

INTRUSION DETECTION UNITS



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The intended primary application of this Standard is stated in its scope. It is important to note that it remains the responsibility of the user of the Standard to judge its suitability for the particular application.

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February 11, 2005

NOTICE OF PARTIAL DEFERRAL

Second Edition of ULC-S306-03, Intrusion Detection Units

Since the release of the 2nd edition of this Standard in December 2003, issues have been identified with regards to the implementation of Subsection 8.3 (Glass Breakage Detector) in the 2nd edition.

Therefore, with the approval of the ULC Committee on Security and Burglar Alarm Equipment and Systems, this Notice of Partial Deferral takes effect immediately as follows:

1. Implementation of the Second edition of ULC-S306-03, Intrusion Detection Units, except for Subsection 8.3 (Glass Breakage Detector); and
2. Deferral of the implementation of Subsection 8.3 (Glass Breakage Detector) from the 2nd edition and reinstatement Subsection 8.3 (Glass Breakage Detector) from the 1st edition of CAN/ULC-S306-M89 (Standard for Intrusion Detection Units) until such time as the ULC Committee on Security and Burglar Alarm Equipment and Systems has resolved the concerns that have been raised. Subsection 8.3 from the 1st edition is attached to this Notice of Partial Deferral.

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Yours truly,

G. Rae Dulmage
Director, Standards Department



8.3 GLASS BREAKAGE DETECTOR

8.3.1 General

8.3.1.1 Glass breakage detectors shall detect breakage of any portion of a glass window(s) it is protecting. The detector may operate on the direct mounting or remote mounting (acoustic) principle.

8.3.1.2 The installation instructions shall specify types and minimum size of glass for which the protection is to be provided.

(Amendment No. 1, Dated May 1992, Revised Clause 8.3.1.2)

8.3.1.3 When installed as intended and adjusted properly, the system shall alarm when the protected glass is given a sharp blow.

(Amendment No. 1, Dated May 1992, Revised Clause 8.3.1.3)

8.3.1.4 The impact produced by a 535 g steel ball striking the centre of an 0.46 m square piece of 3 mm float glass with a 0.4 J impact is acceptable as the point at which the detector SHALL NOT produce an alarm. Any impact greater than 0.4 J MAY produce an alarm and actual glass breakage at any impact level SHALL produce an alarm. The detector is to be set at a minimum sensitivity and the distance from the glass to the detector is 3 m.

8.3.1.5 The unit shall not alarm at least 95 times out of 100 consecutive attempts at the impact specified in Clause 8.3.1.4, with each attempt being conducted at 1 second interval. Allow 15 seconds for the circuitry to stabilize after every twenty attempts.

8.3.1.6 The frame supporting the glass shall be metal and sufficiently substantial so that it will not move when the glass is struck with the ball. The glass shall be held with 1.6 mm neoprene gasket or similar resilient material around and both sides of the glass to ensure that the glass has reasonably even pressure on the clamping surface.

8.3.1.7 A field tester (glass break simulator) shall be provided to facilitate proper field installation. The field tester shall not be adjustable.

(Amendment No. 1, Dated May 1992, Added Clauses 8.3.1.4 through 8.3.1.7)

8.3.2 Sensitivity-Attack Test

8.3.2.1 The alarm point and the breakage point shall be determined by successively greater impacts, each impact not more than 10% greater than the previous impact, beginning with a magnitude which does not cause alarm. Multiple trials shall be performed and the results averaged.

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8.3.3 Stability

8.3.3.1 The system shall demonstrate a high degree of stability with sensitivity equal to or greater than that specified in Clauses 8.3.1.2 and 8.3.1.3.

8.3.3.2 At normal sensitivity the system shall not be adversely affected by noise or building vibration.

8.3.4 Temperature Test

8.3.4.1 Detectors shall be tested at their maximum and minimum rated temperatures for a period of 12 h and the sensitivity and range tests repeated. Detectors intended to be mounted directly on surfaces exposed to outside temperatures shall be tested at -20 to +66°C. The maximum sensitivity reduction shall not be greater than 10% of normal sensitivity.

8.3.5 Adhesive Test

8.3.5.1 Direct mounting devices installed in accordance with the installation instructions the detector shall remain firmly attached when subjected to conditions specified in Clauses 8.3.5.3 through 8.3.5.8.

8.3.5.2 Following each test condition described in Clauses 8.3.5.3 through 8.3.5.7, security of the adhesive bond shall be determined by dropping a 19 by 150 by 300 mm, 370 ±60 g pine board from a height of 300 mm in a direction parallel to the glass so as to impact the side of the sensor. The product shall be allowed to return to room temperature prior to this test.

8.3.5.3 The security of the adhesive bond shall not be impaired by soaking in water at 20 to 25°C for a period of 24 h. Prior to inspecting, the sample shall be removed from the water, mounted vertically and allowed to dry.

8.3.5.4 The security of the adhesive bond shall not be impaired by exposure to a temperature of 66°C for a period of 24 h.

8.3.5.5 The security of the adhesive bond shall not be impaired by exposure to a temperature of -40°C for a period of 24 h.

8.3.5.6 The security of the adhesive bond shall not be impaired by exposure to air at 100% relative humidity, maintained at a temperature of 30 ±2°C for a period of 24 h.

