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ULC/ORD-C1076-M1986

PROPRIETARY BURGLAR
ALARM UNITS
AND SYSTEMS



Underwriters' Laboratories of Canada

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Underwriters' Laboratories of Canada,
7 Crouse Road,
Scarborough, Ontario.
M1R 3A9

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**PROPRIETARY BURGLAR
ALARM UNITS AND SYSTEMS**

Prepared and Published by
UNDERWRITERS' LABORATORIES OF CANADA



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UNDERWRITERS' LABORATORIES OF CANADA

FOREWORD

Certification organizations are periodically called upon to respond promptly to a need to provide a certification service for devices, constructions, materials and systems for which no recognized standards of acceptance are available. Accordingly, the certification agency draws upon its experience, existing specifications and requirements in related areas, together with assistance from its advisory councils to develop and prepare an "Other Recognized Document" (ORD) for use in conducting the necessary tests and evaluation investigation.

Underwriters' Laboratories of Canada has over the years prepared many ORD's in response to requests from, and in conjunction with, industry, code writing bodies, regulatory agencies and others prior to inaugurating a certification programme. In many instances such documents have become published ULC Standards and subsequently National Standards of Canada. It is the intention of Underwriters' Laboratories of Canada to continue this practice, as appropriate.

Comments on the content of this ORD should be directed to the Head Office of Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, CANADA, M1R 3A9.

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UNDERWRITERS' LABORATORIES OF CANADA

General Offices and Testing Station 7 CROUSE ROAD SCARBOROUGH, ONTARIO CANADA M1R 3A9

Telephone (416) 757-3611 Fax (416) 757-9540

ULC/ORD-C1076-M1986

In Reply,
Please Refer to

PROPRIETARY BURGLAR ALARM

UNITS AND SYSTEMS

PREFACE

This is the First Edition of ULC/ORD-C1076M, entitled "Proprietary Burglar Alarm Units and Systems".

A product which complies with these requirements will not necessarily be acceptable, if, when examined and tested, it is found to have features not covered by the document which may impair the result contemplated by these requirements.

A product employing materials or having forms of construction differing from those detailed in these requirements may be examined and tested according to the intent of the requirements, and if found to be substantially equivalent, may be given recognition.

These requirements are written in SI Units and has been prepared to accommodate metric conversion in Canada. Although this Edition is generally in soft-converted and rounded metric units, where new metric sizes of products have been established, such sizes are included in the document. An Appendix of equivalent Imperial Units is included for information purposes only.

GENERAL

1. SCOPE

1.1 These requirements apply to the construction, performance and operation of equipment intended for use in proprietary burglar alarm units and systems employed to protect against burglary. These products are normally intended for indoor use.

1.2 A proprietary burglar alarm system as referred to by these requirements is a system in which alarm initiating circuits and devices are installed at a property and are connected directly or indirectly to constantly monitored receiving equipment at a central supervising station. The central supervising station is located at the protected property and intended for operation by personnel responsible to the owner of the protected property. The protected property may consist of a single property or of noncontiguous properties under a single ownership. The system is arranged so that a predetermined change in the alarm initiating circuits or devices automatically causes transmission of an alarm signal over a supervised signalling channel to the central supervising station.

1.3 These systems normally operate within the limits of Class 2 remote-control and signal circuits as defined by Section 16 of the Canadian Electrical Code, Part 1.

1.4 Proprietary systems are classed as Grade A or Grade B. In a Grade A system, the protection circuit must respond to both an increase and a decrease in the circuit resistance or current within the limits indicated in the appropriate sections of this Guide. See Clauses 52.3, 56.2, and 60.6. A Grade B system need not comply with these limitations, but must provide supervision of the protection circuit.

1.5 A Grade A system that provides line security shall be classed as Grade AA. A Grade B system that provides line security shall be classed as Grade BB. See Line Security, Section 63.

1.6 Regardless of the grade of equipment and protection service determined by this Guide, protective devices installed on individual properties are further classified as to extent of protection at each location. Rules covering installation and classification (of extent) of alarm protective equipment at individual locations are published in the requirements of Installation and Classification of Mercantile and Bank Burglar Alarm Systems, ULC-S302, which should be consulted by burglar alarm installers.

1.7 Proprietary burglar alarm units and systems are also specially designated as to their intended use on mercantile premises, mercantile safes and vaults, and bank safes and vaults.

1.8 Equipment intended for combination burglar alarm and fire-protective signalling systems shall comply with the requirements of the Standard for Control Units for Fire Alarm Systems, ULC-S527.

2. GLOSSARY

2.1 For the purpose of these requirements, the following definitions apply.

2.2 CIRCUITS, ELECTRICAL:

A HIGH-VOLTAGE - A circuit involving a potential of not more than 300 V and having circuit characteristics in excess of those of a low-voltage power limited circuit.

B LOW-VOLTAGE (Power Limited) - A circuit involving a potential of not more than 30 Vrms (42.4 V peak) and providing not more than 100 VA rated output. The power limitation shall be provided by the construction of the transformer, a fixed impedance, a non-interchangeable fuse, a nonadjustable manual reset circuit protective device, or a regulating network.

2.3 CORD-CONNECTED UNIT - A unit intended for connection to the power source by means of a supply cord. By the nature of its construction, such a unit is intended to be moved for reasons of interchange or realignment of the units of a system.

