

**STANDARD FOR EQUIPMENT FOR FIRE SIGNAL RECEIVING
CENTRES AND SYSTEMS**



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TABLE OF CONTENTS

ULC STANDARDS COMMITTEE ON FIRE ALARM AND LIFE SAFETY EQUIPMENT AND SYSTEMS	I
ULC STANDARDS SUBCOMMITTEE ON CONTROL UNITS FOR FIRE ALARM SYSTEMS	II
ULC STANDARDS WORKING GROUP ON EQUIPMENT FOR FIRE SIGNAL RECEIVING CENTRES AND SYSTEMS	III
PREFACE	IV
1 SCOPE	1
2 REFERENCE PUBLICATIONS	2
3 GLOSSARY	4
4 SYSTEM REQUIREMENTS	6
4.1 GENERAL	6
4.2 MAIN POWER SUPPLY	7
4.3 EMERGENCY POWER SUPPLY	8
4.4 CIRCUIT PROTECTION	8
4.5 INPUT CIRCUIT OPERATION	9
4.6 OUTPUTS CIRCUIT OPERATION	10
4.7 VISUAL DISPLAYS, CONTROLS AND RECORDING DEVICES	11
4.8 MANUAL CONTROLS	13
5 COMMUNICATION SYSTEMS	13
5.1 GENERAL	13
5.2 COMMUNICATION TYPES	14
5.3 ACTIVE COMMUNICATION SYSTEMS	15
5.4 PASSIVE COMMUNICATION SYSTEMS	15
6 SOFTWARE-CONTROLLED EQUIPMENT	15
7 INSTRUCTIONS AND DRAWINGS	17
8 CONSTRUCTION	18
8.1 PRODUCT ASSEMBLY	18
8.2 PROTECTION OF SERVICE PERSONNEL	18
8.3 ENCLOSURES	19
8.3.1 General	19
8.3.2 Enclosure Strength and Integrity	20
8.3.3 Stability	20
8.3.4 Protection from Electric Shock	21
8.3.5 Confinement of Fire Hazards	22
8.3.6 Enclosure Openings – General	23
8.3.7 Enclosure Openings – Top	23

8.3.8	Enclosure Openings – Sides and Front	23
8.3.9	Enclosure Openings – Bottom	24
8.3.10	Cast Metal Enclosures	24
8.3.11	Sheet Metal Enclosures	24
8.3.12	Nonmetallic Enclosures	25
8.3.13	Screens and Expanded Metals	26
8.3.14	Enclosure Cover	26
8.3.15	Corrosion Protection	27
8.4	MECHANICAL ASSEMBLY	27
8.5	FIELD WIRING CONNECTIONS	28
8.5.1	General	28
8.5.2	Field Wiring Compartment	28
8.5.3	Field Wiring Leads	29
8.5.4	Field Wiring Terminals (Standard Application)	30
8.5.4.1	General	30
8.5.4.2	Types and Sizes	30
8.5.4.3	Size of Screws	30
8.5.4.4	Material for Terminal Parts	30
8.5.4.5	Terminal Plates and Threading	31
8.5.4.6	Identification	31
8.5.5	Field Wiring Terminals (Custom Application)	31
8.5.5.1	General	31
8.5.5.2	Quick Connect Terminals	31
8.5.5.3	Push-In Terminals	32
8.5.5.4	Other Terminals	32
8.6	INTERNAL WIRING	32
8.6.1	General	32
8.6.2	Separation of Circuits	33
8.7	COMPONENTS – ELECTRICAL	33
8.7.1	Mounting of Components	33
8.7.2	Insulating Materials	33
8.7.3	Current-Carrying Parts	34
8.7.4	Bushings	34
8.7.5	Semiconductors	34
8.7.6	Transformers, Relays	34
8.7.6.1	General	34
8.7.6.2	Isolation Transformers	35
8.7.6.3	Bobbins	35
8.7.6.4	Leads	35
8.7.6.5	Protection Against Fire Hazards	36
8.7.7	Capacitors	37
8.7.8	Storage Batteries	37
8.7.9	Protective Devices	38
8.7.10	Overcurrent Protection	39
8.8	PRINTED-WIRING BOARDS	39
8.9	END-OF-LINE DEVICES	39
8.10	VOLTAGE-DROPPING RESISTORS	39
8.11	SWITCHES	39
8.12	OPERATING MECHANISMS	39
8.13	ACROSS-THE-LINE COMPONENTS	40
8.14	LITHIUM BATTERIES	40
8.15	SPACINGS	40

9 MARKING	42
9.1 GENERAL	42
9.2 IDENTIFICATION AND RATING	42
9.3 CAUTIONS OR WARNINGS	43
10 PERFORMANCE TESTS	45
10.1 GENERAL	45
10.2 NORMAL OPERATION	45
10.3 ELECTRICAL SUPERVISION	46
10.4 ELECTRICAL RATINGS TEST	46
10.4.1 Power Input Circuits	46
10.4.2 Other External Circuits	46
10.5 BATTERY TESTS	47
10.5.1 General	47
10.5.2 Discharged Battery	47
10.5.3 Charged Battery	47
10.5.4 Discharged Battery - Second Trial	48
10.5.5 Battery Charger Test	48
10.5.6 Battery Compartment Ventilation	48
10.6 VARIABLE VOLTAGE OPERATION TEST	48
10.7 TEMPERATURE RISE	49
10.8 DIELECTRIC VOLTAGE-WITHSTAND TEST	51
10.9 ELECTRIC SHOCK CURRENT TEST	51
10.10 VARIABLE AMBIENT TEMPERATURE AND HUMIDITY TEST	53
10.10.1 General	53
10.10.2 Low Temperature Test	54
10.10.3 High Temperature Test	54
10.10.4 Humidity Test	55
10.10.5 Wet Location and Outdoor-Use Test	55
10.10.5.1 General	55
10.10.5.2 Corrosion Tests	55
10.10.5.2.1 General	55
10.10.5.2.2 Salt Spray Test	56
10.10.5.2.3 Hydrogen Sulphide (H ₂ S) Test	56
10.10.5.2.4 Sulphur-Dioxide/Carbon-Dioxide (SO ₂ -CO ₂) Test	56
10.10.5.3 Dust Test	56
10.10.5.4 Water Spray Test	57
10.10.5.5 Gasket Testing	57
10.10.5.5.1 General	57
10.10.5.5.2 Gasket Accelerated Aging Test	58
10.10.5.5.3 Gasket Low Temperature Test – Outdoor Use	58
10.10.5.6 Polymeric materials tests	58
10.11 JARRING TEST	58
10.12 ENDURANCE TEST	59
10.12.1 General	59
10.12.2 Integral Operating Devices	60
10.12.3 Power Supplies	60
10.12.4 Battery Charger	60
10.12.5 Printers	60
10.12.6 Audible Signal Device	60
10.13 OVERLOAD TEST	60

10.13.1	Products Supplied From AC Power	60
10.13.2	Separately Energized Circuits	61
10.13.3	Battery Charger Transfer Mechanism	61
10.14	TRANSIENT TEST	62
10.14.1	General	62
10.14.2	Externally-Induced Supply-Line Transients	62
10.14.3	Internally-Induced Transients	62
10.14.4	Input/Output (Extra Low Voltage) Field-Wiring Transients	63
10.15	ELECTROSTATIC DISCHARGE TEST	63
10.16	RADIO FREQUENCY INTERFERENCE TEST	64
10.17	EVALUATION OF CONFORMAL COATINGS ON PRINTED WIRING BOARDS	64
10.17.1	Test Program I	64
10.17.2	Test Program II	65
10.18	TESTS ON SPECIAL TERMINAL ASSEMBLIES	65
10.18.1	General	65
10.18.2	Mechanical Pull Test	66
10.18.3	Flexing Test	66
10.18.4	Millivolt Drop Test	66
10.18.5	Temperature Test	66
10.19	STRAIN RELIEF TEST	66
10.20	ABNORMAL OPERATION TESTS	67
10.20.1	General	67
10.20.2	Operation	68
10.20.3	Field-Wiring Circuits	68
10.20.4	Electronic Components	68
10.20.5	Cooling Fans And Blowers	68
10.20.6	Transformer Power Supply Burnout	69
10.20.7	Communications Circuits Out	70
10.21	MECHANICAL STRENGTH TESTS FOR ENCLOSURES	70
10.22	FLAME TEST FOR POLYMERIC MATERIALS	70
10.22.1	General	70
10.22.2	Flammability Test for Fire Enclosures of Movable Equipment Having a Total Mass Exceeding 18 kg and of Stationary Equipment	71
10.22.2.1	Samples	71
10.22.2.2	Conditioning of Samples	71
10.22.2.3	Mounting of Samples	71
10.22.2.4	Test Flame	71
10.22.2.5	Test Procedure	71
10.22.2.6	Compliance Criteria	71
10.22.3	Flammability Test for Fire Enclosures of Movable Equipment Having a Total Mass Not Exceeding 18 kg, and for Material and Components Located Inside Fire Enclosures	71
10.22.3.1	Samples	71
10.22.3.2	Conditioning of Samples	72
10.22.3.3	Mounting of Samples	72
10.22.3.4	Test Flame	72
10.22.3.5	Test Procedure	72
10.22.3.6	Compliance Criteria	72
10.23	IGNITION TEST THROUGH BOTTOM-PANEL OPENINGS	72
10.24	BATTERY REPLACEMENT	73
10.25	PERMANENCE OF MARKING	73
10.25.1	General	73
10.25.2	Environment Exposure	74