8.3.5.7 The security of the adhesive bond shall not be impaired by the application of window cleaning liquids to the detector and surrounding glass surface. The glass surface shall be mounted in a vertical position and the cleaning liquid applied so as to completely saturate the detector and surrounding glass surface. The cleaning liquid shall not be wiped away, and other applications shall be made, with 5 min between applications, until a total of four applications

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have been made. The test in Clause 8.3.5.2 shall not be conducted for at least 24 h after the last application. The following window cleaning liquids shall be used:

- A Commercial foaming type spray without ammonium hydroxide (NH_4OH);
and
- B Solution of ammonia water consisting of one part of an ammonium hydroxide (NH_4OH) 30 $\pm$ 3% solution with eight parts distilled water.

8.3.5.8 The detector shall be capable of supporting a static load of 220 N applied at the point of contact in a direction parallel to the surface of the glass for a period of 1 min.

8.3.5.9 Partial or complete dislodgement of the detector shall be considered as indicating an inadequate adhesive bond.

8.3.5.10 The requirements of Clauses 8.3.5.2 and 8.3.5.8 shall not apply if electrical supervision is provided so as to initiate an alarm or trouble signal in the event of complete or partial dislodgement of the detector.

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INTRUSION DETECTION UNITS

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REFERENCE PUBLICATIONS

The documents shown below are referenced in the text of this Standard. Unless otherwise stated elsewhere in this Standard such reference shall be considered to indicate the edition and/or revisions of the document available at the date on which the Committee approved this ULC Standard.

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 - C22.2 No. 1, Audio, Video and Similar Electronic Equipment
 - C22.2 No. 21, Cord Sets and Power Supply Cords
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 - CAN/CSA-C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials
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- CAN/ULC-S302, Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults
 - CAN/ULC-S310, Standard for Installation and Classification of Residential Burglar Alarm Systems
 - CAN/ULC-S304, Standard for Central and Monitoring Station Burglar Alarm Units
 - ULC-S318, Standard for Power Supplies for Burglar Alarm Systems
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- MIL-HDBK-217F(2)-February 2, 1995, Reliability Prediction of Electronic Equipment
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INTRUSION DETECTION UNITS

PREFACE

This is the Second Edition of Intrusion Detection Units, ULC-S306-03.

This Edition of the Standard has been formally approved by the ULC Committee on Security and Burglar Alarm Equipment 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 Standard 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.

Only metric SI units of measurement are used in this Standard. If a value for measurement is followed by a value in other units in parentheses, the second value may be approximate. The first stated value is the requirement.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patents rights. Underwriters' Laboratories of Canada shall not be held responsible for identifying any or all such patents rights.

Requests for interpretation of this Standard should be sent to the Standards Department of Underwriters' Laboratories of Canada. The requests should be worded in such a manner as to permit a "yes" or "no" answer based on the literal text of the requirement concerned.

1. SCOPE

1.1 These requirements cover *intrusion detection units* for burglary protection signalling systems to be employed in *outdoor* or ordinary *indoor* (non-hazardous) locations to automatically indicate the presence of an intruder by actuating electrical control circuits.

1.2 An intrusion detector as covered by these requirements consists of one or more unit assemblies of electrical *components* which are designed to detect the presence, movement, sound, or other activity of an intruder. Provision is made for the connection of power supply, remote control, and signal circuits by a prescribed method of wiring.

1.3 *Intrusion detection units* should be installed in accordance with the Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults, CAN/ULC-S302; or the Standard for Installation and Classification of Residential Burglar Alarm Systems, CAN/ULC-S310.

2. GLOSSARY

NOTE: Terms used in this Standard that are in *italic* print are defined as follows:

COMPONENT – Any part of the *intrusion detection unit*, such as housing, attachment plugs, fuse holder, fuse, switch, electrical parts and the like.

CORD-CONNECTED UNIT – A unit intended for connection to the power source by means of a supply cord.

DEFEAT – The ability to compromise a detector so that it is unable to detect an intruder.

EXTRA-LOW VOLTAGE (POWER LIMITED) -- A circuit involving a potential up to and including 30 V rms (42.4 V dc or ac peak) and providing not more than 100 VA rated output. The 100 VA limit 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.

FALSE ALARM – An alarm indicating an emergency condition, when no emergency exists.

FAULT CONDITION – The condition in which the normal operation of the detector is impaired.

HIGH VOLTAGE – Any voltage above 750 V rms (1060 V dc or ac peak).

INDOOR – Subject to normal interior temperatures and conditions. Unheated areas in cold climates will be considered *outdoor* application.

INTRUSION DETECTION UNIT – Equipment designed to detect and signal phenomena caused by attempted intrusion, burglary or aggression.

LINE VOLTAGE – The voltage at any field connected source of supply, nominally 50 to 60 Hz, 120 V.

LOW VOLTAGE – A circuit involving a potential from 31V rms (43.8 V dc or ac peak) to 750 V rms (1060 V dc or ac peak) and having circuit characteristics in excess of those of an *extra-low voltage* power limited circuit.

NORMAL CIRCUIT CONDITION (STANDBY CONDITION) – The ready-to-operate condition which exists prior to the detector being tripped or actuated by the presence of an intruder.