2.4 LINE-VOLTAGE - The voltage at any field connected source of supply, nominally 50 to 60 Hz; 115, 208, or 230 V.

2.5 NORMAL STANDBY CONDITION - The ready-to-operate condition which exists prior to being tripped or operated by an intrusion.

2.6 RADIO FREQUENCY - Electromagnetic radiation normally 20 kilohertz (kHz) or higher.

2.7 "SAFETY" CIRCUIT - Any circuit that is relied upon to reduce the risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons (an interlock circuit, for example).

2.8 SECONDARY BATTERY - Any battery which, by construction, is intended to be recharged.

3. GENERAL

3.1 The term "product" as used in this Guide refers to all types of proprietary burglar alarm units and systems.

3.2 Unless otherwise indicated, all voltage and current values mentioned in this Guide are root-mean-square (rms).

3.3 A component of a product covered by this Guide shall comply with the requirements for that component and shall be used in accordance with its recognized rating and other limitations of use. A component need not comply with a specific requirement that involves a feature or characteristic not needed in the application of the component in the product covered by this Guide, or superseded by a requirement in this Guide.

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4. INSTALLATION AND OPERATING INSTRUCTIONS

4.1 A copy of the installation and operating instructions intended to accompany the product and related schematic wiring diagrams and installation drawings are to be furnished with the sample submitted for investigation to be used as a guide in the examination and test of the product, and for this purpose need not be in final printed form.

4.2 The instructions and drawings shall include at least the following:

- A Typical installation drawing layouts and complete representative installation wiring diagram(s) for the product(s) indicating recommended locations and wiring methods which shall be in accordance with the Canadian Electrical Code, Part I;
- B A concise description of the operation, testing, and maintenance procedures for the product(s), and recommended testing frequency (which shall be at least once per year);
- C Replacement parts, such as lamps or batteries, shall be identified in the instructions by a part number, manufacturer's model number, or the equivalent;
- D A description of the conditions which might be expected to result in false alarms or impaired operation of the product(s); and
- E A description of any features provided to protect against electric shock or risk of fire, and a warning against bypassing such features.

4.3 The instructions may be incorporated on the inside of the product, on a separate sheet, or as part of a manual. If not included directly on the product, the instructions or manual shall be referenced in the marking information on the product. See Marking, Section 66.

CONSTRUCTION

ASSEMBLY

5. GENERAL

Product Assembly

5.1 The product shall be factory-built as a complete assembly and shall include all the essential components necessary for its intended function when installed (used) as intended. The product may be shipped from the factory as two or more major subassemblies. See Clause 5.2.

5.2 If the product is not assembled by the manufacturer as a complete unit, it shall be arranged in major subassemblies. Each subassembly shall be capable of being incorporated into a final assembly without requiring alteration, cutting, drilling, threading, welding, or similar tasks by the installer. Two or more subassemblies, which must bear a definite relationship to each other for the correct installation or operation of the product, shall be arranged and constructed to permit them to be incorporated into the complete assembly only in the correct relationship with each other without need for alteration or alignment, or such subassemblies shall be assembled, tested, and shipped from the factory as one element.

Electrical Protection

5.3 Louvers and other openings in the enclosure shall be constructed and located to prevent unintentional contact with uninsulated high-voltage live parts. In determining compliance with this requirement, parts such as covers, panels and grilles used as part of the enclosure are to be removed unless tools are required for their removal or an interlock is provided.

5.4 Uninsulated high-voltage live parts shall be located, guarded, or enclosed as indicated in Clauses 5.5 to 5.7.

5.5 Openings directly over uninsulated high-voltage live parts shall not exceed 5 mm in any dimension unless the configuration is such that direct entry to uninsulated high-voltage live parts is prevented. See also Clause 7.8.

5.6 An opening in an electrical enclosure shall not permit entrance of a 25 mm diameter rod and shall be sized and so arranged that a probe, as illustrated in Figure 1, cannot be made to contact any uninsulated live electrical part (other than low-voltage) when inserted through the opening in a straight or articulated position.

5.7 An opening that permits entrance of a 25 mm diameter rod is acceptable under the conditions described in Figure 2.

6. PROTECTION OF SERVICE PERSONNEL

6.1 An uninsulated live part of a high-voltage circuit within the enclosure shall be located, guarded, or enclosed so as to minimize the likelihood of accidental contact by persons performing service functions which may be performed with the equipment energized.

6.2 During the examination of a product in connection with the requirements in Clause 6.1, a part of the outer enclosure which may be removed without the use of tools, or part of the outer enclosure which may be removed by the user to allow access for making normal operating adjustments, is to be disregarded; that is, it will not be assumed that the part in question affords protection against electric shock.

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6.3 An electrical component which may require examination, replacement, adjustment, servicing, or maintenance with the product energized shall be located and mounted with respect to other components and with respect to grounded metal so that it is accessible for such service without subjecting the serviceman to the likelihood of electric shock from adjacent uninsulated high-voltage live parts.

6.4 The following are not considered to be uninsulated live parts: coils of relays and solenoids, and transformer windings, if the coils and windings are provided with insulating over-wraps rated for the potentials encountered; terminals and splices with insulation rated for the potential encountered; and insulated wire.

7. ENCLOSURES

General

7.1 The frame and enclosure of a product shall have the strength and rigidity to resist total or partial collapse and the attendant reduction of spacings, loosening or displacement of parts, or other defects. See Mechanical Strength Tests for Enclosures, Section 49.

