floor, or by running it under the floor - buried in the soil. Don't forget that in a combustible wall, in the attic or in the basement or crawl space is considered in the building. The point at which a service raceway or cable pierces the outside skin of a building, it is inside that building.

6-210 Oil switches and oil circuit breakers used as consumer's service switches

1) Isolating switches shall be installed on the supply side and interlocked with oil switches and oil circuit breakers except in the case of metal clad equipment, where the primary isolating device shall be considered to be the equivalent of an isolating switch or link.

2) Where overcurrent trip coils are used for breakers, one shall be installed on each ungrounded conductor of the circuit; however, if the capacity of the transformers and the extent of the network supplying the service is sufficiently small, and a deviation has been allowed in accordance with Rule 2-030, two trip coils, one in each phase of a 4-wire, two-phase ungrounded service, shall be permitted to be used.

6-212 Wiring space in enclosures (see Appendix B)

1) Enclosures for circuit breakers and externally operated switches shall not be used as junction boxes, troughs, or raceways for conductors feeding through or tapping off to other electrical equipment.

2) Notwithstanding Subrule 1), service equipment designed for accommodating current monitoring devices or other associated electrical equipment that must, for its operation, be connected to the line side of the service disconnecting means, shall be permitted.

3) Consumer's service conductors that enter a service box that is not equipped with a barrier between the line and load sides shall

   a) enter the service box as close as possible to the line terminals of the main switch or circuit breaker; and

   b) not come into contact with or cross conductors connected to the load terminals of the main switch or circuit breaker.

APPENDIX B - Rule 6-212 2)

Code users should be aware that Clause 6.4 of CSA C22.2 No. 0.19 also allows service equipment to contain associated equipment such as phase failure/ phase reversal relays.

There are several reasons for this rule.

First, enclosures for switches and circuit breakers are certified as having sufficient space and interior dimensions to place the conductors needed for that switch or breaker. Any additional conductors would overload the enclosure beyond the design load and/or restrict the design clearance dimensions so that conductor insulation bending radius may be compromised.

In a switch there are moving parts that can damage the conductor insulation unless they are carefully trained into position and out of harm's way.

Maintenance work and replacement of parts becomes more difficult when these enclosures are used improperly.

Combination service panel boards - Inside your service panel is a barrier that divides the space into two separate sections. The main service breaker is (usually) in the top section and the branch circuit breakers are (normally) in the lower section although there is nothing wrong with installing it with the mains section at the bottom.

Finally, the supply conductors cannot cross the load conductors in this area.

6-214 Marking of service boxes

If there is more than one service box, each box shall be labelled in a conspicuous, legible, and permanent manner to indicate clearly which installation or portion of an installation it controls.

WIRING METHODS

6-300 Installation of underground consumer's service conductors

1) Except where a deviation has been allowed in accordance with Rule 2-030, consumer's service conductors that are located underground shall be

   a) installed in rigid conduit, or electrical non-metallic tubing permitted only for the underground portion of the tubing run, and be of a type for use in wet locations in accordance with Rule 12-102 3); or

   b) a single- or multi-conductor cable for service entrance use below ground in accordance with Rule 12-102 3), provided that the installation is in accordance with Rule 12-012.

2) Raceways entering a building and forming part of an underground service shall be sealed and shall

   a) enter the building above ground where practicable;

   b) be suitably drained; or

   c) be installed in such a way that moisture and gas will not enter the building.

Porch - If the meter is in an open porch, it may be an acceptable location now but remember your customer may want to close in the porch later in the future. By locating it there you may make it impossible to close in the porch or at best make it very expensive. A closed in porch is a heat saver in the wintertime.

These meter leads carry very little current, but their integrity is critical to an accurate measurement of power consumed. The lines must be continuous, i.e., without joints, because an open circuit can cause self-destruction of the metering transformer. Therefore, the rule requires great care, such as you would give to the installation of the main electric service. The rule suggests (passively) there is no need for a service switch for the metering leads, the truth is you may not install -not install- a switch in these lines. The point here is to maintain meter reading accuracy. Switches, conduit fittings and junction boxes, where access may be available to the meter leads would probably, if permitted by the power company, need to be fully accessible and sealable.

6-410 Space required for meters

The space provided for meters shall comply with the requirements of the supply authority.

1) Equipment and wiring for supply authority metering on impedance grounded systems shall comply with the requirements of the supply authority.