OUTDOOR – Subject to the extremes of exterior climatic conditions such as heat, cold, wind and other elements.

PERFORMANCE – The ability of a detector to operate as intended.

PRIMARY BATTERY – Any battery, which by design or construction is not intended to be recharged.

RADIO FREQUENCY – Electromagnetic radiation, nominally above 20 kHz.

SECONDARY BATTERY – Any battery, which, by design or construction is intended to be recharged.

3. GENERAL

3.1 A component of an *intrusion detection unit*, such as an attachment plug, a bell, circuit breaker, cord, fuseholder, fuse, switch, lampholder, receptacle, transformer, wire, etc., shall comply with the requirements for that *component*, except that such requirements may be modified if appropriate for the particular application.

3.2 The term "unit" as used in this Standard refers to all types of *intrusion detection units*.

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

4. INSTRUCTIONS AND DRAWINGS

4.1 A copy of the operating and installation instructions intended to accompany the unit and related schematic wiring diagrams and installation drawings are to be furnished with the sample submitted for investigation.

4.2 The instructions and drawings shall include such directions and information to be adequate for attaining the intended installation, maintenance, and operation of the unit.

4.3 Each unit shall be provided with installation instructions and drawings, which shall include the following information:

- A Typical installation drawing layouts and complete representative installation wiring diagrams for the unit(s) indicating recommended locations and wiring methods which shall be in accordance with CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations. Locations where detector installations are not recommended shall also be included;
- B A concise description of the operation, testing, and proper maintenance procedures for the unit(s). The frequency of testing shall be in accordance with the requirements of the manufacturer and shall not exceed once a 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 improper operation of the unit(s);
- E A description of any features provided to protect against electrical shock or fire, and a warning against bypassing such features; and
- F Devices intended for applications in non-temperature controlled environments shall be indicated accordingly.

4.4 The instructions may be incorporated on the inside of the unit, on a separate sheet, or as part of a manual. If not included directly on the unit, the instructions or manual shall be referenced in the marking information on the unit.

5. CONSTRUCTION - ALL UNITS

5.1 GENERAL

5.1.1 Unless specifically indicated otherwise, the construction requirements specified for a unit shall apply also for any remote accessories with which it is to be employed.

5.1.2 An *intrusion detection unit* shall be constructed so that it will be practical, reliable, and sufficiently durable for its intended installation and use. It shall be suitable for use with acceptable signal-indicating devices, which will permit its application in conformity with applicable Standards.

5.1.3 An acceptable indicating device is considered to be one which has been found by investigation to be suitable for use with the detector.

5.1.4 *Intrusion detection units* shall be electrically supervised so that failure of the power supply will result in an alarm or a trouble signal.

5.2 TEST FEATURES

5.2.1 If provision is made for testing the operability, battery condition, or proximity to alarm of an *intrusion detection unit*, the means provided shall be durable, practical, and shall not result in a risk of personal injury to the personnel involved.

5.2.2 The test means shall be constructed and located so as to prevent *defeat* of the system by unauthorized personnel.

5.3 ENCLOSURE

5.3.1 General

5.3.1.1 A unit shall resist the abuses to which it is likely to be subjected without adversely affecting its *performance* and without increasing its fire and shock hazard due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects. (Refer to Mechanical Strength Tests for Enclosures, Subsection 6.33.)

5.3.1.2 Electrical parts of a unit shall be located or enclosed to provide protection against accidental contact with uninsulated *low voltage* live parts.

5.3.1.3 Operating parts, such as gear mechanisms, light-duty relays, and similar devices, shall be protected against fouling by dust or other material, which may affect adversely their normal operation. (Refer to Dust Test, Subsection 7.3.2.)

5.3.1.4 The mounting means of an enclosure shall be accessible without disassembly of any operating part of the unit. Removal of a completely assembled panel to mount the enclosure is not considered to be disassembly of an operating part.

5.3.1.5 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 Abnormal Operation Test, Subsection 6.22, and Ignition Through Bottom-Panel Openings Test, Subsection 6.32.

5.3.1.6 The requirement in Clause 5.3.1.5 necessitates either a non-flammable bottom in accordance with Clause 5.3.2.4, or a protective barrier as described in Figure 1 under all areas containing flammable materials.

5.3.1.7 A construction employing individual barriers under *components*, groups of *components* or assemblies, as specified in Figure 1, is to be considered as complying with the requirement in Clause 5.3.1.5.

5.3.2 Openings

5.3.2.1 Openings directly over uninsulated *low voltage* live parts shall not exceed 5 mm in any dimension unless the configuration is such that direct entry to uninsulated *low voltage* live parts is prevented. (Refer to Figure 2 for examples of top cover designs and Figure 3 for side openings that are deemed to prevent direct entry.) (Refer also to Clause 5.3.2.2.)

5.3.2.2 An opening in the enclosure that will not permit entrance of a 25 mm diameter rod shall be sized and so arranged that a probe, as illustrated in Figure 4, cannot be made to contact any uninsulated live electrical part (other than *extra-low voltage*) when inserted through the opening in a straight or articulated position.

5.3.2.3 An opening that permits entrance of a 25 mm diameter rod is acceptable under the conditions described in Figure 5.