10.25.2.1 High Temperature	74
10.25.2.2 Humidity	74
10.25.3 Permanence Tests	74
10.26 LEAKAGE CURRENT TEST	74
10.27 SHORT-RANGE RADIO FREQUENCY (RF) DEVICES TEST	75
10.27.1 General	75
10.27.2 Reference Level Determination	76
10.27.3 Interference Immunity	77
10.27.4 Frequency Selectivity	77
10.27.5 Clash	78
10.27.6 Clash Error	79
10.27.7 Error (Falsing) Rate	79
10.27.8 Throughput Rate	80
10.27.9 Transmitter Stability Tests	81
10.27.10 Transmitter Accelerated Aging Test	81
10.28 LONG-RANGE RADIO FREQUENCY (RF) DEVICE TESTS	81
10.28.1 General	81
10.28.2 Reference Signal Level	82
10.28.3 Throughput Rate Test	82
10.28.4 Error (Falsing) Rate Test	82
10.28.5 Adjacent Channel Rejection Test	83
10.28.6 Intermodulation Rejection Test	83
10.28.7 Spurious Response Rejection Test	84
10.28.8 Clash	85

TABLES	86
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FIGURES	100
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APPENDIX A (INFORMATIVE) — EXPLANATORY NOTES	100
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This Standard is dedicated to the memory of **G. Richard Morris** Chair 1989–2001 and member, 1976–2012, of the ULC Standards Committee on Fire Alarm and Life Safety Equipment and Systems.

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STANDARD FOR EQUIPMENT FOR FIRE SIGNAL RECEIVING CENTRES AND SYSTEMS

PREFACE

This is the Second Edition of the Standard for Equipment for Fire Signal Receiving Centres and Systems, CAN/ULC-S559-13.

This Edition of the Standard was developed by the ULC Standards Working Group on Equipment for Fire Signal Receiving Centres and Systems, reviewed by the ULC Standards Subcommittee on Control Units for Fire Alarm Systems, and was formally approved by the ULC Standards Committee on Fire Alarm and Life Safety Equipment and Systems.

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.

Appendix A, identified as Informative, is included for information purposes only.

In Canada, there are two official languages, French and English. All safety warnings must be in French and English. Attention is drawn to the fact that some Canadian authorities may require markings and/or instructions to be in either or both official languages, except as may be stated elsewhere in this Standard.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patent rights. ULC Standards shall not be held responsible for identifying any or all such patent rights.

Requests for interpretation of this Standard should be sent to ULC Standards. 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.

This Standard is intended to be used for conformity assessment.

Document communiqué en vertu de la Loi sur l'accès à l'information.

1 SCOPE

1.1 This Standard covers requirements for fire *signal receiving centres* and systems, which include transmitting and receiving equipment, proprietary fire *signal receiving centre* equipment and *control unit* accessories for use in accordance with the following:

- A CAN/ULC-S524, Installation of Fire Alarm Systems;
- B CAN/ULC-S561, Standard for the Installation and Services for Fire Signal Receiving Centres and Systems;
- C CSA-22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations;
- D Figure 1A, Typical Arrangement of Equipment for Fire Signal Receiving Centres and Systems; and
- E Figure 1B, Recommended Demarcation Between Fire Alarm Control Unit and Signal Transmitting Unit at the Protected Premises.

NOTE: Fire alarm system equipment and installations should comply with Industry Canada rules and regulations, as applicable, concerning the following:

- A Electromagnetic radiation;
- B Use of radio frequencies; and
- C Connection to the public switched telephone network of telephone equipment, systems, and protection apparatus.

1.2 *Proprietary fire alarm systems* incorporating the features and functions of a fire alarm system, and/or incorporating transponders of distributed type systems, shall be in accordance with the requirements of CAN/ULC-S527, Control Units for Fire Alarm Systems.

1.3 Equipment covered by the scope of this Standard incorporating the features and functions of a fire alarm system, shall be in accordance with the requirements of CAN/ULC-S527, Control Units for Fire Alarm Systems.

1.4 These requirements cover fire *signal receiving centre* systems, including protected premise unit and receiver for ordinary (non-hazardous) indoor and outdoor locations.

1.5 Changes or additions to the equipment covered by the scope of this Standard shall be tested according to the relevant sections of this Standard. Examples of changes and additions include, but are not limited to:

- A Operating system programme;
- B Changes or additional features to system operation;
- C Electrical/electronic or mechanical components; and
- D Other software temporarily or permanently installed; such as for test or maintenance.

1.6 Programming methods, test, service and other software intended for use with the equipment for fire *signal receiving centres* and systems shall be included in the evaluation of this equipment.

1.7 The term “product” as used in this Standard refers to all items of equipment covered by the scope of this Standard.

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

1.9 The requirements of this Standard apply uniformly to all equipment covered by the scope of this Standard regardless of whether they are used as a component of a fire *signal receiving centre* and systems or separately enclosed and referred to as an accessory.

1.10 Signal receiving units used in fire *signal receiving centres*, *satellite centres*, *signal processing centres* and *bridging centres* shall comply with the requirements of this Section.

2 REFERENCE PUBLICATIONS

2.1 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. All undated references shall be interpreted as referring to the latest edition of that document.

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- MIL-HDBK-338B-2012, Electronic Reliability Design Handbook
- MIL-STD-883H-2012, Test Method Standard Microcircuits

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- ASTM B117-09, Standard Practice for Operating Salt Spray (Fog) Apparatus
- ASTM B240-09, Standard Specification for Zinc and Zinc Aluminum (ZA) Alloys in Ingot Form for Foundry and Die Castings
- ASTM D396-09, Standard Specification for Fuel Oils
- ASTM E11-09, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

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- CSA C22.1-12, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations
- CAN/CSA 60065–03 (Amd1, 2006) Audio, Video and Similar Electronic Equipment Apparatus — Safety Requirements

- CAN/CSA C22.2 No. 0.4-04 (R2006), Bonding of Electrical Equipment
 - CSA C22.2 No. 0.15-01, Adhesive Labels
 - CAN/CSA C22.2 No. 0.17-00 (R2009), Evaluation of Properties of Polymeric Materials
 - CAN/CSA C22.2 No. 65-03 (R2010), Standard for Wire Connectors
 - CSA C22.2 No. 66.1-06 / ANSI/UL 5085-1-06, Low Voltage Transformers – Part 1: General Requirements
 - CSA C22.2 No. 66.2-06 / ANSI/UL 5085-2-06, Low Voltage Transformers – Part 2: General Purpose Transformers
 - CSA C22.2 No. 66.3-06 / ANSI/UL 5085-3-06, Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers
 - CAN/CSA C22.2 No. 94-M91 (R2006), Special Purpose Enclosures
 - CAN/CSA C22.2 No. 153-09, Quick Connect Terminals
 - CAN/CSA C22.2 No. 158-10, Terminal Blocks
 - CSA C22.2 No. 60950-1-07 / UL 60950-1-07, Information Technology Equipment Safety - Part 1: General Requirements (Bi-National)
 - CAN/CSA E60384-1-03, Fixed Capacitors for Use in Electronic Equipment - Part 1: Generic Specification
 - CAN/CSA Z234.1-00, Metric Practice Guide – General Instruction No. 1
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Standard published by Institute of Electrical and Electronics Engineers Inc.
445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331

- ANSI/IEEE Y32.9-72 (R1989), Standard for Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction.
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Standard Published by the International Electrotechnical Commission
3 Rue de Varembe, PO Box 131 Geneva, Switzerland CH-1211
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- IEC 60695-11-3-12, Fire Hazard Testing – Part 11-3: Test Flames – 500 W Flames – Apparatus and Confirmation Test Methods
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- CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- CAN/ULC-S524, Installation of Fire Alarm Systems
- CAN/ULC-S527, Control Units for Fire Alarm Systems
- CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems
- CAN/ULC-S561, Standard for the Installation and Services for Fire Signal Receiving Centres and Systems

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- ANSI/UL 486E-10, Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
- UL 796-10, Printed Wiring Boards
- UL 969-95 (R2008), Marking and Labeling Systems
- UL 1439-04, Tests for Sharpness of Edges on Equipment
- UL 1642-05 (R2009), Standard for Lithium Batteries
- ANSI/UL 5085-1-06 / CSA C22.2 No. 66.1-06, Low Voltage Transformers – Part 1: General Requirements
- ANSI/UL 5085-2-06 / CSA C22.2 No. 66.2-06, Low Voltage Transformers – Part 2: General Purpose Transformers
- ANSI/UL 5085-3-06 / CSA C22.2 No. 66.3-06, Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers
- UL 60950-1-07 / CSA C22.2 No. 60950-1-07, Information Technology Equipment Safety Part 1: General Requirements (Bi-National)

3 GLOSSARY

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

ACTIVE COMMUNICATION — A type of communication in which the integrity of the *communication channel(s)* is continuously monitored so as to identify to the fire *signal receiving centre* any fault or failure that could affect signal transmission and reception.