2) Where a neutral point reference conductor is required for metering on impedance grounded systems, the reference conductor shall be

   a) insulated for the nominal system voltage;

   b) isolated from ground throughout its entire length; and

   c) permitted to be in the same raceway or cable assembly as the consumer's service conductors and to be carried through or extended from the consumer's service box to the metering equipment.

This is due to the requirement to locate the service conductors on the outside surface of the building. Meter openings are no longer necessary because they are now mounted on the outside surface of buildings. The physical space chosen for that meter must still, of course, be acceptable to your local Electric Utility authority. 6-412 Metering requirements for impedance grounded systems

TABLE 65
Enclosure selection table for non-hazardous locations

(See Rules 2-400 and 2-402.)

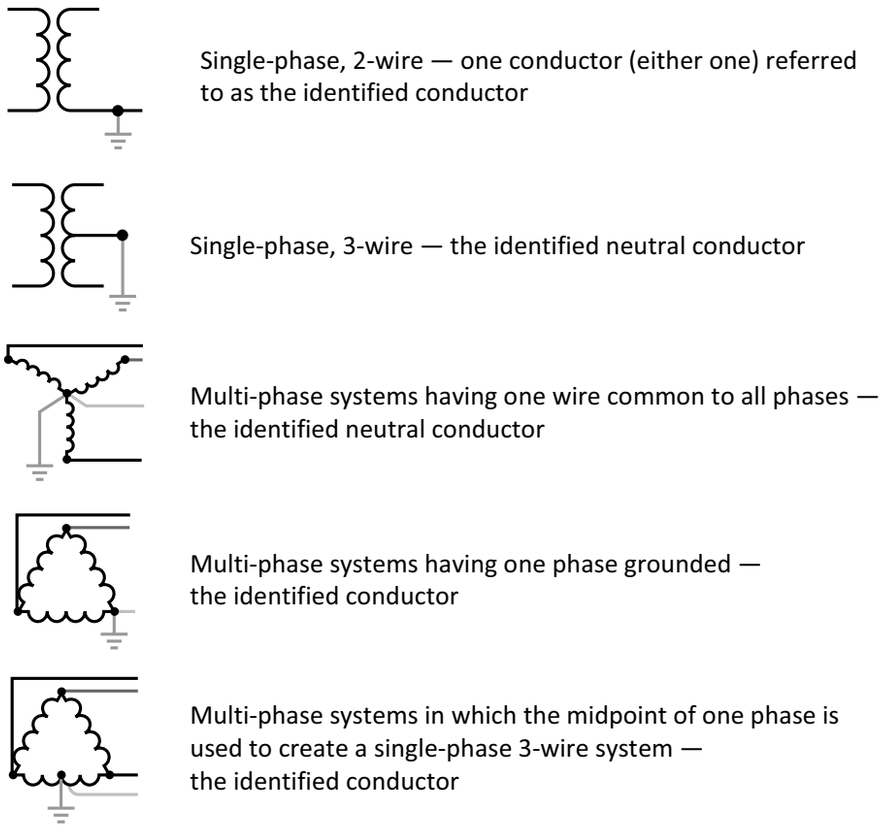
Provides a degree of protection against the following environmental conditions	Enclosure type															
	Indoor use						Indoor/outdoor use								Submersible	
	1	2	5	12*	12K†	13	3	3X	3R	3RX	3S	3SX	4	4X	6	6P
Accidental contact with live parts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dripping and light splashing of non-corrosive liquids	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Circulating dust, lint, fibres, and flyings	—	—	—	X	X	X	X	X	—	—	X	X	X	X	X	X
Settling dust, lint, fibres, and flyings	—	—	X	X	X	X	X	X	—	—	X	X	X	X	X	X
Hosedown and splashing water	—	—	—	—	—	—	—	—	—	—	—	—	X	X	X	X
Corrosion	—	—	—	—	—	—	—	X	—	X	—	X	—	X	—	X
Occasional temporary submersion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X
Occasional prolonged submersion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X
Oil and coolant seepage, spraying and splashing	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—
Rain, snow, and external formation of ice‡	—	—	—	—	—	—	X	X	X	X	X	X	X	X	X	X
External formation of ice§	—	—	—	—	—	—	—	—	—	—	X	X	—	—	—	—
Wind-blown dust	—	—	—	—	—	—	X	X	—	—	X	X	X	X	X	X

**Without knockouts. †With knockouts.*

‡External operating mechanism(s) is not required to operate when the enclosure is ice covered.

§External operating mechanism(s) shall be operable when the enclosure is ice covered.