5.3.2.4 Openings may be provided in the bottom panels or protective pans under areas containing materials which do not comply with the Tests on Thermoplastic Materials, Subsection 6.27, if constructed in a manner that prevents materials from falling directly from the interior of the unit onto the supporting surface or any other location under the unit. Figure 6 illustrates a

type of baffle that meets this requirement. A second construction that meets this requirement is a 1 mm sheet-steel bottom panel in which are 2 mm, maximum, round holes 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 Test, Subsection 6.32.

5.3.2.5 A compartment enclosing electrical parts shall not be open to the floor or other support on which the unit rests.

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

5.3.2.7 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 ordinary hand tools, wires, hooks, and the like, without causing an alarm signal.

5.3.3 Cast Metal Enclosure

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

5.3.3.2 Cast metal of lesser thickness may be employed if, upon investigation, consideration being given to the shape, size, and function of the enclosure, it is found to have equivalent mechanical strength. (Refer to Drop Test, Subsection 6.30, and Mechanical Strength Tests for Enclosures, Subsection 6.33.)

5.3.4 Sheet Metal Enclosure

5.3.4.1 The thickness of sheet metal employed for the enclosure of a unit shall be not less than that indicated in Table 2 or Table 3, as applicable.

5.3.4.2 Sheet metal of lesser thickness may be employed, if, upon investigation, consideration being given to the shape, size, and function of the enclosure, it is found to have equivalent mechanical strength. (Refer to Drop Test, Subsection 6.30, and Mechanical Strength Tests For Enclosures, Subsection 6.33.)

5.3.4.3 At any point where conduit or armoured cable is to be attached, sheet metal shall be of such thickness or shall be so formed or reinforced that it will have stiffness at least equivalent to that of an uncoated flat sheet of steel having a minimum thickness 1.35 mm.

5.3.4.4 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.

5.3.5 Nonmetallic Enclosure

5.3.5.1 Among the factors to be taken into consideration when judging the acceptability of a non-metallic enclosure with respect to aging are: mechanical strength; resistance to impact; moisture-absorption; 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. See tests on Thermoplastic Materials, Subsection 6.27, and Mechanical Strength Tests for Enclosures, Subsection 6.33.

5.3.6 Doors and Covers

5.3.6.1 An enclosure cover shall be provided with a supervisory contact, which is connected in the closed protective wiring circuit, if it gives access to any relays, terminals, controls, or related *components* that might be subjected to tampering, without causing an alarm signal. (Refer to Control, Subsection 8.2.)

5.3.6.2 An enclosure cover shall require the use of a tool (e.g. screwdriver, etc.) to facilitate its removal.

5.3.6.3 *Intrusion detection units* intended for residential applications are not required to have tamper contacts.

5.3.7 Screens and Expanded Metal

5.3.7.1 Screens and expanded metal used as a guard, enclosure, or part of an enclosure, shall comply with Clauses 5.3.7.3, 5.3.7.4 and the Mechanical Strength Tests for Enclosures, Subsection 6.33.

5.3.7.2 The requirements of Clauses 5.3.7.3 and 5.3.7.4 are not applicable if removal of a screen or expanded metal mesh used as a guard, enclosure, or part of an enclosure does not expose *low voltage* live parts or create a risk of fire or unintentional contact with moving parts that may cause a risk of injury to persons.

5.3.7.3 Perforated sheet steel and sheet steel employed for expanded metal mesh shall be not less than 1.07 mm thick (1.17 mm if zinc coated) if the mesh openings or perforations are 323 mm² or less in area and shall be not less than 2.03 mm thick (2.13 mm if zinc coated) for larger openings. The largest dimension shall not exceed 100 mm.

5.3.7.4 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, Subsection 5.19) 0.53 mm expanded steel mesh or perforated sheet steel (0.58 mm if zinc coated) may be employed, provided that:

A The exposed mesh on any one side or surface of the unit so protected has an area of not more than 464 cm² and has no dimension greater than 300 mm; or

B The width of an opening so protected is not greater than 89 mm.

5.3.7.5 The wires of a screen shall be not less than 1.3 mm in diameter if the screen openings are 323 mm² or less in area and shall be not less than 2.1 mm in diameter for larger screen openings.

5.3.8 Electric Shock

5.3.8.1 Any part that is exposed only during operator servicing shall not present the risk of electric shock. (Refer to Electric Shock Current Test, Subsection 6.11.)

5.3.8.2 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 MΩ, a minimum wattage rating of ½ W, and shall be effective with the power switched in either the on or off position.

5.3.8.3 The conductive connection need not be provided if:

- A Such a connection is established in the event of electrical breakdown of the antenna isolating means;
- B The breakdown does not result in a risk of electric shock; and
- C In a construction employing an isolating power transformer, the resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 MΩ.

5.3.8.4 The maximum value of 5.2 MΩ mentioned in Clause 5.3.8.3 is to include the maximum tolerance of the resistor value used: that is, a resistor rated 4.2 MΩ with 20% tolerance or a resistor rated 4.7 MΩ with a 10% tolerance is acceptable.

5.3.8.5 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 ¼ W.

5.3.8.6 The insertion in any socket of any plug-in *component* used in the unit shall not result in a risk of electric shock.