AUTOMATION SYSTEM(S) — A computer system that consists of hardware and software components. These components include the alarm-monitoring software supplied by the automation system developer, the operating system, and programming languages, required to make the system operational. Refer to Appendix A — Explanatory Notes, Automation System(s).

BRIDGING CENTRE(S) — A normally unattended physical location where *communication channels* from multiple protected premises are connected together for transmission on a *communication channel* to subsequent *bridging centres*, *satellite centres* or *signal processing centres* without being processed or modified in any way.

CLASS A CIRCUIT (Return Loop Circuit) — A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.

CLASS B CIRCUIT (Terminated Circuit) — A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

COMMUNICATION CHANNEL — A facility or service extending from a protected premises for the purpose of transmitting alarm, trouble and supervisory signals from a protected premises to a fire *signal receiving centre*.

COMMUNICATION SYSTEM(S) — A *communication channel* or channels and associated equipment utilized to transmit signals to a fire *signal receiving centre*.

COMPATIBLE — Correct electrical, electronic or mechanical interaction between a series of system components that depend on individual unique characteristics that are connected together to meet the intent of this Standard (e.g. *control unit* and field devices).

COMPROMISE — Any unauthorized action that affects the transmission of valid data between the protected premises and the fire *signal receiving centre*.

CONTROL UNIT — A unit which provides the control and logic processing for a fire alarm system

ELECTRICAL SUPERVISION — A means whereby a fault condition, which would interfere with the operation of a circuit, is detected.

EXTENDED CIRCUIT(S) — System circuits that extend beyond the equipment enclosure.

GROUND FAULT(S) — A circuit impedance to ground sufficient to prevent normal operation.

OPEN CIRCUIT FAULT — A circuit impedance increase sufficient to prevent normal operation.

OPERATING PROGRAM — The program developed by the manufacturer that provides the basic operating instructions to the processor(s). These instructions form the basis of the *control unit's* normal operation and shall be the minimum instructions set to meet the intent of this Standard

PASSIVE COMMUNICATION — A type of communications that is not continuously monitored to detect failures or faults but rather incorporates dual or multiple *communication systems*.

PROPRIETARY FIRE ALARM SYSTEM(S) — An on-site facility in which the system is monitored at all times by trained personnel designated by the owners of the protected properties.

RISK OF FIRE — A risk of fire is determined to exist within a circuit unless that circuit meets both of the following criteria:

- A The circuit is supplied by a power source such that the maximum open-circuit voltage potential available to the circuit is not more than 30 V rms or 42.4 V DC or 42.4 V peak; and
- B The circuit in which the power available to the circuit is limited to a value less than 15 W.

SATELLITE CENTRE(S) — A remote fire *signal receiving centre*, which is connected to a fire *signal receiving centre*, another *satellite centre* or a *signal processing centre* by means of a *communication system*.

SHORT CIRCUIT FAULT — A circuit impedance decrease sufficient to prevent normal operation.

SIGNAL PROCESSING CENTRE(S) — A normally unattended physical location where signals are received, either directly from protected premises or by way of *bridging centres* and where the signals are altered or processed prior to being transmitted to a *satellite centre* or a fire *signal receiving centre*.

SIGNAL RECEIVING CENTRE — A facility that receives alarm signals and at which trained personnel and service persons are on duty at all times.

SIGNAL TRANSMITTING UNIT — A communication device that transmits signals from the protected premises to the fire *signal receiving centre*.

SPECIFIC TROUBLE INDICATION — A *trouble signal* which consists of a common *trouble signal* and a specific visual indication which identifies the failed circuit or item of equipment, or operational malfunction.

SUPPLEMENTARY CIRCUIT — A circuit which connects a *control unit* to *supplementary devices*, located within or outside the fire *signal receiving centre*.

SUPPLEMENTARY DEVICE(S) — A device which does not have a life-safety application, and is connected to the fire *signal receiving centre*, but is not part of the fire *signal receiving centre*.

TROUBLE SIGNAL — A visual and audible indication of equipment failure, circuit failure, fault condition, or operational malfunction.

4 SYSTEM REQUIREMENTS

4.1 GENERAL

4.1.1 All devices incorporated in a system shall be *compatible* in all respects for that system.

4.1.2 The type of communication between the protected premises and the receiving equipment shall be supervised for loss of the capability to communicate. This supervision may be achieved by the types described in this Standard and shall comply with the requirements in Section 5, Communication Systems.

4.1.3 A *trouble signal* shall be generated if the system is incapable of performing its intended function as outlined in this Standard.

4.1.4 The connection of ancillary equipment to the system shall not interfere with the operation of equipment covered by the scope of this Standard.

4.1.5 Equipment covered by the scope of this Standard, which is intended for use with door(s) removed shall be tested in this configuration to the requirement of Section 10, Performance Tests.

4.1.6 The following general requirements apply to fire *signal receiving centres* equipment, *satellite centres* equipment and *proprietary fire alarm system* equipment.

4.1.7 The equipment shall record each alarm and trouble/supervisory event using the following arrangement.

- A Event;
- B Event acknowledge;
- C Event Return to normal; and
- D Event Return to normal acknowledge.

4.1.8 Data transmission of signals from the protected premises/area to the fire *signal receiving centre* shall be as described in one of the arrangements in Section 5, Communication Systems.

4.1.9 In addition to the requirements of Subsections 4.1, General and 4.5, Input Circuit Operation., the equipment shall also be subject to all other requirements detailed in this Standard.

4.1.10 Transmitting equipment whether or not they are used within *proprietary fire alarm systems* or fire *signal receiving centres* shall be subject to the pertinent sections of this standard.

4.2 MAIN POWER SUPPLY

4.2.1 A fire *signal receiving centre* and system shall be energized by a permanently wired supply in accordance with CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations, Section 32.

4.2.2 Where equipment and accessories require two or more supply circuits, the installation wiring drawing required by Section 7, Instructions and Drawings, shall detail grouping, identification and warning markings of the disconnecting means as required by CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

4.2.3 Except as noted, loss of any operating main power supply shall result in a *specific trouble indication* and shall result in automatic transfer to the emergency power supply with no loss of information in accordance with Article 3.2.7.8 (4) of the National Building Code of Canada. A reduction of main power supply voltage to a value less than 85 % of rated voltage shall be considered a loss of supply except as noted below in Clause 4.2.4.

*Exception: Audible and/or visual trouble indication is not required at the **signal transmitting units** providing the **signal transmitting unit** transmits a primary power failure signal to the fire **signal receiving centre**. The primary power failure transmission may be delayed up to 3 h. Primary power failure transmission is not required if primary power is restored within the delay time.*

4.2.4 Transfer to the secondary power source shall occur between 85 % to 90 % inclusive of the rated voltage.

Exception: Transfer to the secondary power source may occur below 85 % when operation of the product is not impaired and compatibility of connected equipment is maintained.

4.2.5 Transfer to the primary operating source shall occur at a value of 90 % or less of the rated voltage. Transfer from the secondary to the primary power source shall occur within 30 min.

4.2.6 The transfer values shall be set to ensure that the system does not cycle between primary and secondary sources.

4.2.7 The transfer to or from the emergency power supply shall not result in loss of fire alarm system operation, including loss of alarm status, or loss of system memory except as otherwise indicated in this standard.

4.2.8 Rectifiers and battery chargers whether integral with the *control unit* or assembled for separate installation are considered elements of the *control unit* and are subject to the same requirements.

4.3 EMERGENCY POWER SUPPLY

4.3.1 An emergency power supply shall be provided to energize the *signal transmitting unit* and fire *signal receiving centre* and systems in the event of a total primary power failure or if the primary power supply voltage is reduced to less than 85 % of the rated voltage of the equipment.

4.3.2 The minimum standby time required is 24 h followed by at least one successful communication between the signal transmission unit and the Signal receiving equipment. For products which normally have no status change signaling operations during the discharge period, the normal standby load shall be the quiescent current of the product plus any specified normal supervisory power supply loads not automatically disconnected upon transfer to secondary power. For products which will normally have status-change signaling occurring throughout the discharge period and which draw more operating current when signaling than while in the quiescent mode, the normal standby load shall be a steady state load equal to the signaling current of the product plus any specified normal supervisory power supply loads not automatically disconnected upon transfer to secondary power.

4.3.3 Transfer to the emergency power supply shall be automatic and shall not result in the loss of any signalling operation of the fire *signal receiving centre* and systems.

4.3.4 Fire *signal receiving centres* and systems, which are intended to utilize the building emergency AC supply system for their emergency power supply, shall comply with Clause 4.2.3.