FIGURE B10-3
Common solidly grounded configurations



10-210 Grounding connections for solidly grounded ac systems supplied by the supply authority (see Appendix B)
The grounded conductor of a solidly grounded ac system supplied by the supply authority shall

a) be connected to a grounding conductor at one point only at the consumer's service;

b) have a minimum size as specified

i) for a bonding conductor; and

ii) for a neutral conductor when the grounded conductor also serves as a neutral;

c) be connected to the equipment bonding terminal by a system bonding jumper; and

d) have no other connection to the non-current-carrying conductive parts of electrical equipment on the supply side or the load side of the grounding connection.

APPENDIX B - Rule 10-210

The system bonding jumper may be a bonding screw or bonding strap supplied with the consumer's service equipment, sized in accordance with the corresponding Canadian Electrical Code, Part II Standard. Where the system bonding jumper provided by the manufacturer is removed or missing, a field-installed system bonding jumper is sized in accordance with Rule 10-616.

Meter mounting devices are often supplied with a termination point for a system grounded conductor (neutral) that is solidly connected to the conductive metal enclosure of the meter mounting device. This arrangement may not have been tested for suitability as a system bonding jumper and should not be used as such. If the grounding connections for a solidly grounded system are to be made at the meter mounting device, an isolated neutral bus that incorporates provision for a bonding screw, a bonding strap, or a field-installed system bonding jumper should be installed as prescribed by the manufacturer.

The term "grounded conductor" is used to refer to the conductor or point of an electrical system that is grounded.

Where the midpoint conductor (neutral) of a single-phase or multi-phase midpoint system is solidly grounded, the grounded conductor serves as the identified neutral conductor intended to carry the unbalanced load (neutral currents). The grounded conductor serves as the bonding conductor in addition to its primary function of carrying neutral currents.

A consumer's service that is supplied by the supply authority and grounded at the meter mounting device is shown in Figure B10-4.

T-coding and gas groups are normally independent of each other, but with optical radiation, this is not the case because of the particular causes of ignition by lasers and the use of other, supporting equipment. In addition, equipment may have more than one T-code or EPL for different parts of the equipment. Therefore, attention must be paid to gas grouping, T-codes, and EPLs in applying optical equipment.

See Table 18 for equipment and types of protection permitted in the three Zones. Other equipment may be permitted by specific Rules (e.g., fuses in Rule 18-150).

18-092 Wiring methods, Zone 0 (see Appendix B)

1) Circuits terminating in a Zone 0 location shall be intrinsically safe.

2) A cable that has a continuous metallic or non-metallic outer jacket, is marked "HL", and contains one or more circuits that are not intrinsically safe, shall be permitted to pass through a Zone 0 location, provided that

   a) it passes completely through the Zone 0 location with no fittings or connections within the Zone 0 location; and

   b) it is protected from mechanical damage by a raceway or other effective means within the Zone 0 location.

3) Rigid metal conduit containing one or more circuits that are not intrinsically safe shall be permitted to pass through a Zone 0 location, provided that it passes completely through the Zone 0 location with no fittings, couplings, or connections within the Zone 0 location.

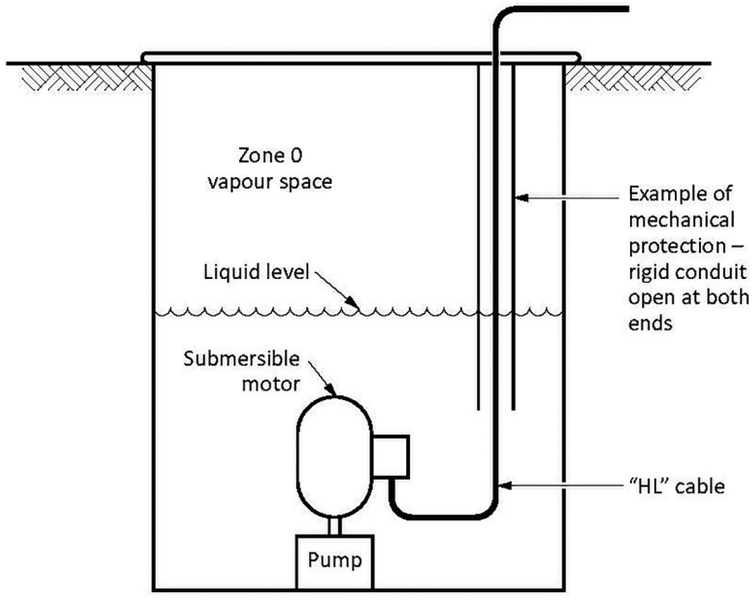
APPENDIX B - Rule 18-092

Only intrinsically safe circuits are allowed in Zone 0; therefore, there is no risk of ignition. Then it is left up to the designer to pick a wiring method that provides the level of mechanical protection that would be required for secure operation of the process. For example, tray cable in tray would be acceptable for intrinsically safe wiring. In many cases, such wiring is not needed as the Zone 0 equipment is installed at the Zone 0 boundary, with the equipment connections not located in Zone 0.