5.4 CORROSION PROTECTION

5.4.1 Iron and steel parts, other than bearings and the like, where such protection is impracticable, shall be protected against corrosion by enamelling, galvanizing, sherardizing, plating, or other equivalent means, as determined by the requirements of the Corrosion Test, Subsection 6.12. Bearing surfaces shall be of such materials and design so as to resist binding due to corrosion.

5.4.2 The requirement of Clause 5.4.1 applies to all enclosures of sheet steel or cast iron, and to all springs and other parts upon which mechanical operation may depend.

5.4.3 The requirements of Clause 5.4.2 do not apply to parts such as washers, screws, bolts, and the like, if malfunctioning of such unprotected parts would not be likely to result in a risk of electrical shock, risk of fire, unintentional contact with hazardous moving parts, or impair the operation of the unit. Parts made of stainless steel, polished or treated, if necessary, do not require additional protection against corrosion.

5.4.4 Metal shall not be used in combinations such as to cause galvanic action. (Refer to Corrosion Test, Subsection 6.12.)

5.4.5 The requirements of Clause 5.4.4 do not apply if galvanic action does not result in improper operation of the product, risk of electric shock, risk of fire, or unintentional contact with moving parts that may cause a risk of injury to persons.

5.4.6 A cabinet and enclosure of corrosion-resistant material may be employed without special corrosion protection.

5.5 FIELD WIRING CONNECTIONS

5.5.1 General

5.5.1.1 Wiring terminals or leads shall be provided for connection of conductors of at least the size required by CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

5.5.2 Field Wiring Compartment

5.5.2.1 The field wiring compartment in which connections are to be made shall be of acceptable size for completing all wiring connections as specified by the installation wiring diagram.

5.5.2.2 Internal *components* in the wiring area and wire insulation shall be protected from sharp edges by insulating or metal barriers having smooth, rounded edges.

5.5.2.3 The wiring terminals of a unit constructed for mounting in an outlet box shall be so located or protected that, upon installation, the wiring in the outlet box is not forced against the terminals so as to damage the conductor insulation.

5.5.3 Terminals (General Application)

5.5.3.1 A wiring terminal shall be prevented from turning.

5.5.3.2 Any of the following terminal configurations may be employed on all circuits to which field wiring connections are made:

- A Connectors and Lugs - 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 thick. Securing screws may be plated steel;
- B Terminal Plates With Wire Binding Screws (for No. 10 AWG and Smaller Wires) - A terminal plate tapped for a wire binding screw shall 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 screw. The plate shall 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. If a wire binding screw is employed at a wiring terminal, the screw shall not be smaller than a 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. The screws may be plated steel. Other constructions may be employed if they provide equivalent thread security of the wire binding screw. 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 separate 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.

5.5.4 Terminals (Qualified Application)

5.5.4.1 Any of the following terminal configurations may be employed for connection of field wiring provided all of the conditions in Clause 5.5.4.2 are met. (Refer to Tests on Special Terminal Assemblies, Subsection 6.34):

- A Telephone Type Terminals - Non-ferrous 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 non-ferrous terminals which require a special tool and terminal post design;
- C Quick Connect Terminals - Non-ferrous 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 - Non-ferrous (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 acceptable 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 non-ferrous 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.

5.5.4.2 Any of the terminal configurations listed in Clause 5.5.4.1 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 of the circuit application; and

- D If a lead is to be disconnected for testing or routine servicing it shall comply with the requirements of Subsection 6.34.2, Disconnection and Reconnection.

5.5.5 Leads

5.5.5.1 If leads are provided in lieu of wiring terminals, they shall be:

- A Stranded copper;
- B Not less than 150 mm long provided with strain relief;
- C Not smaller than No. 22 AWG or not smaller than No.18 AWG for connection of a line-voltage source; and
- D Provided with insulation, if of rubber or plastic, not less than 0.79 mm in thickness.

5.5.5.2 Leads may be less than 150 mm in length if it is evident that the use of longer leads may result in a hazard.

5.5.6 Cords and Plugs

5.5.6.1 A portable unit, that is intended to be connected to *low voltage* or *line voltage*, shall be provided with no less than 1800 mm of flexible cord of acceptable type and rating for connection to the supply circuit. The cord shall be in compliance with the applicable requirements of CSA Standard C22.2, No.21, Cord Sets and Power Supply Cords.

5.5.6.2 The cord may be less than 1800 mm in length if it is evident that the use of a longer cord may result in an electrical shock, risk of fire or unintentional contact with hazardous moving parts, or is not required for the intended operation of the unit.

5.5.6.3 A flexible cord is acceptable for use with a stationary unit.

5.5.6.4 The flexible cord shall be of Type SJ, SJT or equivalent, minimum No.18 AWG. It shall be rated for use at the voltage and current rating of the unit.

5.5.6.5 The investigation of such a unit is to include consideration of the need and the desirability of its being movable.

5.5.6.6 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 it is judged that the tubing, or the equivalent, is necessary to prevent the clamp from damaging the cord or supply leads.

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

5.5.7 Strain Relief

5.5.7.1 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. (Refer to Strain Relief Test, Subsection 6.31.)

5.5.7.2 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.

5.6 POLARITY IDENTIFICATION

5.6.1 In a unit 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 screw shells of lampholders and to which no primary over-current-protective devices of the single-pole type are connected.