4.3.5 Batteries used for the emergency power supply shall be of the rechargeable storage type and shall comply with Section 8, Construction, outlining construction requirements for storage batteries and they shall be sized to meet the requirements of Section 10, Performance Tests, outlining battery tests.

4.3.6 The *electrical supervision of extended circuits*, which are required to give a *specific trouble indication*, shall be maintained while operating from the emergency power supply.

4.3.7 Battery chargers, whether integral with the equipment covered by the scope of this Standard or assembled for separate installation, are considered elements of the fire *signal receiving centre* and systems and are subject to the requirements of this Standard.

4.3.8 All equipment having individual primary power shall have power-on indication. Power on indication is not required at the *signal transmitting units* provided that the *signal transmitting unit* transmits a primary power failure signal to the fire *signal receiving centre*. The primary power failure transmission may be delayed up to 3 h. Primary power failure transmission is not required if primary power is restored within the delay time.

4.4 CIRCUIT PROTECTION

NOTE: This section refers to hard wired circuits. For other technologies refer to appropriate sections.

4.4.1 All *extended circuits* of equipment covered by the scope of this Standard shall be arranged so that a single *short circuit fault*, *open circuit fault* or *ground fault* on any circuit shall not:

- A Affect the operation of any other circuit;
- B Affect the operation of the equipment covered by the scope of this Standard for functions not associated with the faulted circuit;
- C Result in loss of stored memory; and
- D Result in damage to the equipment.

Exception: Wiring in metallic conduit interconnecting separately enclosed items of a fire signal receiving centre and systems and its accessories, located in the same room, and interconnected by runs not exceeding 18 m, is considered equipment wiring and need not comply with Clause 4.4.1.

4.4.2 *Extended circuits* of equipment covered by the scope of this Standard intended for installation in hazardous locations, such as intrinsically safe shall comply with the requirements of this Standard and the application requirements of C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations, for the hazard.

NOTE: *Ground fault* detection may be removed from the intrinsically safe circuit providing a *ground fault* on that circuit does not affect other circuits and also does not affect the *ground fault* detection on the remainder of the *extended circuits*.

4.4.3 All *extended circuits* of equipment covered by the scope of this Standard shall not exceed 120 V nominal (150 V maximum to ground).

4.4.4 The circuit(s) interconnecting the fire alarm *control unit* or other premises equipment with the *signal transmitting unit* shall be considered an input circuit and comply with the requirements of Clause 4.5.1.

Exception No. 1: Trouble indication at the signal transmitting unit is not required if the condition is transmitted to and specifically indicated at the fire signal receiving centre.

Exception No. 2: Electrical supervision for ground fault is not required if a single ground fault does not prevent the transmission of a status change and, the presence of a second ground fault would not result in a normal to off-normal status change indication.

4.5 INPUT CIRCUIT OPERATION

4.5.1 Input circuit performance shall be in accordance with the following and in accordance with Table 1, Performance of Input Circuits:

- A An *open circuit fault* or *short circuit fault* on an input circuit to a receiver shall result only in a *specific trouble indication*;
- B An *open circuit fault* on an input circuit to a *signal transmitting unit* shall result only in a *trouble signal* transmission;
- C A single *ground fault* on an input circuit to a receiver and to a transmitter shall not result in normal to off-normal status;

- D The inputs of a *signal transmitting unit* that is integrated into a local fire alarm *control unit* or intended for wiring in metallic conduit interconnecting the separately enclosed *signal transmitting unit* and the source of the input signal, located in the same room, and interconnected by runs not exceeding 18 m, is considered equipment wiring and need not comply with Items A and B;
- E Each monitored input shall be individually, visually and audibly annunciated and recorded at the fire *signal receiving centre*;
- F Each input circuit shall be individually, visually and audibly annunciated for normal to off-normal status change, and off-normal to normal status change. Annunciation of an off-normal to normal status change following an acknowledgement and manual reset operation is considered in compliance with this requirement;
- G The visual indication of an acknowledged status shall be distinct from an unacknowledged status and each status change shall be latched until acknowledged; and
- H A normal to off-normal and an off-normal to normal status change shall be latched until acknowledged and each change shall be visually and audibly annunciated. The visual indication for each status shall be distinctive.

4.5.2 When proprietary systems are connected to field devices the input circuits shall comply with the requirements of CAN/ULC-S527, Control Units for Fire Alarm Systems and the requirements specified in Clause 4.5.1 items F, G and H.

4.6 OUTPUTS CIRCUIT OPERATION

4.6.1 The following shall be considered system outputs:

- A Circuits provided for remote transmission of status information;
- B Remote visual display circuits (if provided);
- C Printers or recording devices circuits;
- D Computer's keyboard, video monitor, mouse-type device, or touch screen; and
- E Audible and visual indicators on the fire *signal receiving centre* equipment.

4.6.2 All means of interconnecting equipment, devices, and appliances shall be monitored for integrity of the interconnecting conductor(s) and/or equivalent path(s) so that the occurrence of a single *ground fault* or single *open circuit fault* shall automatically result in a *trouble signal*, except as specified in Clause 4.6.3.

4.6.3 The requirement in Clause 4.6.2 does not apply to the following circuits:

- A *Trouble signal* circuits;
- B Interconnection between equipment within a common enclosure;
- C A circuit for *supplementary device(s)* where a *short circuit fault*, an *open circuit fault*, or a *ground fault* does not affect the normal operation of the equipment, except for omission of the supplementary feature (when necessary to comply with Clause 4.6.2 overcurrent protective devices provided for *supplementary circuit* protection shall be non-interchangeable);

- D Conductors for *ground fault* detection, where a single *ground fault* does not prevent the required normal operation of the system;
- E A non-interfering shunt circuit, when a fault condition of the circuit wiring results only in the loss of the non-interfering feature operation;
- F The circuit connections extended to additional fire alarm *control unit* equipment when these wiring connections are intended to be made within 18 m of each other and are enclosed within conduit or equivalently protected against mechanical injury;
- G The circuit of a printer in the fire *signal receiving centre* is not required to be monitored for integrity regarding single *open circuit fault*, single *ground fault*, wire-to-wire *short circuit faults*, or printer malfunction; and
- H The interconnecting wiring of a stationary computer and the computer's keyboard, video monitor, mouse-type device, or touch screen, provided that the equipment is installed in accordance with CAN/ULC-S561, Standard for the Installation and Services for Fire Signal Receiving Centres and Systems, the interconnecting wiring does not exceed 2.4 m; and failure of cable does not cause the failure of the required system functions not initiated from the keyboard, mouse, or touch screen.

4.7 VISUAL DISPLAYS, CONTROLS AND RECORDING DEVICES

4.7.1 Visual displays and controls for fire *signal receiving centre* and systems shall:

- A Be located and grouped for convenient viewing and operation by one person at one location;
- B Clearly indicate that the displayed information is either a fire alarm, fire supervisory, fire trouble, monitoring (medical, panic, or security) or other conditions (user definable);
- C Have a means for testing of visual indicators that are not supervised; and
- D Ensure that any internally monitored condition of a fire *signal receiving centre* equipment other than the signals in Clause 4.7.2 shall be annunciated visually and/or audibly for normal to off-normal status change. A printout shall not be acceptable as the only means of annunciation.

4.7.2 Any status changes that occur in an initiating device at the protected premises shall be presented at the fire *signal receiving centre* in a format that expedites prompt operator interpretation. Status change signals shall provide the following information:

- A Identification of the type of signal to show whether it is a fire alarm, fire supervisory, fire trouble, monitoring (medical, panic, or security), or other conditions (user definable);
- B Identification of the signal to differentiate between an initiation of a fire alarm, fire supervisory, fire trouble, monitoring (medical, panic, or security), or other conditions (user definable), and a restoration or return to normal from one or more of these conditions; and
- C Identification of the protected premise location for each status change signal.

4.7.3 The type of recording and display or indication of received signals shall meet all of the following conditions:

- A Each incoming signal requiring action to be taken by the operator shall result in an audible signal and not less than two methods of displaying the type, condition, and location of the status change. The same audible means may be used to indicate all status changes;

NOTE: Two methods of display are required to permit continued operation in the event of failure of one display. As an example, a printer and visual display would meet the intent of this requirement.

- B Each incoming signal shall be automatically recorded. The record shall provide the type of signal, condition, and location in addition to the time and date the signal was received. Recording devices shall be capable of recording 50 events within 90 s and shall meet all the requirements of this Standard;
- C The visual indication of an acknowledged status shall be distinct from an unacknowledged status and each status shall be maintained until acknowledged at the receiver;
- D Failure to acknowledge or act upon an incoming signal shall not prevent subsequent signals from being received, indicated, or displayed, and recorded;
- E Failure of a recording device shall not result in the loss of any incoming signal or signal record;
- F If a single display, which does not permit viewing of all received signals concurrently, is used, the display shall either:
- i) Retain each signal on the visual display until manually acknowledged. The display shall also indicate if additional signals are waiting to be displayed; or
 - ii) Sequentially display each received signal in a scrolling manner until each signal is manually acknowledged. Each signal shall be displayed a minimum of 2 s and a maximum of 5 s during each scroll;
- G For *proprietary fire alarm system* receiving equipment when concurrent signals are received, they should be displayed as follows in descending order of priority:

INPUT LEVEL	PRIORITY
Fire alarm signals	1
Signals related to life safety emergency conditions	2
Fire supervisory signals	3
Signals associated with property and building safety	4
Trouble signals associated with fire alarm, life and/or property safety	5
Other	6

- H For *proprietary fire alarm system* receiving equipment, means shall be provided for the operator to re-display any alarm, supervisory, or *trouble signals* which have been acknowledged but for which a restoration to normal signal has not been received; and
- I The recording device shall be subject to the requirements of Clause 4.7.5, Sections 8, Construction, 9, Marking, and 10, Performance Tests.