7.2 Operating parts, such as gear mechanisms, light-duty relays, and similar devices, shall be enclosed to protect against malfunction from dust or from other material which may impair their intended operation.

7.3 An enclosure containing other than power limited circuits shall be constructed to minimize the possibility of emission of flame, molten metal, flaming or glowing particles, or flaming drops. See Ignition Through Bottom-Panel Openings Tests, Section 48.

7.4 The requirement in Clause 7.3 necessitates either a nonflammable bottom in accordance with Clause 7.9, or a protective barrier as described in Figure 3 under all areas containing combustible materials.

EXCEPTION: See Clause 7.10.

7.5 A construction employing individual barriers under components, groups of components, or assemblies, as specified in Figure 3 is to be considered as complying with the requirement in Clause 7.3.

Doors and Covers

7.6 An enclosure cover shall be hinged, sliding, or similarly attached so as to prevent its being removed if it gives access to fuses or any other overcurrent protective device, the intended functioning of which requires renewal, or if it is necessary to open the cover in connection with the intended operation of the unit.

EXCEPTION: If its position is supervised by a tamper contact which is connected in the closed protective circuit, an enclosure need not comply with the requirements of this clause. See also Clause 29.5.

7.7 Fasteners requiring the use of a tool or key shall be used for all enclosures if access is not required for operation of the product.

Enclosure Openings

7.8 Openings in the enclosure shall be so constructed and of such size that direct entry of foreign objects is prevented. See also Clause 5.5. See Figure 4 for examples of top cover designs that are deemed to prevent direct entry. See also Figure 5 for side openings.

7.9 Openings may be provided in the bottom panels or protective pans under areas containing materials not classified as 0.6V-1, in accordance with the CSA Standard C22.2 No. 0.6-M1982, Flammability Testing of Polymeric Materials, if constructed in a manner that prevents materials from falling directly from the interior of the product onto the supporting surface or any other location under the product. Figure 6 illustrates a type of baffle that meets this requirement. A second construction that meets this requirement is a 1.02 mm sheet-steel bottom panel in which 1.0 mm maximum, round holes are spaced no closer together than 3 mm centre-to-centre. Constructions other than these two are acceptable if they comply with the Ignition Through Bottom-Panel Openings Tests, Section 48.

7.10 The bottom of the enclosure under areas containing only materials classified as 0.6V-1 or better, may have openings not larger than 40 mm².

7.11 Openings are acceptable, without limitation of the size or number of openings, in areas containing only PVC, TFE, CTFE, FEP, and neoprene insulated wire or cable, in areas containing plugs and receptacles, and in areas underneath impedance protected or thermally protected motors.

7.12 Openings in the enclosure shall not give access to any relays, terminals, controls, or related components that might be subject to tampering by hand or with tools.

Screens and Expanded Metal

7.13 Screens and expanded metal used as a guard, enclosure, or part of an enclosure, shall comply with the requirements of Clauses 7.14 and 7.15 and with the Mechanical Strength Tests for Enclosures, Section 49.

7.14 Perforated sheet steel and sheet steel employed for expanded metal mesh shall be not less than 1.07 mm in thickness [1.17 mm if zinc coated] if the mesh openings or perforations are 320 mm² or less in area, and shall be not less than 2.03 mm in thickness [2.13 mm if zinc coated] for larger openings. The largest dimension shall not exceed 100 mm.

EXCEPTION: If the indentation of a guard or the enclosure will not alter the clearance between uninsulated live parts and grounded metal so as to impair performance or reduce spacings below the minimum required values, see Spacings,

General, Section 22, 0.53 mm expanded steel mesh or perforated sheet steel [0.58 mm if zinc coated] may be employed, provided that the exposed mesh on any one side or surface of the product is protected has an area of not more than 465 cm² and has no dimension greater than 300 mm, or that the width of an opening so protected is not greater than 90 mm.

7.15 The wires of a screen shall be not less than No. 16 AWG steel if the screen openings are 320 mm² or less in area, and shall be not less than No. 12 AWG steel for larger screen openings.

Cast Metal

7.16 The thickness of cast metal for an enclosure shall be as indicated in Table 1.

EXCEPTION: Cast metal of lesser thickness may be employed if, consideration being given to the shape, size, and function of the enclosure, it provides equivalent mechanical strength. See Mechanical Strength Tests for Enclosures, Section 49.

TABLE 1

CAST-METAL ENCLOSURES

Use, or Dimensions of Area Involved ^a ,	Minimum Thickness	
	Die-Cast Metal, Millimetres	Cast Metal of Other Than the Die-Cast Type, Millimetres
Area of 155 cm ² or less and having no dimension greater than 150 mm	1.6	3.2
Area greater than 155 cm ² or having any dimension greater than 150 mm	2.5	3.2
At a threaded conduit hole	7.0	7.0
At an unthreaded conduit hole	3.2	3.2
^a The area limitation for metal 1.6 mm in thickness may be obtained by the provision of reinforcing ribs subdividing a larger area.		

Sheet Metal

7.17 The thickness of sheet metal for an enclosure shall be not less than that indicated in Table 2 or 3, whichever applies.

EXCEPTION: Sheet metal of lesser thickness may be employed if, consideration being given to the shape, size, and function of the enclosure, it provides equivalent mechanical strength. See Mechanical Strength Tests for Enclosures, Section 49.

7.18 A sheet metal member to which a wiring system is to be connected in the field shall have a thickness of not less than 0.81 mm if of uncoated steel, of not less than 0.86 mm if of galvanized steel, and of not less than 1.14 mm if of nonferrous metal.