5.6.2 A terminal intended for the connection of a grounded supply conductor shall be of, or plated with, metal that is substantially white in colour and shall be readily distinguishable from the other terminals; or proper 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 grey colour and shall be readily distinguishable from the other leads.

5.7 TERMINATION OF RACEWAYS

5.7.1 Except as indicated in Clause 5.7.2, an enclosure shall have provision for the connection of armoured cable or conduit.

5.7.2 An enclosure without provision for the connection of armoured cable or conduit may be acceptable if there are furnished with it definite instructions indicating the sections of the unit which are intended to be drilled in the field for the connection of raceways or, if the unit is portable or a low-energy device, connected by a power-supply cord or Class 2 wiring.

5.8 INTERNAL WIRING

5.8.1 The internal wiring of a unit shall consist of conductors having insulation rated for the potential involved and the temperatures to which it may be subjected and having adequate mechanical strength and current-carrying capacity for the service. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string, ties, or equivalents, unless of sufficient rigidity to retain a shaped form.

5.8.2 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.

5.8.2 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 actual use.

5.8.3 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, well-rounded edges.

5.8.4 All splices and connections shall be mechanically secured and bonded electrically.

5.8.5 Stranded conductors clamped under wire-binding screws or similar parts shall have the individual strands soldered together or equivalently arranged to insure reliable connections.

5.8.6 A splice shall be provided with insulation equivalent to that of the wires involved if permanence of required electrical spacing between the splice and uninsulated metal parts is not assured.

5.8.7 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, Subsection 6.19, after they are subjected to the Humidity Test, Subsection 6.9; Temperature Test, Subsection 6.21; and other applicable tests described in this Standard. Electrical connections between circuits under test shall be disconnected prior to testing.

5.9 SEPARATION OF CIRCUITS

5.9.1 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.

5.9.2 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 0.8 mm in thickness. Any clearances between the edge of a barrier and a compartment wall shall be not less than 1.6 mm.

5.10 BONDING FOR GROUNDING

5.10.1 An exposed (Refer to Clause 5.10.2) non-current-carrying metal part, which is liable to become energized, of a unit operating at more than 30 V rms or of a unit equipped with auxiliary function contacts rated at more than 30 V rms shall be reliably bonded to the point of connection of the field-equipment grounding terminal or lead, if provided or required, and to the metal surrounding the knockout, hole, or bushing provided for field power-supply connections.

5.10.2 Except as indicated in Clause 5.10.3, uninsulated metal parts of electrical enclosures, capacitors, and other electrical *components* are to be bonded for grounding if they may be contacted by the user or by a serviceman in servicing the equipment.

5.10.3 The following metal parts need not comply with the requirement of Clause 5.10.2:

- A Adhesive attached metal foil markings, screws, handles, and the like which are located on the outside of the detector enclosure and isolated from electrical *components* or wiring by grounded metal parts so that they are not liable to become energized;
- B Isolated metal parts, such as small assembly screws, and the like which are positively separated from wiring and uninsulated live parts;
- C Panels and covers which do not enclose uninsulated live parts if wiring is positively separated from the panel or cover so that it is not liable to become energized; and
- D Panels and covers which are insulated from electrical *components* and wiring by an insulated barrier of vulcanized fibre, varnished cloth, phenolic composition, or similar material not less than 0.8 mm thick and reliably secured in place.

5.10.4 A bonding conductor shall be of material suitable for use as an electrical conductor. If of ferrous metal, it shall be protected against corrosion by painting, plating, or the equivalent. The conductor shall be not smaller than the maximum size wire employed in the circuit wiring of the *component* or part. A separate bonding conductor or strap shall be installed in such a manner that it is protected from mechanical damage.

5.10.5 The bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, brazing, or welding. The bonding connection shall reliably penetrate nonconductive coatings such as paint. Bonding around a resilient mount shall not depend on the clamping action of rubber or similar material.

Note 1: A bolted or screwed connection that incorporates a star washer under the screw head is considered acceptable for penetrating non-conductive coatings.

Note 2: Where the bonding means depend upon screw threads, two or more screws or two full threads of a single screw engaging metal are considered acceptable.

Note 3: Metal-to-metal hinge-bearing members for doors or covers may be considered as a means for bonding the door or cover for grounding providing that a multiple bearing, pin-type hinge is employed.

5.10.6 Splices shall not be employed in conductors used to bond electrical enclosures or *components*.

5.10.7 On an equipment grounding terminal, 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.

5.10.8 The surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be green, with or without one or more yellow stripes. No other lead shall be so identified.

5.10.9 In a cord connection unit, the insulation of the grounding connector, if used, shall be green, with or without one or more yellow stripes. The grounding conductor shall be secured to the grounding terminal or lead at the enclosure and to the grounding blade or equivalent contacting member of an attachment-plug. In no case shall a green-identified conductor of a cord be used as a circuit conductor. Ordinary solder alone shall not be used for securing the grounding conductor.

5.11 INSULATING MATERIALS

5.11.1 A base for the support of live-metal parts shall be of a strong, non-combustible, moisture-resistant insulating material, such as porcelain, phenolic or cold-molded composition, or the equivalent.