4.7.4 A computer work station used as one of the required displays or as fire *signal receiving centre* equipment shall comply with all the requirements of this section. Mechanical protection shall be provided if failure of the computer or its associated components such as monitor, mouse or storage device, inhibit the normal operation of the fire *signal receiving centre*.

4.7.5 Printers, displays, control functions etc. may be provided by and/or operated from external *automation systems* provided:

- A A fault does not impair normal operation of the fire *signal receiving centre* equipment; and
- B The communication between signal receiving equipment and *automation system* shall be supervised. Upon the failure of the *automation system* the required functions of the receivers connected to the *automation system* (which may be suppressed) shall revert to their normal operation as required in Section 4.7.3.

4.8 MANUAL CONTROLS

4.8.1 All manual controls shall comply with the following:

- A Clearly marked for intended function in accordance with Table 2, Label Designations;
- B Physically protected and secured against operation by unauthorized personnel;
- C Where applicable, space shall be provided for adequate field labeling; and
- D Provide *trouble signal* when control is not in its normal position.

5 COMMUNICATION SYSTEMS

5.1 GENERAL

5.1.1 In order to prevent degradation of the signal in transit, reliability of the communication of alarm, supervisory, and *trouble signals* shall be achieved by any of the following:

- A Signal repetition — multiple transmissions repeating the same signal;
- B Parity check — a mathematical checksum algorithm of a digital message that verifies correlation between transmitted and received message; or
- C An equivalent means to (A) or (B) that provides a certainty of 99.99 % that the received message is identical to the transmitted message.

5.1.2 The maximum number of *signal transmitting units* connected to any transmission channel shall be in accordance with the manufacturer's recommendations.

5.1.3 Where a portion of the *communications system* cannot be monitored for integrity, a redundant *communication channel* shall be provided, and:

- A Provision shall be made to monitor the integrity of the redundant communications path; and
- B Failure of both the primary and redundant communications paths shall be annunciated at the fire *signal receiving centre* within 24 h of the failure.

5.1.4 The maximum duration between the initiation of an alarm at the *signal transmitting unit* at the protected premises, transmission of the signal, and subsequent display and recording of the alarm signal at the fire *signal receiving centre* shall not exceed 60 s.

5.1.5 The maximum duration between the time of the initiation of any status change other than an alarm at the protected premises, transmission of the signal, and subsequent display and recording of the signal at the fire *signal receiving centre* shall not exceed 90 s.

5.1.6 *Communication systems* shall be capable of receiving signals from multiple protected premises at an average rate of no less than one fire alarm signal every 10 s.

5.1.7 Concurrent status changes occurring at the input of a *signal transmitting unit* shall be transmitted to the fire *signal receiving centre* in a priority manner.

Exception: When all inputs (alarm and status change) can be transmitted within 60 s the transmissions are not required to be prioritized.

5.1.8 For transmitters that buffer events for subsequent transmission, the contents of the event buffer shall be transmitted following the priority levels indicated.

5.1.9 The priority levels of signals shall be as follows:

<u>INPUT LEVEL</u>	<u>PRIORITY</u>
Fire alarm signals	1
Signals related to life safety emergency conditions	2
Fire supervisory signals	3
Signals associated with property and building safety	4
<i>Trouble signals</i> associated with fire alarm, life and/or property safety	5
Other	6

5.1.10 The integrity of all *communication systems* and all *communication channels* (including redundant channels) shall be monitored at the fire *signal receiving centre*.

5.1.11 Remote *signal transmitting unit* programming or configuration access shall require the use of a valid password, the panel's account or network address, and a hardware or software key to enable a remote programming mode. If an internet connection is used, the data shall be encrypted and an audit trail shall be created in the subscriber *control unit* and/or the fire *signal receiving centre* listing the data change. Remote alteration of the fire *control unit* software is not acceptable through the remote *signal transmitting unit*.

5.1.12.1 A *communication channel* using public access packet switched data networks shall detect the introduction into the *communication channel* of digital information that has been previously exchanged between the protected premises and the fire *signal receiving centre*. Such a *compromise* attempt shall be automatically detected and indicated within 180 s at the signal centre equipment. For testing purposes a device that has been programmed accordingly shall be used to capture and analyze the digital data that is being transmitted in order to produce a signal which simulates the original transmitted data signal.

5.2 COMMUNICATION TYPES

5.2.1 This section describes the types of communication between the protected premises and the fire *signal receiving centre*. These communication types may be classified as:

- A *Active communication systems*; and
- B *Passive communication systems*.

5.3 ACTIVE COMMUNICATION SYSTEMS

5.3.1 Any fault of an *active communication* system shall be annunciated and recorded at the fire *signal receiving centre* within 180 s of the occurrence of the fault.

5.3.2 Protected premises that are unable to communicate signals to the fire *signal receiving centre* as a result of a fault of an *active communication* system shall be indicated at the fire *signal receiving centre*.

5.4 PASSIVE COMMUNICATION SYSTEMS

5.4.1 Where *passive communication* systems are used there shall be two or more separate *communication channels* and at least two of the *passive communication channels* shall use non-interdependent types of communications. A *communication channel* is a path extending from the protected premises.

Exception: If only one type of passive communication is available at the protected premises, there shall be two channels provided. Separate paths throughout the protected premises and through any common carrier or third party communications network to the fire signal receiving centre shall be provided for each communication channel.

5.4.2 *Passive communication* systems may use one or more communication types in tandem to form a *communication system*.

5.4.3 *Passive communication* systems for fire *signal receiving centre* service shall not share a common *communication channel* from the protected premises.

5.4.4 Each *communication channel* shall be supervised for faults, which prevent the communications between the protected premises and the fire *signal receiving centre*.

5.4.5 Alarm signals shall be transmitted simultaneously over all *communication channels*. *Trouble signals* and supervisory signals may be transmitted over one channel. If the signal is not received and acknowledged, it shall be transmitted over an alternative channel.

5.4.6 Each *communication channel* shall be tested for functionality at intervals not exceeding 24 h.

5.4.7 The failure of any *communication channel* shall cause the *communication system* to send a *trouble signal* on another *communication channel* within 180 s of the occurrence of the fault.

5.4.8 In the event that the failure of any of the *communication channels* cannot be transmitted to the fire *signal receiving centre* within 180 s of the detection of the failure, the failure shall be indicated at the protected premise within 15 min. The 15 min delay allows for self-restoration of the failure.

6 SOFTWARE-CONTROLLED EQUIPMENT

6.1 The release level of the software shall be visibly marked on the product or shall be capable of being displayed on a visual annunciator provided as part of the *control unit*.

6.2 Any means of altering or generating data shall not affect the firmware or site specific data, except as intended.

6.3 The execution of the *operating program* shall be monitored. The monitoring device or watchdog shall signal a *trouble signal* if routines associated with the required functions of the program are not executed within 90 s.

6.4 The function of the monitoring device or watchdog, and the *trouble signal* shall not be prevented by a failure in the execution of the *operating program*.

6.5 The alteration of the site specific program shall not be possible at Access Levels 1 or 2, as specified in Clause 6.7.

6.6 A *trouble signal* shall result within 90 s of any occurrence of the following malfunctions:

- A The system does not execute its program due to a hardware or software fault;
- B The system does not execute its program due to loss of energy to the processor or memory elements; and
- C Rotation ceases, or fails to start when required, in a system that incorporates memory-storage devices having rotating elements.

NOTE: The *trouble signal* may be common to Items A, B and C.

6.7 If applicable access levels are identified as follows:

- A Access Level 1: By Persons having a general responsibility for safety supervision, who might be expected to investigate and initially respond to a fire alarm or trouble indication;
- B Access Level 2 (optional): By persons who have a specific responsibility for safety, and who are trained to operate the fire *signal receiving centre* and systems; and
- C Access Level 3: By persons who are trained and authorized by the manufacturer to:
 - i) Re-configure the site specific data held within the fire *signal receiving centre* and systems or controlled by it; and
 - ii) Maintain the fire *signal receiving centre* and systems in accordance with the manufacturer's published instructions and data.

6.8 Where applicable, access to features and functions of a software-controlled *control unit* shall be determined according to Table 3, Access Levels.