For specific requirements and information regarding intrinsically safe wiring in Zone 0 locations, see Rule 18-066 and the Note to Rules 18-050 and 18-066.

Subrules 2) and 3) deal with installations that require non-intrinsically safe wiring to pass through a Zone 0 location. One common example is to supply power to a submersible pump motor in an enclosed oily water sump. See Figure B18-4 for a typical example using cable.

FIGURE B18-4
Typical oily water sump, Zone 0 installation



18-094 Sealing, Zone 0

1) Where a conduit run that contains circuits in accordance with Rule 18-092 1) terminates in a Zone 0 location, a flammable fluid migration seal shall be installed with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit crosses the Zone 0 boundary.

2) Flammable fluid migration seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.

RESISTANCE DEVICES

26-550 Location of resistance devices
Resistance devices, including wiring to the resistance elements, shall be installed so that the danger of igniting adjacent combustible material is reduced to a minimum.

26-552 Conductors for resistance devices
Insulated conductors used for connection between resistance elements and controllers, unless used for infrequent motor starting,

a) shall be selected in accordance with Rule 12-102 3) as being suitable for the temperature involved and in no case less than 90 °C; and

b) shall be permitted to be grouped where the voltage between any two insulated conductors in the group does not exceed a maximum of 75 V, provided that the insulated conductors have a flameretardant insulation or jacket.

26-554 Use of incandescent lamps as resistance devices
1) Incandescent lamps shall be permitted to be used

a) as protective resistors for automatic controllers; or

b) where a deviation has been allowed in accordance with Rule 2-030, as resistors in series with other devices, provided that the resulting installation is acceptable.

2) Where incandescent lamps are used as resistors, they shall

a) be mounted in porcelain lampholders on non-combustible supports;

b) be arranged so that they cannot be subjected to a voltage greater than that for which they are rated;

c) be provided with a permanently attached nameplate showing the wattage and voltage of the lamp to be used in each lampholder;

d) not carry or control the main current; and

e) not constitute the regulating resistance of the device.

PANELBOARDS

26-600 Location of panelboards (see Appendix G)
1) Panelboards shall not be located in coal bins, clothes closets, bathrooms, stairways, high ambient rooms, dangerous or hazardous locations, nor in any similar undesirable places.

2) Panelboards in dwelling units shall be installed as high as possible, with no overcurrent device operating handle positioned more than 1.7 m above the finished floor level.

The placing of a panelboard is an important part of the installation. Often, panels are located without proper regard to accessibility for maintenance or future expansion. Panelboards should be located where they will remain accessible. As indicated in the rule, they may not be in coal bins, clothes closets, bathrooms, stairways, high ambient rooms, dangerous or hazardous locations (unless approved for these locations) nor in any other similar location. The most inexpensive location is not necessarily the best location for the panel.

Positioning - Panelboards should be mounted in a vertical position wherever possible. Having said that, it must also be noted that there is no rule requiring panels to be in the upright position. Panels may have 60 or more circuit breakers. This means panels will be longer. In some cases it will be difficult to comply with the requirement that the top of the top breaker be within 1.7 m (70 inches) above the floor and at the same time keep the lowest breakers at a reasonable height above the floor in a dwelling. In these cases, mounting the panelboard in a horizontal position may be the only practical solution. The one remaining question is; what is a reasonable minimum height above the floor. The code does not answer that question. A panelboard in any other place other than a dwelling unit need not comply as long as meets requirements of other sections of the code.

Note - Breakers may be mounted in the horizontal position but knife switches may not be in the horizontal position - they must be mounted "so that gravity will not tend to close them," The blades in most switches in good condition would not fall into either the open or closed position however, the argument is that after some use these blades, or perhaps only one blade, may be damaged or become loose enough to fall into the closed position and a person's life may be in danger.

26-602 Panelboards in dwelling units (see Appendix B)
1) A panelboard shall be installed in every dwelling unit except for

a) dwelling units in hotels and motels; and

b) dwelling units that have been created by subdivision of a single dwelling and are not individually metered for electrical power consumption.