5.11.2 A base mounted on a metal surface which may be grounded shall be provided with an insulating barrier between the mounting surface and all live-metal 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.

5.11.3 Ordinary vulcanized fibre may be used for insulating bushings, washers, separators, and barriers, but not for the sole support of live-metal parts where shrinkage, current leakage, or warping of the fibre may introduce an electric shock or risk of fire.

5.11.4 A countersunk sealed live part shall be covered with a waterproof insulating compound which will not melt at a temperature 15°C higher than the maximum normal operating temperature of the assembly, and at not less than 65°C in any case. The depth or thickness of sealing compound shall be not less than 3.2 mm.

5.11.5 The thickness of a flat sheet of insulating material, such as phenolic composition, or the equivalent, employed for panel-mounting of parts shall be not less than that indicated in Table 4.

5.12 MOUNTING OF PARTS

5.12.1 All parts shall be securely mounted in position and prevented from loosening or turning if such motion may affect the normal *performance* of the equipment or introduce an electric shock or risk of fire.

5.12.2 Uninsulated live-metal parts shall be secured to their supporting surfaces so that they will be prevented from turning or shifting in position if such motion may result in a reduction of spacings to less than those indicated in Subsection 5.19, Spacings.

5.12.3 Friction between surfaces is not acceptable as a means to prevent turning, loosening, or shifting of a part as required in Clauses 5.12.1 and 5.12.2, but a lock washer that provides both spring take-up and an interference lock or equivalent means may be accepted.

5.13 CURRENT-CARRYING PARTS

5.13.1 A current-carrying part shall be of gold, silver, copper, or a copper alloy or equivalent.

5.13.2 Bearings, hinges, and the like, are not acceptable for use as carrying current parts.

5.14 BUSHINGS

5.14.1 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 smoothly rounded surface against which the cord may bear.

5.14.2 If the cord hole is in phenolic composition or other suitable non-conducting 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.

5.14.3 Ceramic materials and some molded compositions are considered to be acceptable for insulating bushings, but bushings of wood and of hot-molded shellac are not acceptable.

5.14.4 Fibre may be employed where it will not be subjected to a temperature higher than 90°C under normal operating conditions if the bushing is not less than 1.2 mm in thickness and if it is so formed and secured in place that it will not be affected by conditions of ordinary moisture.

5.14.5 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 liable to cut into the rubber.

5.14.6 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 fills completely the space between the grommet and the metal in which it is mounted.

5.15 TRANSFORMERS, COILS AND RELAYS

5.15.1 Except as noted in Clause 5.15.2, a transformer shall be of the two-coil or insulated type.

5.15.2 An auto-transformer may be employed provided that the terminal or lead connected to the auto-transformer winding which is common to both input and output circuits

identified and the output circuits are located only within the enclosure containing the auto-transformer. (Refer to Clause 5.6.1.)

5.15.3 Coils shall be treated with an insulating varnish and baked, or otherwise impregnated, to exclude moisture.

5.15.4 Film-coated wire is not required to be given additional treatment to prevent moisture absorption.

5.16 SWITCHES

5.16.1 A switch provided as part of the unit shall have a current and voltage rating not less than that of the circuit which it controls when the unit is operated under any condition of intended service. If the circuit controlled has a power factor less than 75%, the switch shall have a horsepower rating (judged on the basis of the ampere equivalent) or a rating of not less than 200% of the maximum load current.

5.16.2 A relay or other acceptable means may be provided for initiation of an alarm signal. The methods employed shall allow compliance with alarm signal supervisory requirements as defined in CAN/ULC-S304, Standard for Central and Monitoring Station Burglar Alarm Units.

5.17 OVERCURRENT PROTECTION

5.17.1 If a primary circuit breaker or fuses are provided, their rating shall be in accordance with the maximum input to the unit.

5.18 SEMICONDUCTORS

5.18.1 Semiconductors shall be rated for the intended application under all environmental conditions to which they may be exposed in service. See Sections 6 (Performance-All Units); and 8, Construction and Performance-Specific Units.

5.19 SPACINGS

5.19.1 Spacings between uninsulated live parts and between uninsulated live parts and dead-metal parts shall be not less than those indicated in Clauses 5.19.2 through 5.19.9.

5.19.2 The spacing between an uninsulated live part and a wall or cover of a metal enclosure, a fitting for conduit or metal-clad cable, and a metal piece attached to a metal enclosure, where deformation of the enclosure is liable to reduce spacings, shall be not less than that indicated in Table 5.

5.19.3 The spacings between an uninsulated live part and an uninsulated live part of opposite polarity, an uninsulated grounded dead-metal part other than the enclosure, and

exposed dead-metal part which is isolated (insulated) shall be not less than those indicated in Table 5.

5.19.4 If a short circuit between uninsulated live parts of the same polarity would prevent the normal signalling operation of the unit without simultaneously producing an alarm signal, the spacings between such parts shall be not less than those indicated for "other parts" in Table 5.

5.19.5 The through-air and over-surface spacings at an individual *component* part shall be judged on the basis of the volt-amperes used and controlled by the individual *component*. However, the spacing from one *component* to another, and from any *component* to the enclosure or to other uninsulated dead metal parts excluding the *component* mounting surface, shall be judged on the basis of the maximum voltage and total volt-ampere rating of all *components* in the enclosure.