Product Enclosure Mounting

7.19 An enclosure shall have means for mounting which shall be accessible without disassembly of any operating part of the product. Removal of a completely assembled panel to mount the enclosure is not considered to be disassembly of an operating part.

Polymeric Materials

7.20 Among the factors taken into consideration when judging the acceptability of a nonmetallic enclosure are: the mechanical strength; resistance to impact; moisture-absorptive properties; flammability and resistance to ignition from electrical sources; dielectric strength, insulation resistance, and resistance to arc tracking; and resistance to distortion and creeping at temperatures to which the material may be subjected under any conditions of use. All these factors are considered with respect to aging in accordance with the Polymeric Materials Test, Section 45, and Mechanical Strength Tests for Enclosures, Section 49.

Electric Shock

7.21 Any part that is exposed only during operator servicing shall not present the risk of electric shock. See Electric Shock Current Test, Section 34.

7.22 Each terminal provided for the connection of an external antenna shall be conductively connected to the supply circuit grounded conductor. The conductive connection shall have a maximum resistance of 5.2 M Ω , a minimum wattage rating of 1/2 W, and shall be effective with the power switch in either the on or off position.

TABLE 2

MINIMUM THICKNESS OF SHEET METAL FOR ENCLOSURES
CARBON STEEL OR STAINLESS STEEL

Without Supporting Frame ^a		With Supporting Frame or Equivalent Reinforcing ^a		Minimum Thickness	
Maximum Width ^b , Millimetres	Maximum Length ^c , Millimetres	Maximum Width ^b , Millimetres	Maximum Length, Millimetres	Uncoated, Millimetres	Metal Coated Millimetres
102 121	Not limited 146	159 172	Not Limited 210	0.52	0.59
152 178	Not limited 222	241 254	Not Limited 318	0.68	0.75
203 229	Not limited 292	305 330	Not Limited 406	0.78	0.88
318 356	Not limited 457	495 533	Not Limited 635	1.02	1.16
457 508	Not limited 635	686 737	Not Limited 914	1.34	1.43
559 635	Not limited 787	838 889	Not Limited 1092	1.52	1.62
635 737	Not limited 914	990 1041	Not Limited 1295	1.69	1.79
838 889	Not limited 1194	1295 1372	Not Limited 1676	2.00	2.14
1067 1194	Not limited 1500	1626 1727	Not Limited 2134	2.30	2.47
1321 1524	Not limited 1880	2032 2134	Not Limited 2616	2.73	2.85
1600 1854	Not limited 2286	2464 2616	Not Limited 3226	3.11	3.23

- ^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes a single sheet with single formed flanges (formed edges), or a single sheet which is corrugated or ribbed, or an enclosure surface loosely attached to a frame, for example, with spring clips.
- ^b The width is the smaller dimension of a rectangular sheet metal piece which is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.
- ^c For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 12.5 mm wide.

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TABLE 3
MINIMUM THICKNESS OF SHEET METAL FOR ENCLOSURES
ALUMINUM, COPPER OR BRASS

Without Supporting Frame ^a		With Supporting Frame or Equivalent Reinforcing ^a		
Maximum Width ^b , Millimetres	Maximum Length ^c , Millimetres	Maximum Width ^b , Millimetres	Maximum Length, Millimetres	Minimum Thickness, Millimetres
76 89	Not limited 102	178 216	Not Limited 241	0.58
102 127	Not limited 152	254 267	Not Limited 343	0.74
152 165	Not limited 203	356 381	Not Limited 457	0.91
203 241	Not limited 292	483 533	Not Limited 635	1.14
305 356	Not limited 406	711 762	Not Limited 940	1.47
457 508	Not limited 635	1067 1143	Not Limited 1397	1.91
635 737	Not limited 914	1524 1627	Not Limited 1981	2.41
940 1067	Not limited 1346	2210 2362	Not Limited 2896	3.10
1321 1524	Not limited 1880	3124 3302	Not Limited 4064	3.89

^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes a single sheet with single formed flanges (formed edges), or a single sheet which is corrugated or ribbed, or an enclosure surface loosely attached to a frame, for example, with spring clips.

^b The width is the smaller dimension of a rectangular sheet metal piece which is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

^c For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 12.5 mm wide.

7.23 The conductive connection specified in Clause 7.22 need not be provided if such a connection is established in the event of electrical breakdown of the antenna isolating means, or the breakdown does not result in a risk of electric shock and in a construction employing an isolating power transformer, or the resistance of the conductive connection between the supply circuit and chassis does not exceed $5.2 \text{ M}\Omega$.

7.24 The maximum value of $5.2 \text{ M}\Omega$ specified in Clauses 7.22 and 7.23 is to include the maximum tolerance of the resistor value used; that is, a resistor rated $4.2 \text{ M}\Omega$ with 20% tolerance or a resistor rated $4.7 \text{ M}\Omega$ with a 10% tolerance is acceptable. A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements for antenna isolating capacitors may be rated a minimum of $1/4 \text{ W}$.

7.25 The insertion in any socket of any plug-in component used in the product shall not result in a risk of electric shock.

8. Corrosion Protection

8.1 Iron and steel parts, other than bearings, and the like, where such protection is impracticable, shall be protected against corrosion by enameling, galvanizing, sherardizing, plating, or other equivalent means. Bearing surfaces shall be of such materials and construction as to resist binding due to corrosion.