2) Every panelboard installed in accordance with Subrule 1) shall have a single supply protected by overcurrent devices, and this supply shall be capable of being disconnected without disconnecting the supply to any other dwelling unit.

ii) be placed on a minimum of 150 mm of crushed stone on the ground;

iii) have dimensions approximately 1.2 m × 1.8 m; and

iv) be permitted to be covered by a layer of crushed stone, asphalt, or concrete not exceeding 150 mm in depth.

36-312 Grounding of metallic fence enclosures of outdoor stations

1) The fence shall be located at least 1 m inside the perimeter of the station ground electrode area.

2) The station ground electrode shall be connected to the fence by a tap conductor at each end post, corner post, and gate post, and at intermediate posts at intervals not exceeding 12 m by a conductor of not less than No. 2/0 AWG copper.

3) The tap conductor at each hinge gate post shall be clamped or bonded to the gate frame by a copper braid or a flexible copper conductor of at least No. 2/0 AWG.

4) The tap conductor shall be connected to the fence post, the bottom tension wire, the fence fabric (for which the conductor may be woven in at least two places), the top rail, and each strand of barbed wire, with the connection to the bottom tension wire, the fence fabric, and barbed wire strands made with bolted or equivalent connectors, and with the top rail connections bonded at every joint by a jumper equivalent to No. 2/0 AWG copper.

5) When there is a metal boundary fence in proximity to the station fence, the touch voltages within 1 m of all parts of the boundary fence shall not exceed the tolerable values specified in Table 52.

TABLE 15
Bending radii — High-voltage cable

(See Rules 34-400 and 36-102.)

Type of cable	Cable diameter multiplying factor (see Note)		
	Up to and including 25 mm diameter	Over 25 mm diameter and up to and including 50 mm diameter	Over 50 mm diameter
Lead covered	10	12	12
Corrugated aluminum-sheathed	10	12	12
Smooth aluminum-sheathed	12	15	18
Tape shielded	12	12	12
Flat tape armoured	12	12	12
Wire armoured	12	12	12
Non-shielded	7	7	7
Wire shielded	7	7	7
Portable power cables 5 kV and less	6	6	6
Portable power cables over 5 kV	8	8	8

Note: *The bending radius is the radius measured at the innermost surface. It equals the overall diameter of the cable multiplied by the appropriate number shown in Columns 2, 3, and 4.*

Section 58 — Passenger ropeways and similar equipment

SCOPE

58-000 Scope (see Appendix B)

1) This Section applies to passenger ropeways as defined in the CSA Z98 passenger ropeways standard, including

   a) tramways;

   b) chairlifts;

   c) gondolas;

   d) surface ropeways;

   e) passenger conveyors; and

   f) similar equipment.

2) This Section supplements or amends the general requirements of this Code.

APPENDIX B - Rule 58-000

For further information, consult the following:

a) CSA Z98, Passenger Ropeways and Passenger Conveyors;

b) ANSI B77.1, Passenger Ropeways — Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors — Safety Standard; and

c) CSA C22.3 No. 1, Overhead Systems.

GENERAL

58-002 Special terminology

In this Section, the following definitions shall apply:

CABIN — an enclosed or semi-enclosed carrier for transporting passengers, excluding bubble chairs.

PASSENGER CONVEYOR — a device using a moving flexible element to transport persons uphill for recreational or sport activities.

STATION — a location at which loading and/or unloading may take place.

GENERAL REQUIREMENTS

58-010 Working clearances

1) The headroom in working spaces around controllers, disconnecting means, and other electric equipment shall be not less than 2.0 m.

2) Notwithstanding Subrule 1) and Rule 2-308, headroom shall be permitted to be unrestricted where

   a) conditions of maintenance and supervision ensure that only authorized persons have access to such areas;

   b) working space is kept clear of obstructions; and

   c) one or more of the following requirements is met:

      i) live parts of the equipment are suitably guarded, isolated, or insulated, and the equipment can be examined, adjusted, serviced, or maintained while energized without removal of this protection;

      ii) a cautionary label is applied to the electric equipment advising that the electric equipment is not to be examined, adjusted, serviced, or maintained while energized; or

      iii) voltage applied to unguarded or uninsulated parts shall not exceed 30 V rms or 42 V peak.

58-012 Grounding of circuits of less than 50 V

Circuits of less than 50 volts-to-ground shall be grounded in accordance with Rule 10-206 3), except that

   a) ungrounded isolated haul ropes shall be permitted for communication, control, remote control, monitoring, supervision, and signal circuits; and

   b) communication, control, remote control, monitoring, supervision, and signal circuits shall be permitted to be isolated, provided that they are grounded in accordance with Rule 10-212.