6.9 The base *operating program* of a fire *signal receiving centre* and system upon which any mandatory requirements are predicated, shall be stored in memory in a format so as not to be accessible for modification.

6.10 A hard disk drive may be used as a memory storage device, providing manufacturer's MTBF (mean time between failures) ratings are not less than 100 000 h, and, it meets all other pertinent requirements in this Standard.

Exception: Memory storage devices described in Clause 6.10 may be used for initial loading of the operating system, database downloading where system operation is not inhibited, or providing enhancements to required annunciators. When used for this function the 100 000 MTBF ratings may be waived.

6.11 Memory for assignment and allocation of inputs, ancillary functions and/or operations shall be guarded by access levels as detailed in Clause 6.7 and Table 3, Access Level..

6.12 Site specific data in volatile memory shall be protected against power loss by a back-up energy source, which is capable of maintaining the memory contents for a minimum of 14 continuous days.

6.13 Site specific data shall have a mechanism which normally prevents the memory from being written-to during program execution.

6.14 The alteration of site specific data shall not affect the operating system.

6.15 Other software temporarily or permanently installed in the fire *signal receiving centre* and systems shall not affect the operating system or site specific data.

7 INSTRUCTIONS AND DRAWINGS

NOTE: In Canada, there are two official languages, French and English. Attention is drawn to the fact that some Canadian authorities may require markings to be in either or both official languages. Markings and/or instructions in both official languages may be required when submitting products for the purpose of testing for compliance to this Standard.

7.1 All equipment intended for use with the fire *signal receiving centre* and systems shall be furnished with operating and maintenance instructions, installation instructions, wiring drawings, and software documentation.

7.2 The operating instructions shall detail the following:

- A Identify all operating controls and their function;
- B Identify all visual and audible indicators and their function; and
- C Describe the sequence of operation for the intended system modes of operation.

7.3 The maintenance instructions shall detail the following:

- A Identify all over current protective devices requiring restoration and/or replacement, their location and rating, and the circuit protected by each;
- B Identify equipment parts including emergency power supply batteries which require periodic replacement;
- C Maintenance procedures for units, including emergency power supply batteries, and the frequency of such procedures; and
- D All test and maintenance instruction codes and software necessary to provide test and inspection requirements of CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems.

7.4 The installation instructions shall cover the following items:

- A Conduit entry for the various circuits and circuit segregation;
- B Mounting and orientation; and
- C Location of units with respect to environmental conditions, clearances for enclosure doors, and distance from floor and/or ceiling.

7.5 The installation wiring drawings shall cover the following:

- A A wiring method, which shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part I, Section 32;
- B Designation of manufacturer's recommended wire type for use with the signal transmitter and/or receiver;
- C Wire gauge related to power capacity requirement, transmission loss limitations, and/or circuit length;
- D Typical examples of wiring connections to each separately wired assembly, for equipment intended for use, and wire gauge related to terminal size, and power capacity;
- E Identify all *compatible* devices by manufacturer and model designation, or by the parameters necessary to determine compatibility;
- F Electrical input rating of equipment and electrical rating of all *extended circuits*; and
- G Impedance value for testing at which *open circuit faults*, *short circuit faults*, and *ground faults* prevent normal operation.

7.6 Software documentation shall be provided which gives an overview of the site specific software, including all available commands and instructions on how to enter/revise the site specific software.

8 CONSTRUCTION

8.1 PRODUCT ASSEMBLY

8.1.1 All components of a product necessary for its intended function, when installed (used) as intended, shall be factory built and tested.

8.1.2 If the product is shipped by the manufacturer as two or more components, installation instructions with each component positively identified shall be furnished. Each component shall be capable of being installed without requiring alteration, cutting, drilling, threading, welding, soldering, critical alignment, or similar tasks by the installer.

NOTE: This is not intended to prevent installers from cutting specific wire entrance ways as required at the installation site.

8.2 PROTECTION OF SERVICE PERSONNEL

8.2.1 An uninsulated live part at a hazardous potential 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. (See also Subsection 8.3.4, Protection from Electric Shock.)

8.2.2 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 service personnel to the likelihood of electric shock from adjacent un-insulated live parts at hazardous potential.

8.2.3 The following are not considered to be un-insulated live parts:

- A Coils of relays and solenoids, and transformer windings, if the coils and windings are provided with insulating over wraps rated for the potentials encountered;
- B Terminals and splices with insulation rated for the potential encountered; and
- C Insulated wire.

8.2.4 The means of access to a compartment containing live parts at hazardous potential not intended to be serviced with the equipment energized shall be marked in accordance with Clause 9.3.4. Any removable barrier or guard provided to shield a live part at hazardous potential shall be marked in accordance with Clause 9.3.5. A removable cover, guard or shield providing access to components connected to a voltage supply that is over 2500 V (peak) shall be hinged, chained or otherwise permanently attached, or shall be provided with an interlock in accordance with Clause 8.3.4.2.

8.2.5 Provision shall be made for the automatic discharge of the energy stored in capacitors if the safety of an area to which service personnel have access is dependent upon de-energizing the equipment, unless the equipment is marked with a clear instruction specifying the time required for discharge to a potential less than 30 V (rms) or 42.4 V (peak) if the time for self-discharge to this value is greater than 5 s.

8.3 ENCLOSURES

8.3.1 General

8.3.1.1 The product shall be enclosed or inherently constructed and enclosed so that:

- A The product is protected from damage from forces and impacts applied to the enclosure;
- B The product is protected from damage by the entry of foreign objects;
- C Protection against electrical shock from enclosed live parts is provided; and
- D Ignition by the product, of combustible material adjacent to the product, is prevented.

8.3.1.2 The enclosure of equipment having a cathode-ray tube that has a maximum screen dimension of 125 mm or more shall comply with the applicable Impact Tests and Implosion Test of CAN/CSA 60065, Audio, Video and Similar Electronic Equipment Apparatus - Safety Requirements.

8.3.1.3 Operating parts which may be affected by dust shall be enclosed to exclude entry of dust.

8.3.1.4 The enclosure of a product shall be provided with means for mounting of the product in its intended position. The mounting means shall be accessible without disassembly of any components of the product. Removal of a complete assembly is not considered to be disassembly of a component. There shall be at least 12.5 mm of free space around a key hole opening intended for mounting, and no live parts shall be located less than the minimum spacing requirements indicated in Table 4, Minimum Spacings.

8.3.1.5 The enclosure of a product shall have provision for installation wiring entry by means of conduit openings in accordance with Subsection 8.3.10, Cast Metal Enclosures.

8.3.1.6 An enclosure, edge, frame, projection, guard, opening, handle or similar construction shall be smooth and free from sharp edges that are capable of injury to persons during intended maintenance and use.

Exception: A sharp edge that should be exposed to enable the product to perform its intended function.

8.3.1.7 For edges where the degree of sharpness cannot be determined by inspection, compliance with Clause 8.3.1.6 shall be determined by the test procedure in UL 1439, Standard for Test for Sharpness of Edges on Equipment.

8.3.2 Enclosure Strength and Integrity

8.3.2.1 The frame and enclosure of a product shall be sufficiently strong and rigid to resist total or partial collapse with attendant reduction of spacings, loosening or displacement of parts and development of other conditions which could impair operation of the product and increase the *risk of fire* or electrical shock. The enclosure shall also provide the required degree of product protection from damage by the entry of foreign objects.

8.3.2.2 In determining compliance with Clause 8.3.2.1, all elements that contribute to the enclosing function, including enclosures of individual components, shall be considered.

8.3.2.3 An enclosure shall be considered to comply with Clause 8.3.2.1 if it complies with the minimum thickness requirements specified in Table 5, Cast Metal Enclosures; Table 6, Minimum Thickness of Sheet Metal for Enclosures and Barriers, Carbon Steel or Stainless Steel; or Table 7, Minimum Thickness of Sheet Metal for Enclosures and Barriers, Aluminum, Copper, or Brass; or if it complies with the Subsection 10.21, Mechanical Strength Tests for Enclosures, and the applicable requirements of Subsections 8.3.6, Enclosure Openings-General; 8.3.7, Enclosure Openings-Top; 8.3.8, Enclosure Openings-Sides and Front; and 8.3.9, Enclosure Openings-Bottom.

8.3.3 Stability

8.3.3.1 Under all conditions of servicing and intended use, a fully assembled product shall not become physically unstable to the degree that creates a risk of injury to operators or service personnel.

8.3.3.2 A product shall not tip over when tilted 10° from its intended, upright position, while all doors, covers, gates, drawers, and similar parts are in place and closed, and all casters and jacks, when provided, are in their most unfavourable position.

Exception: For fixed or stationary equipment without casters where specialized handling is required to transport the product, this test is to be performed after the equipment is installed as intended.

8.3.3.3 The requirements in Clauses 8.3.3.4 through 8.3.3.8 shall apply to all freestanding products. A freestanding product is defined as one that is floor standing and not intended to be secured to other units or to the floor or other parts of the building.