8.2 The requirement of Clause 8.1 applies to all enclosures of sheet steel or cast iron, and to all springs and other parts upon which intended mechanical operation may depend.

EXCEPTIONS: This requirement does not apply to parts, such as washers, screws, bolts, and the like, if corrosion of such unprotected parts would not be likely to result in a risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons or to impair the operation of the unit.

Parts made of stainless steel, polished or treated, if necessary, do not require additional protection against corrosion.

8.3 Metals used in cabinets and enclosures shall be galvanically compatible.

EXCEPTION: This requirement does not apply if galvanic action does not result in malfunction of the product, risk of fire, electric shock, or unintentional contact with moving parts that can cause injury to persons.

8.4 Hinges and other attachments shall be resistant to corrosion.

FIELD WIRING CONNECTIONS

9. GENERAL

9.1 Wiring terminals or leads shall be provided for connection of conductors of at least the size required by the Canadian Electrical Code, Part 1.

10. CORD CONNECTED PRODUCTS

10.1 A portable product that is intended to be connected to high-voltage or line voltage shall be provided with no less than 1800 mm of flexible cord and a two or three prong attachment-plug of acceptable type and rated for connection to the supply circuit..

EXCEPTION: A cord may be less than 1800 mm in length if it is evident that the use of a longer cord may result in damage to the cord or product, or result in a risk of fire, electric shock, or injury to persons, or is not required for the intended operation of the product.

10.2 A flexible cord is acceptable for use with a stationary product.

10.3 A flexible cord shall be of Type SJ, SJT, or equivalent and shall be no smaller than No. 18 AWG. It shall be rated for use at the voltage and current rating of the product.

10.4 The power supply cord shall be provided with strain relief means so that a stress on the cord will not be transmitted to terminals, splices, or internal wiring. See Strain Relief Test, Section 47.

10.5 If a knot in a flexible cord serves as strain relief, a surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, which may cause abrasion of the insulation on the conductors.

10.6 Clamps of any material (metal or otherwise) are acceptable for use on cords and supply leads without varnished-cloth insulating tubing or the equivalent under the clamp unless the tubing or the equivalent is necessary to prevent the clamp from damaging the cord or supply leads.

10.7 The supply cord or supply leads shall be prevented from being pushed into the unit through the cord-entry hole if such displacement is likely to subject the cord or supply leads to mechanical damage or to exposure to a temperature higher than that for which the cord or supply leads are suitable or is likely to reduce spacings (such as to a metal strain-relief clamp) below the minimum acceptable values or is likely to damage internal connections or components.

11. PERMANENTLY CONNECTED PRODUCTS

General

11.1 A fixed product shall have provision for connection of one of the wiring systems that, in accordance with the Canadian Electrical Code, Part 1, would be suitable for it.

11.2 A knockout provided for connection of a field-wiring system to a field-wiring compartment shall accommodate conduit of the size required by the Canadian Electrical Code.

11.3 The location of a terminal box or compartment in which power supply connections are to be made shall be such that the connections are to be accessible without removing parts other than a service cover or panel and the cover of the outlet box or compartment in which the connections are made.

11.4 A terminal compartment intended for the connection of a supply raceway shall be secured in position and shall be prevented from turning.

11.5 The product shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity not less than that required by the product. It is assumed that branch circuit conductors rated 60°C will be used.

Field Wiring Terminals

General

11.6 As used in these requirements, field-wiring terminals are those terminals to which power supply (including equipment grounding) or control connections will be made in the field when the product is installed.

11.7 A field-wiring terminal shall be prevented from turning or shifting in position. This may be accomplished by means such as two screws or rivets; by square shoulders or mortices; by a dowel pin, lug, or offset; or by a connecting strap or clip fitted into an adjacent part. Friction between surfaces is not acceptable for preventing movement of the terminals.

General Application

11.8 Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for No. 8 AWG and larger wires. If the connectors or lugs are secured to a plate, the plate thickness shall be not less than 1.3 mm. Securing screws may be plated steel.

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11.9 A wire binding screw intended for connection of the power supply (line voltage) source shall be not smaller than No. 10. The screw may be of plated steel.

EXCEPTION: A No. 8 screw may be used for the connection of one No. 14 AWG and a No. 6 screw may be used for the connection of a No. 16 AWG or smaller conductor.

11.10 For connection of other than power supply (line voltage) circuits using No. 10 AWG and smaller wires, a wire binding screw shall be not smaller than No. 8, except that a No. 6 screw may be employed for the connection of a No. 14 AWG or smaller conductor and a No. 4 screw may be used for a No. 19 AWG or smaller conductor.

11.11 Terminal plates tapped for wire binding screws shall:

A Have not less than two full threads in the metal (the terminal plate metal may be extruded to provide the two full threads) and shall have upturned lugs, clamps, or the equivalent to hold the wires in position. Other constructions may be employed if they provide equivalent thread security of the wire binding screw.

B Be of a nonferrous metal not less than 1.3 mm in thickness for a No. 8 or larger screw, and not less than 0.76 mm in thickness for a No. 6 or smaller screw.

11.12 If two or more conductors are intended to be connected by wrapping under the same screw, a nonferrous intervening metal washer shall be employed for each additional conductor. A separator washer is not required if two conductors are separated and intended to be secured under a common clamping plate. If the wires protrude above terminal barriers, the nonferrous separator shall include means, such as upturned tabs or sides, to retain the wire.