5.19.6 The spacing requirements in Table 5 shall not apply to the inherent spacings of a *component* which is provided as part of the unit, except at wiring terminals. Such spacings shall be judged on the basis of the requirements for the *component*. The electrical clearance resulting from the assembly of a *component* into the complete device, including clearances to dead metal or enclosures, shall be those indicated in Table 5.

5.19.7 An insulating liner or barrier of vulcanized fibre, varnished cloth, mica, phenolic composition, or similar material employed where spacings would otherwise be insufficient, shall be not less than 0.7 mm in thickness; except that a liner or barrier not less than 0.3 mm in thickness may be used in conjunction with an air spacing of not less than 50% of the through-air spacing required. The liner shall be located so that it will not be affected adversely by arcing.

5.19.8 Insulating material having a thickness less than that specified in Clause 5.19.7 may be used if, upon investigation, it is found to be adequate for the particular application.

5.19.9 Film-coated wire is considered to be a bare current-carrying part in determining compliance of a unit with the spacing requirements, but is acceptable as turn-to-turn insulation in coils.

5.19.10 Spacings on printed wiring boards may be less than those indicated in Table 5 provided the minimum spacings of Table 6 are maintained and a coating in compliance with Subsection 6.29, Evaluation of Conformal Coatings on Printed Wiring Boards, is utilized.

6. PERFORMANCE - ALL UNITS

6.1 GENERAL

6.1.1 Test Units and Data

6.1.1.1 *Intrusion detection units* that are fully representative of production units are to be used for each of the following tests, unless otherwise specified.

6.1.1.2 The accessories employed for testing are to be those specified by the wiring diagram of the unit. However, substitute accessories may be used if they produce functions and load conditions equivalent to those obtained with the accessories intended to be used with the unit in service.

6.1.1.3 Unless specified otherwise, all tests shall be conducted at the maximum sensitivity setting in accordance with the manufacturer's instructions.

6.1.2 Test Samples and Miscellaneous Data

6.1.2.1 The following samples are to be provided for testing:

- A Two or more complete *intrusion detection units*;
- B For each encapsulated or sealed assembly, one or more samples of each such assembly shall be provided in the unencapsulated or unsealed condition; and
- C Installation and operating instructions. (Refer to Clauses 4.1 and 4.2.)

6.1.3 Test Voltages

6.1.3.1 Unless specifically noted otherwise, the test voltage for each test of a unit shall be as follows, at rated frequency:

Rated Voltage, Nameplate	Test Voltage
110 to 120	120
220 to 240	240
Other	Marked Rating

6.1.4 Department of Communications Requirements

6.1.4.1 A unit which utilizes *radio frequencies* shall be shown to comply with the regulations of the Department of Communications, Ottawa, before it is submitted for test.

6.2 NORMAL OPERATION TEST

6.2.1 If equipment must be mounted in a definite position in order to function as intended it shall be tested in that position.

6.2.2 A unit shall be capable of performing its intended function when installed in accordance with Clause 6.2.3.

6.2.3 The unit is to be mounted in the intended manner and its terminals connected to circuits of related equipment as indicated by the installation-wiring diagram so as to represent a typical system combination.

6.2.4 Power-input supply terminals are to be connected to supply circuits of rated voltage and frequency. A unit under test shall be in the *normal circuit condition* and ready for its intended signalling operation when it is connected to related products and circuits as specified in Clauses 6.2.1 and 6.2.3.

6.2.5 The representative system combination is to be maintained in the "closed-period" condition, except during operation, throughout the test program, to obtain information regarding the stability, sensitivity, uniformity of operation, and related features of *performance*.

6.2.6 When the detector generates an alarm condition, the condition shall be maintained for at least 1 s.

6.3 CURRENT PROTECTION TEST

6.3.1 Internal damage to circuitry shall not result if field-wiring terminals are accidentally shorted or jumped to power supply terminals. (Refer to Clause 6.3.4.)

6.3.2 A power source of rated test voltage is to be connected between the terminal under test and ground. (Refer to Clause 6.1.3.1.)

6.3.3 All connections to power terminals, input and output lines shall be reversed as pairs, individually, or connected to any terminal adjacent to the correct one.

6.3.4 If damage can result, then markings clearly visible to the installer during installation shall warn of consequences of improper connection. If correct polarity is required, then polarity markings shall appear immediately adjacent to wiring terminals.

6.4 INPUT MEASUREMENT TEST

6.4.1 The power input shall not exceed 110% of the marked rating during normal operation.

6.5 ELECTRICAL SUPERVISION TEST

6.5.1 The minimum mean time between failures (MTBF) of the product shall be 50 000 h (6 years) as calculated in accordance with the requirements of the United States MIL-HDBK-217, Reliability Prediction of Electronic Equipment.

6.5.2 A *component* whose reliability causes the product not to meet the requirements of Clause 6.5.1 shall either not impair the intended operation; be indicated by a trouble or alarm signal; or the unit shall be provided with a test feature.

6.5.3 An *intrusion detection unit* shall be electrically supervised so that a malfunction of the power supply or loss of primary power and loss of standby battery capability shall result in an alarm or a trouble signal before the sensitivity and/or range of the unit is increased or reduced by more than 50%.