8.3.3.4 In conducting the tests described in Clauses 8.3.3.5 through 8.3.3.7, the equipment shall be installed as intended. All casters and jacks, when provided, are to be placed in their most unfavorable positions, and wheels are to be locked or blocked. However, when casters are being used only to transport the product, and jacks are lowered after installation, then the jacks (and not the casters) are to be used in their most unfavourable position for the test, consistent with reasonable levelling of the product.

8.3.3.5 A freestanding product that has an external surface (work top or ledge) at a height not exceeding 1.00 m from the floor and that is prone to being stepped on or sat upon, shall not tip over when a continuous downward force of 800 N is applied to that surface at the point of maximum moment. For this test, all doors, covers, gates, drawers, and similar parts shall be in place and closed.

8.3.3.6 Products described in Clause 8.3.3.5 shall not include delicate parts such as keyboards, control panels, or spools which shall not be considered as prone to being stepped on or sat upon.

8.3.3.7 A freestanding product more than 1.00 m high and weighing more than 25.0 kg shall not tip over when a force equal to 1/5 the weight of the unit but not more than 250 N is applied in any direction, except upward, at a height not exceeding 2.00 m from the floor. For this test, all doors, drawers, frames, and the like that can be opened for operator or serviceman servicing are to be opened and in the most unfavourable position. Separate tasks are to be performed when operator and service extensions are different or when special stabilizers are used in accordance with Clause 8.3.3.8.

8.3.3.8 A stabilizing means is not prohibited from being used to improve stability when doors, drawers, and the like are opened. The stabilizing means shall be automatic in operation or interlocked when associated with user use. For service personnel, where it is not automatic in operation, a conspicuous marking shall be provided to caution the personnel on its use. See Clause 9.3.6.

8.3.4 Protection from Electric Shock

8.3.4.1 Electrical parts of a product shall be enclosed to provide protection from unintentional contact with uninsulated live parts at hazardous potential. A shock hazard from such contact is considered to exist if the open-circuit potential is higher than 42.4 V (peak) and the available current or stored energy exceeds the values specified in Subsection 10.9, Electric Shock Current Test. The probe illustrated in Figure 2, Articulate Probe, is to be used to determine that an uninsulated live part cannot be contacted under the following conditions:

- A The probe may be articulated into any configuration and may be rotated or angled to any position before, during or after insertion into the area being investigated;
- B Doors restricting access to operating controls shall be in the open position. Doors and covers not equipped with an interlock providing access to compartments containing components which may require servicing with the equipment energized shall be opened or removed. Any removable barrier or guard provided to shield a live part, and marked in accordance with Clause 9.3.5, shall remain in place while applying the probe for the purpose of this requirement; and

Exception: This requirement does not apply to the screw shell of a lamp holder or equivalently mounted components.

- C Product parts such as covers, doors, panels and grilles used as part of the enclosure are to be removed unless a tool or key is required for their opening or removal, or an interlock is provided.

8.3.4.2 An interlock that is relied on for protection from electric shock shall be arranged so that:

- A It cannot be reset inadvertently;
- B If it can be actuated intentionally so as to restore power to the de-energized parts, the re-closing or replacement of the cover, door, panel or grille will automatically restore the interlock to a position in which it will perform as intended when the cover, door panel or grille is next opened or removed; and
- C A *trouble signal* will result when the interlock operates.

8.3.4.3 A product incorporating exposed metal parts which could be energized to a hazardous potential level as a result of an abnormal condition within the product shall be provided with means for grounding. All equipment shall have a grounding terminal means complying with the requirements of CSA-C22.2 No. 0.4, Bonding of Electrical Equipment. Except as provided within the Standard, the grounding terminal

means shall be used for no other purpose. Notwithstanding the need for bonding and grounding for protection against electrical shock, metal enclosures and dead metal parts which are likely to become energized shall be bonded and grounded for *ground fault* detection reasons.

8.3.4.4 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 0.5 W, and shall be effective with the power control in either the “on” or “off” position.

Exception: The conductive connection need not be provided if such a connection is established in the event of electrical breakdown of the antenna isolating means; the breakdown does not result in a risk of electric shock; and, 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 M Ω .

8.3.4.5 The maximum resistance value of 5.2 M Ω specified in Clause 8.3.4.4 is to include the maximum tolerance of the resistor value used; that is, a resistor rated 4.2 M Ω with 20 % tolerance or a resistor rated 4.7 M Ω 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 0.25 W.

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

8.3.4.7 A product incorporating separately energized control circuits at hazardous potential shall comply with the following:

- A The separately energized control circuits shall not exceed 150 V to ground; or
- B The installation wiring drawing for the product required by Clause 8.5 shall detail grouping, identification and warning marking of the disconnecting means as required by CSA C22.1, Part I, Safety Standard for Electrical Installations; or
- C The bare live parts associated with the separately energized control circuits are protected against inadvertent contact by means of barriers and the product or protecting barriers are marked with a warning sign complying with Subsection 9.3, Cautions or Warnings.

8.3.5 Confinement of Fire Hazards

8.3.5.1 The enclosure of a product not energized from a Class 2 supply or containing other than Class 2 circuits, shall be of a material and constructed so as to prevent the emission or propagation of flame, molten metal, flaming or flowing particles, or flaming drops originating from the product. The evaluation of fire hazard confinement shall include direct expulsion of material by explosion of a component based on the maximum energy available to the component. See also Subsection 8.7.7, Capacitors. The maximum energy available to a product shall include the energy from an integral or externally located emergency power supply battery.

8.3.5.2 In determining compliance with Clause 8.3.5.1, all elements that contribute to confinement of fire hazard, including enclosures of individual components, shall be considered.

8.3.5.3 An enclosure shall be considered to comply with Clause 8.3.5.1 if it complies with the following tests, as applicable:

- A Subsection 10.20, Abnormal Operation Tests;

- B Subsection 10.22, Flame Test for Polymeric Materials; and
- C Requirements of Clauses 8.3.6.1 and 8.3.6.2.

8.3.6 Enclosure Openings – General

8.3.6.1 An enclosure intended for recessed mounting and whose front panel is to be flush with the surface of the wall shall have no openings that vent into concealed spaces of a building structure, such as into hollow spaces in the wall, when the product is mounted as intended.

8.3.6.2 The requirement in 8.3.6.1 does not apply to an opening for a mounting screw or nail or for a manufacturing operation (such as paint drainage) when:

- A An opening for non-mounting purposes does not have a dimension greater than 7 mm or an area greater than 35.5 mm²;
- B An opening for mounting does not have a dimension greater than 19.05 mm or an area greater than 430 mm² and there are no more holes than are needed to mount the product; and
- C Where more than four mounting screws are required additional mounting holes shall be not more than 300 mm apart.

8.3.7 Enclosure Openings – Top

8.3.7.1 An opening directly over an uninsulated live part involving a *risk of fire*, electric shock, or electrical-energy/high-current levels, shall not exceed 5.0 mm in any dimension unless the configuration is such that a vertically falling object cannot fall into the unit and contact an uninsulated live part. See Figure 3, Cross Sections of Top Cover Designs, for examples of top cover designs complying with the intent of the requirement.

8.3.8 Enclosure Openings – Sides and Front

8.3.8.1 An opening in the side of the enclosure shall:

- A Not exceed 4.8 mm in any dimension;
- B Be provided with louvers shaped to deflect an external falling object outward. See Figure 4, Cross Sections of Louver Designs, for examples of louver designs complying with the requirement; or
- C Be located and sized so that objects which are present cannot drop into the unit and fall (with no horizontal velocity) onto uninsulated live parts involving a *risk of fire*, electric shock, or electrical-energy/high-current levels, or parts involving injury to persons. (See Figure 5, Example of Enclosure Side Opening).

8.3.8.2 When a portion of a side panel falls within the area traced out by the 5° angle in Figure 5, Example of Enclosure Side Opening, that portion of the side panel shall be investigated as a bottom enclosure in accordance with Subsection 8.3.9, Enclosure Openings – Bottom.

8.3.9 Enclosure Openings – Bottom

8.3.9.1 The bottom of an enclosure shall consist of a complete or partial bottom enclosure under a component, groups of components, or assemblies, as shown in Figure 6, Enclosure Bottom, that complies with the ventilation opening requirements in Clauses 8.3.9.2 and 8.3.9.3 unless a test demonstrates that the bottom enclosure provided contains flames, glowing particles or similar burning debris when all combustible material in the interior is ignited.

Exception: Openings without limitation on their size and number are permitted in areas that contain only wires, cables, plugs, receptacles, and impedance- and thermally-protected motors.

8.3.9.2 Ventilation openings provided in the bottom of an enclosure under materials that are not rated V-1 or less flammable meet the intent of the requirements when the openings are constructed so that materials do not fall directly from the interior of the unit. Other bottom opening constructions that comply with the intent of the requirements are those that incorporate a perforated metal plate as described in Table 8, Perforated Metal Plates, or a galvanized or stainless-steel screen having a 14 by 14 mesh per 25.4 mm constructed of wire with a minimum diameter of 0.4 mm. Other constructions are to be used only when they comply with the Subsection 10.23, Ignition Test Through Bottom-Panel Openings.