Qualified Application

11.13 Any of the following terminal configurations may be employed for connection of field wiring provided all of the conditions in Clause 11.14 are met:

A Telephone Type Terminals - Nonferrous terminal plates employing a narrow V-shaped slot for securing of a conductor in a special post design. Requires special tool for wire connection;

B Solderless Wrapped Terminals - Solderless wrapped nonferrous terminals which require a special tool and terminal post construction;

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- C Quick-Connect Terminals - Nonferrous quick-connect (push-type) terminals consisting of male posts permanently secured to the device and provided with compatible female connectors for connection to field wiring. Requires special tool for crimping of field wires. Mating terminals shall be shipped with the product with instructions for their installation;
- D Push-In Terminals - Nonferrous (screwless) push-in terminals of the type employed on some switches and receptacles. Solid conductors are pushed into slots containing spring type contacts. The leads can be removed by means of a tool inserted to relieve the spring tension on the conductor. Push-in terminals are not considered suitable for use with aluminum conductors. The marking adjacent to the terminal shall indicate that copper conductors only are to be used;
- E Solder Terminals - Conventional nonferrous solder terminals; and
- F Other Terminals - Other terminal connections may be employed if found to be equivalent to items A through E of this Clause and limited to the same restrictions.

11.14 Any of the terminal configurations listed in Clause 11.13 may be employed for connection of field wiring provided all of the following indicated conditions are met:

- A If a special tool is required for connection, its use shall be indicated on the installation wiring diagram by name of manufacturer and model number or equivalent, along with information as to where the tool may be obtained;
- B The range of wire sizes shall be indicated on the installation wiring diagram. The minimum permissible wire size to be employed shall be not less than No. 22 AWG;
- C The wire size to be employed shall have the current-carrying capacity for the circuit application; and
- D The terminal configuration shall comply with the requirements of the Special Terminal Assemblies Tests, Section 50.

Field Wiring Leads

11.15 If leads are provided in lieu of wiring terminals, they shall be not less than 150 mm long, and shall be not smaller than No. 22 AWG.

EXCEPTION: The lead may be less than 150 mm in length if it is evident that the use of a longer lead may result in damage to the lead insulation or product, or result in an electric shock, a risk of fire or accident, or is not required for the intended operation of the product.

11.16 For connection of a line-voltage source, the leads shall be not smaller than No. 18 AWG.

11.17 Leads intended for connection to an external circuit shall be provided with a strain relief means if stress on the lead may be transmitted to terminals, splices or internal wiring. (See Strain Relief Test, Section 47.)

Polarity Identification

11.18 In a product intended to be connected to a grounded circuit, one terminal or lead shall be identified for the connection of the grounded conductor. The identified terminal or lead shall be the one which is connected to the screw shells of lampholders and to which no primary overcurrent-protective devices of the single-pole type are connected.

11.19 A terminal intended for the connection of grounded supply conductor shall be composed of or plated with metal that is substantially white in colour and shall be distinguishable from the other terminals, or identification of the terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded power-supply conductor shall be finished to show a white or natural gray colour and shall be distinguishable from the other leads.

12. GROUNDING

12.1 A grounding means shall be provided for all equipment containing parts which require grounding. See Bonding for Grounding, Section 16.

12.2 The following are considered to constitute means for grounding:

- A In a product intended to be permanently connected by a metal enclosed wiring system, a knockout or equivalent opening in the metal enclosure of the product;
- B In a product intended to be permanently connected by a nonmetallic enclosed wiring system, such as nonmetallic-sheathed cable, an equipment grounding terminal or lead; and
- C In a cord-connected product, an equipment grounding conductor in the cord.

12.3 On a permanently-connected product, a terminal intended solely for the connection of an equipment grounding conductor shall be capable of securing a conductor of the size suitable for the particular application in accordance with the Canadian Electrical Code, Part 1.

12.4 A soldering lug, a push-in, a screwless connector, or a quick-connect or similar friction fit connector shall not be used for the grounding terminal intended for the connection of field supply connections or for the grounding wire in a supply cord.

12.5 On a permanently-connected product, a wire binding screw intended for the connection of an equipment grounding conductor shall have a green coloured head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked "G", "GR", "GROUND" or "GROUNDING", or the like, or by a marking on a wiring diagram provided on the product. See also Clause 12.6. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the product and shall be located so that it is unlikely to be removed during service operations such as replacing fuses, resetting manual-reset devices, or the like.

12.6 If a pressure wire connector intended for grounding is located where it could be mistaken for a neutral conductor of a grounded supply, it shall be identified by a marking "EQUIPMENT GROUND" and/or with a green colour identification.

12.7 On a permanently-connected product, the surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be finished in a continuous green colour or a continuous green colour with one or more yellow stripes, and no other lead shall be so identified.

12.8 On a cord-connected product, the grounding conductor of the flexible cord shall be finished with a continuous green colour or with a continuous green colour with one or more yellow stripes, and no other conductor shall be so identified. The grounding conductor shall be secured to the frame or enclosure of the product by a positive means, see Bonding for Grounding, Section 16, that is not likely to be removed during any servicing operation not involving the power supply cord. The grounding conductor shall be connected to the grounding blade of the attachment plug.