8.3.9.3 The bottom of the enclosure under areas containing only materials rated V-1 or less flammable shall have openings no larger than 40 mm².

8.3.10 Cast Metal Enclosures

8.3.10.1 The minimum thickness of parts of an enclosure die-cast of zinc-alloy specified in ASTM B240, Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloys in Ingot Form for Foundry and Die Castings, shall be as indicated in Table 5, Cast Metal Enclosures. Enclosures of lesser thickness are acceptable if due to the shape and size, equivalent mechanical strength is obtained and the product complies with Subsection 10.21, Mechanical Strength Tests for Enclosures.

8.3.10.2 Enclosures of other alloys or cast by other methods are acceptable if the minimum thickness of metal is not less than indicated in Table 5, Cast Metal Enclosures, and the product complies with Subsection 10.21, Mechanical Strength Tests for Enclosures.

8.3.10.3 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, there shall be not less than 3-½ nor more than 5 threads in the metal, and the construction shall be such that a standard conduit bushing can be properly attached.

8.3.10.4 If threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall be not less than 3-½ full threads in the metal, and there shall be a smooth, rounded inlet hole which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

8.3.10.5 A product constructed in such a manner as to be supported by rigid conduit shall be provided with conduit hubs, or the equivalent, having not less than 5 full threads.

8.3.11 Sheet Metal Enclosures

8.3.11.1 The thickness of sheet metal employed for the enclosure of a product shall be not less than that indicated in Table 6, Minimum Thickness of Sheet Metal for Enclosures and Barriers, Carbon Steel or Stainless Steel; and in Table 7, Minimum Thickness of Sheet Metal for Enclosures and Barriers, Aluminum, Copper, or Brass.

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.

8.3.11.2 A plate or plug closure for an unused conduit opening or other hole in the enclosure shall have a thickness not less than:

- A 0.36 mm for steel or 0.48 mm for nonferrous metal for a hole having a maximum dimension of 6.4 mm; or
- B 0.69 mm for steel or 0.81 mm for nonferrous metal for a hole having a maximum dimension of 35 mm.

8.3.11.3 A hole larger than 35 mm diameter shall have a closure whose thickness is not less than that required for the enclosure of the product or shall have a standard knockout seal. Such plates or plugs shall be securely mounted.

8.3.11.4 A knockout in a sheet metal enclosure shall be secured but shall be capable of being removed without undue deformation of the enclosure.

8.3.11.5 A knockout shall be provided with a surrounding surface area of sufficient size to permit seating of a conduit bushing, and shall be so located that a bushing employed at any knockout likely to be used during installation will not result in spacings between uninsulated live parts and the bushing of less than those indicated under Subsection 8.15, Spacings.

8.3.11.6 A sheet metal member to which a wiring system is to be connected in the field shall have a thickness 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.

8.3.12 Nonmetallic Enclosures

8.3.12.1 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, resistance to arc tracking, and resistance to distortion and creeping at temperatures to which the material may be subjected. All these factors are considered with respect to ageing. See also Subsection 10.21, Mechanical Strength Tests for Enclosures; and Subsection 10.22, Flame Test for Polymeric Materials.

8.3.12.2 A connection box or similar compartment having provisions for conduit connection of installation wiring, and a suitable grounding terminal means, shall be provided.

8.3.12.3 The metal plate to which conduit or armoured cable is attached shall be suitable for the conduit or cable to be secured, but in any case, if of sheet steel shall be not less than 0.75 mm thick and not less than 1.09 mm thick if of nonferrous metal.

8.3.12.4 A plate or plug closure for an unused conduit opening or other hole in the connection box or similar compartment shall have a thickness not less than:

- A 0.36 mm for steel or 0.48 mm for nonferrous metal for a hole having a maximum dimension of 6.4 mm; or
- B 0.69 mm for steel or 0.81 mm for nonferrous metal for a hole having a maximum dimension of 35 mm.

8.3.12.5 A hole larger than 35 mm diameter shall have a closure whose thickness is not less than that required for the connection box or similar compartment or shall have a standard knockout seal. Such plates or plugs shall be securely mounted.

8.3.12.6 A knockout in the connection box or similar compartment shall be secured but shall be capable of being removed without undue deformation of the connection box or compartment.

8.3.12.7 A knockout shall be provided with a surrounding surface area of sufficient size to permit seating of a conduit bushing, and shall be so located that a bushing employed at any knockout likely to be used during installation will not result in spacings between uninsulated live parts and the bushing of less than those indicated under Subsection 8.15, Spacings.

8.3.12.8 Conductive coatings applied to nonmetallic surfaces such as the inside surface of an enclosure, shall comply with the appropriate requirements in CAN/CSA-C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials, unless flaking or peeling of the coating cannot result in the reduction of spacings or the bridging of live parts.

8.3.12.9 A polymeric enclosure intended for connection to a rigid metallic conduit system shall comply with the requirements for polymeric enclosure rigid metallic conduit connections in CAN/CSA-C22.2 No. 94, Special Purpose Enclosures.

8.3.12.10 The continuity of a conduit system shall be provided by metal-to-metal contact and not rely on a polymeric material and shall comply with the requirements for polymeric enclosure bonding in CAN/CSA-C22.2 No. 94, Special Purpose Enclosures.

8.3.12.11 Polymeric material that is not used as an enclosure, but that is attached to or exposed on the outside of a product such as a viewing window, shall have flammability characteristics as shown in Table 9, Flammability Characteristics of Polymeric Material.

8.3.13 Screens and Expanded Metals

8.3.13.1 Screens and expanded metal used as a guard, enclosure or part of an enclosure, shall comply with the applicable requirements of Subsections 8.3.2, Enclosure Strength and Integrity; 8.3.4, Protection from Electric Shock; and 8.3.5, Confinement of Fire Hazards.

8.3.14 Enclosure Cover

8.3.14.1 If the product is intended for installation in an unsecured area, an enclosure cover shall be provided, and it shall be secured by means requiring the use of a tool or key for opening to prevent unauthorized access.

8.3.14.2 An enclosure cover to permit access to operating controls shall be hinged and shall be secured by non-removable integral means not requiring the use of a tool for opening. For the purpose of securing the cover, a latch, catch, captivated screw, or a keylock actuated by a removable key is acceptable (provided compliance with Clause 8.3.14.1 is observed), but a removable screw is not acceptable.

8.3.14.3 An enclosure cover shall be secured by non-removable integral means if opening of the cover is necessary for periodic maintenance including maintenance testing, but access to operating controls is not involved. For the purpose of securing the cover, a latch, catch, captivated screw, or a keylock actuated by a removable key, is acceptable provided compliance with Clause 8.3.14.1 is observed.

8.3.14.4 Glass covering an observation opening shall be tempered and secured in place so that it cannot be displaced and shall provide mechanical protection for the enclosed parts. The thickness of a glass cover shall not be less than that indicated in Table 10, Thickness of Glass Covers.

8.3.14.5 A glass panel for an opening having an area of more than 929 cm², or having any dimension greater than 305 mm, shall be supported by a continuous groove not less than 4.8 mm deep along all four edges of the panel, or other means that have been determined to be an equivalent arrangement.

8.3.14.6 A transparent material other than glass used for the cover of an observation opening shall be secured in place by a mechanical means and not introduce a *risk of fire*, distort, nor become less transparent at the temperature to which it is intended to be subjected under either normal or abnormal service conditions.

8.3.15 Corrosion Protection

8.3.15.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other means that have been determined to be equivalent, when corrosion of unprotected parts results in a *risk of fire*, electric shock, injury to persons, or impairment of operation of a product.

Exception No. 1: Surfaces of sheet-steel and cast-iron parts within an enclosure are not required to be protected against corrosion when oxidation of the metal due to exposure to air and moisture is not likely to weaken the parts to result in a condition of risk. The thickness of metal and temperature are also to be evaluated.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, and similar equipment, are not required to be protected against corrosion.

8.4 MECHANICAL ASSEMBLY

8.4.1 All parts of a product shall be mounted in position and prevented from loosening or turning when such motion may adversely affect the performance of the product, or may increase the *risk of fire*, electric shock, and/or injury to persons incident to the operation of the product.

8.4.2 A switch, fuseholder, lampholder, attachment-plug receptacle, motor-attachment plug, or other similar component shall be mounted securely and shall not turn.

Exception No. 1: When the turning of a switch is possible, all four of the following conditions shall be met:

- A The switch shall be of a plunger, slide, or other type that does not tend to rotate when operated. A toggle switch is determined to be subject to forces that tend to turn the switch during intended operation of the switch;*
- B The means for mounting the switch makes it unlikely that operation of the switch loosens it;*
- C The spacings are not reduced below the minimum required values when the switch rotates; and*
- D The intended operation of the switch is by mechanical means rather than by direct contact by persons.*

Exception No. 2: When rotation does not reduce spacings below the minimum required value, 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 non-removable jewel, complies with the intent of the requirement.

8.4.3 Friction between surfaces shall not be used for securing the position of the components specified in Clause 8.4.2.