INTERNAL WIRING

13. GENERAL

13.1 Internal wiring shall have thermoplastic or rubber insulation not less than 0.4 mm thick for 0 to 300 V applications if: power is less than 375 VA; current is less than 5 A; and the wiring is not subject to flexing or mechanical abuse. Otherwise, thermoplastic or rubber insulation not less than 0.8 mm thick and rated 300 V shall be used. Other insulating material of lesser thickness may be used if it is equivalent.

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13.2 Leads or a cable assembly connected to parts mounted on a hinged cover shall be of sufficient length to permit the full opening of the cover without applying stress to the leads or their connections. The leads shall be secured or equivalently arranged to prevent abrasion of insulation and jamming between parts of the enclosure.

13.3 Insulation, such as coated fabric and extruded tubing, shall not be affected physically or electrically by the temperature or other environmental conditions to which it may be subjected in intended use.

13.4 Wireways shall be smooth and entirely free from sharp edges, burrs, fins, moving parts, and the like, which may cause abrasion of the conductor insulation. Holes in sheet metal walls through which insulated wires pass shall be provided with a bushing if the wall is 1.07 mm or less in thickness. Holes in walls thicker than 1.07 mm shall have smooth, rounded edges.

14. WIRING METHODS

14.1 All splices and connections shall be mechanically secure and bonded electrically.

14.2 Stranded conductors clamped under wire-binding screws or similar parts shall have the individual strands soldered together or equivalently arranged.

14.3 A splice shall be provided with insulation equivalent to that of the wires involved.

14.4 A printed-wiring assembly employing insulating coatings or encapsulation shall be tested for dielectric voltage withstand before and after being treated. If it is impractical to use untreated samples, finished samples shall be subjected to the Dielectric Voltage Withstand Test, Section 40, after they are subjected to the Humidity Test, Section 33; Temperature Test, Section 41, and other applicable tests described in this Guide.

14.5 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent which shall provide a smooth, rounded surface against which the cord may bear.

14.6 If the cord hole is in phenolic composition or other nonconducting material, or in metal not less than 1.07 mm in thickness, a smooth, rounded surface is considered to be the equivalent of a bushing.

14.7 Ceramic materials and some moulded compositions are acceptable for insulating bushings.

14.8 Fibre may be employed where it will not be subjected to a temperature higher than 90°C under intended operating conditions if the bushing is not less than 1.2 mm in thickness and if it will not be exposed to moisture.

14.9 A soft rubber bushing may be employed in the frame of a motor if the bushing is not less than 1.2 mm in thickness and if the bushing is so located that it will not be exposed to oil, grease, oily vapor, or other substance which may have a deleterious effect on rubber. If a soft rubber bushing is employed in a hole in metal, the hole shall be free from sharp edges, burrs, projections, and the like, which would be likely to cut into the rubber.

14.10 An insulating-metal grommet may be considered to be acceptable in lieu of an insulating bushing, provided that the insulating material used is not less than 0.8 mm in thickness and completely fills the space between the grommet and the metal in which it is mounted.

15. SEPARATION OF CIRCUITS

15.1 Internal wiring of circuits which operate at different potentials shall be separated by barriers, clamps, routing, or other equivalent means, unless all conductors are provided with insulation which is rated for the highest potential involved.

15.2 If a barrier is used to provide separation between the wiring of different circuits, it shall be of metal or of insulating material. A barrier of insulating material shall be not less than 0.71 mm thick. Any clearance between the edge of a barrier and a compartment wall shall be not more than 1.6 mm.

16. BONDING FOR GROUNDING

16.1 In a high-voltage product, provision shall be made for the grounding of all exposed or accessible noncurrent-carrying metal parts which are likely to become energized and which may be contacted by the operator or by service personnel during service operations likely to be performed when the product is energized.

16.2 Uninsulated metal parts, such as cabinets, electrical enclosures, capacitors and other electrical components, are to be bonded for grounding if they may be contacted by the operator or serviceman, except as indicated in Clause 16.3.

16.3 Metal parts described as follows need not be grounded:

- A Adhesive-attached metal-foil markings, screws, handles, and the like, which are located on the outside of enclosures or cabinets and isolated from electrical components or wiring by grounded metal parts so that they are not likely to become energized;

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- B Isolated metal parts, such as small assembly screws, which are positively separated from wiring and uninsulated live parts;
- C Cabinets, panels and covers which do not enclose uninsulated live parts if wiring is positively separated from the cabinet, panel or cover so that it is not likely to become energized; and
- D Panels and covers which are insulated from electrical components and wiring by an insulating barrier of vulcanized fibre, varnished cloth, phenolic composition, or similar materials not less than 0.71 mm in thickness, and secured in place. If material having a lesser thickness is used, consideration is to be given to such factors as its electrical, mechanical and flammability properties when compared with materials in thicknesses specified above.

16.4 The metal enclosure of a product having a slide-out chassis is considered to be grounded if the resistance between the point of connection of the equipment grounding means and enclosure does not exceed 0.1 ohm. Unless a separate grounding conductor is used, this will require that all non-conductive coatings between the enclosure and equipment grounding means be penetrated when the chassis is inserted in the enclosure. In such cases, metal-to-metal contact must be maintained at any point of insertion or withdrawal of the chassis.

16.5 Metal-to-metal hinge bearing members for a door or cover are considered to be a means for bonding a door or cover for grounding if a minimum of two pin-type hinges with a minimum of three knuckles each are employed.

16.6 A separate component bonding conductor shall be of copper, a copper alloy or other material acceptable for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by metallic or non-metallic coatings, such as enameling, galvanizing or plating. A separate bonding conductor or strap shall be protected from mechanical damage or be located within the confines of the outer enclosure or frame, and not be secured by a removable fastener used for any purpose other than bonding for grounding unless the bonding conductor is unlikely to be omitted after removal and replacement of the fastener.

16.7 The bonding shall be by a positive means, such as clamping, riveting, bolted or screwed connection, welding, or soldering and brazing materials having a softening or melting point greater than 445°C. The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel. Bonding around a resilient mount shall not depend on the clamping action of rubber or other nonmetallic material.

EXCEPTION: See Clause 16.10.

16.8 With reference to Clause 16.7, a bolted or screwed connection that incorporates a star washer under the screwhead or a serrated screwhead is acceptable for penetrating nonconductive coatings. If the bonding means depends upon screw threads, two or more screws or two full threads of a single screw shall engage the metal.

16.9 An internal connection for bonding internal parts to the enclosure for grounding, but not for a field installed grounding conductor or for the grounding wire in a supply cord, may employ a quick-connect terminal of the specified dimensions if the connector is not likely to be displaced and the component is limited to use on a circuit having a branch circuit protective device, rated as follows:

<u>Terminal Dimensions, Millimetres</u>	<u>Rating of Protective Device, Amperes</u>
0.51 by 4.75 by 6.4	20 or less
0.81 by 4.75 by 6.4	20 or less
0.81 by 5.2 by 6.4	20 or less
0.81 by 6.4 by 7.9	60 or less

16.10 A connection that depends upon the clamping action exerted by rubber or other nonmetallic material may be acceptable if it complies with Clause 16.14 under any normal degree of compression permitted by a variable clamping device and if the results are still acceptable after exposure to the effects of oil, grease, moisture, and thermal degradation which may occur in service. Also, the effect of assembling and disassembling such a clamping device for maintenance purposes is to be considered, with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

16.11 On a cord-connected product, a bonding conductor or strap shall have a cross-sectional area not less than that of the grounding conductor of the supply cord.

EXCEPTION: See Clauses 16.14 and 16.15.

16.12 On a permanently-connected product, the size of a conductor employed to bond an electrical enclosure shall be based on the rating of the branch circuit overcurrent device to which the equipment will be connected.

16.13 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in 16.12, is considered acceptable.

16.14 A bonding conductor to an electrical component need not be larger than the size of the conductors supplying the component.

16.15 Splices shall not be employed in wire conductors used to bond electrical enclosures or electrical components.

16.16 If more than one size branch circuit overcurrent protection device is involved, the size of the bonding conductor is to be based on the rating of the overcurrent device intended to provide ground-fault protection for the component bonded by the conductor. For example, if a component is individually protected by a branch circuit overcurrent device smaller than other overcurrent devices used with the equipment, a bonding conductor for that component is sized on the basis of the overcurrent device intended for ground-fault protection of the component.

16.17 The continuity of the grounding system of the product shall not rely on the dimensional integrity of nonmetallic material.

ELECTRICAL COMPONENTS

17. GENERAL

Mounting of Components

17.1 A switch, lampholder, attachment-plug, connector base, or similar electrical component shall be secured in position and, except as noted in the following clauses, shall be prevented from turning.

17.2 In the mounting or supporting of small, fragile, insulating parts, screws or other fastenings shall not be tight enough to cause cracking or breaking of those parts with expansion and contraction. Generally, such parts should be slightly loose.

17.3 The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

- A The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch;
- B The means for mounting the switch makes it unlikely that the operation of the switch will loosen it;
- C Spacings are not reduced below the minimum required values if the switch rotates; and
- D The operation of the switch is by mechanical means rather than by direct contact by persons.

17.4 A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation will not reduce spacings below the minimum required values.

17.5 Uninsulated live parts shall be so secured to the base or mounting surface that they will be prevented from turning or shifting in position, if such motion may result in a reduction of spacings below the acceptable values. (The securing of contact assemblies shall provide for the continued alignment of contacts.)

17.6 The means for preventing turning is to consist of more than friction between surfaces.

17.7 Uninsulated live parts shall be so secured to the base or mounting surface that they will be prevented from turning or shifting in position, if such motion may result in a reduction of spacings below the acceptable values. (The securing of contact assemblies shall provide for the continued alignment of contacts.)

17.6 The means for preventing turning is to consist of more than friction between surfaces.

17.7 A lock washer which provides both spring takeup and an interference lock is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

17.8 A flush plate for outlet-box mounting shall be of 0.76 mm or thicker ferrous metal, of 1.01 mm or thicker non-ferrous metal, or of 2.54 mm or thicker nonconductive material.

17.9 A yoke or strap or the mounting ears of a part intended to be mounted on a standard outlet box or similar back box shall be of 1.02 mm or thicker steel. If a nonferrous metal is used, it shall be of thickness sufficient to provide mechanical strength and rigidity not less than that of 1.02 mm thick steel.

Insulating Materials

17.10 Insulating materials used for a base for the support of live parts shall be of a nonflammable, moisture-resistant insulating material, such as porcelain, phenolic or cold-moulded composition, or the equivalent.

17.11 A base mounted on a metal surface shall be provided with an insulating barrier between the mounting surface and all live parts on the underside of the base which are not staked, upset, sealed, or equivalently prevented from loosening so as to prevent such parts and the ends of replaceable terminal screws from coming in contact with the supporting surface.