

Subject 2610

July 6, 2018

SUMMARY OF TOPICS

1. Proposed First Edition of the Standard for Commercial Premises Security Alarm Units and Systems, UL 2610

STP BALLOTS AND ALL COMMENTS DUE: SEPTEMBER 4, 2018

UL's goal is to have no interest category comprise more than one-third of the STP membership balance. To improve the current balance for STP 205A, UL is looking for participants in the AHJ, Commercial/Industrial User, Consumer, Government, Supply Chain and Testing & Standards interest categories. Definitions for these interest categories are available on the Standards STP Internet site:

<http://ulstandards.ul.com/develop-standards/participation/interest-categories/>

If you are interested in applying for STP 205A membership or are aware of potential candidates for this STP, please contact the STP Project Manager, Nicolette.A.Weeks@ul.com.

1. Proposed First Edition of the Standard for Commercial Premises Security Alarm Units and Systems, UL 2610

RATIONALE

Proposal submitted by: Lou Chavez, UL LLC and Al Policano, UL LLC

This is a new standard that combines the following existing UL Standards:

UL 365, Police Station Connected Burglar Alarm Units and Systems;

UL 603, Power Supplies for Use with Burglar-Alarm Systems;

UL 609, Local Burglar Alarm Units and Systems;

UL 636, Holdup Alarm Units and Systems;

UL 1076, Proprietary Burglar Alarm Units and Systems;

UL 1610, Central-Station Burglar-Alarm Units; and

UL 1635, Digital Alarm Communicator System Units.

This new standard is intended to replace the seven standards mentioned into a single document, the Standard for Commercial Premises Security Alarm Units and Systems, UL 2610.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

CONTENTS

INTRODUCTION

1	Scope	8
1.1	General	8
1.2	Central Station Burglar Alarm	9
1.3	Police Station Connected Burglar Alarm	9
1.4	Local Burglar Alarm	9
1.5	Proprietary Burglar Alarm	10
1.6	Holdup Alarm	10
1.7	Digital Alarm Communicator Units	10
1.8	Burglar Alarm Power Supplies	11
1.9	Common Requirements	11
2	Components	12
3	Units of measurement	12
4	Undated references	12
5	Terminology	12
6	Glossary	12
7	Information Required for Assessment	25
8	Version Number	25

CONSTRUCTION

ASSEMBLY

9	General	26
9.1	Specific product requirements	26
9.2	Product assembly	26
9.3	Electrical protection	27
10	Servicing Protection	27
10.1	General	27
10.2	Trained service personnel	28
10.3	Antenna terminal discharge assembly	28
11	Enclosures	28
11.1	General	28
11.2	Doors and covers	31
11.3	Enclosure openings	31
11.3.1	General	31
11.3.2	Enclosure top openings	34
11.3.3	Enclosure side openings	35
11.3.4	Enclosure bottom openings	38
11.4	Screens and expanded metal	39
11.5	Cast metal	39
11.6	Sheet metal	40
11.7	Polymeric materials	43
11.8	Internal materials	43
11.9	Product enclosure mounting	44
11.10	Battery compartments	44
12	Electric Shock	44
13	Corrosion Protection	44

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents

Document Sharing Hub

FIELD WIRING CONNECTIONS

14	General	45
15	Cord-Connected Products	45
16	Permanently-Connected Products	47
17	Other Field-Wiring Connections	49
17.1	General	49
17.2	Field-wiring terminals (general application)	50
17.3	Field-wiring terminals (qualified application)	51
17.4	Field-wiring leads	52
17.5	Power-limited circuits	53
17.6	Communication circuits	54
18	Grounding	54

INTERNAL WIRING

19	General	58
20	Wiring Methods	59
21	Separation of Circuits	60

COMPONENTS, ELECTRICAL

22	General	60
22.1	Mounting of components	60
22.2	Insulating materials	61
22.3	Current-carrying parts	62
23	Protective Devices	62
24	Printed-Wiring Boards	63
25	Transformers and Coils	63
26	Semiconductors	64
27	Across-the-Line Components	64
28	Capacitors	64
29	Voltage-Dropping Resistors	64
30	Switches	64
31	End-of-Line Devices	65
32	Batteries	65
32.1	Rechargeable (secondary) batteries	65
32.2	Nonrechargeable (primary) dry-cell batteries	66
32.3	Lithium batteries	67

SPACINGS

33	General	67
34	Components	69

PERFORMANCE

35	All Units	70
35.1	Specific product information	70
35.2	Test units and data	70
35.3	Test samples and miscellaneous data	70
35.4	Test voltages	71

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

OPERATION

36	Power Over Communications Cable Equipment	71
36.1	General	71
36.2	Installation and Operation	72
36.2.1	Communications circuits	72
36.2.2	Location of midspan PSE or power injector	72
36.2.3	Cabling requirements	72
36.2.4	Additional requirements	72
36.3	Markings	73
36.4	Installation and operating instructions	73
37	Software-Based Receiving Equipment	73
38	Remotely Accessible Control Units	76
38.1	General	76
38.2	Validation of remote access credential	77
38.3	Communication	78
38.4	Communication data integrity standards	79
38.5	Software/Firmware upgrade	80
38.6	Data integrity standards	81
38.7	Software/Firmware deployment process	81
38.8	Event log	82
39	Normal Operation Tests	82
39.1	General	82
39.2	Burglar alarm – Central Station; Proprietary	85
39.3	Burglar alarm – Police Station Connected; Local	85
39.3.1	Mercantile premises alarm systems	85
39.3.2	Mercantile safe and vault alarm systems	86
39.3.3	Bank safe and vault alarm systems	87
39.4	Holdup alarm	88
39.5	Burglar alarm power supplies	90
39.6	Outside alarm devices	90
39.7	Intrusion and perimeter detection devices	90
40	Communication Operation Tests	90
40.1	General	90
40.2	Single path transmission methods	92
40.3	Transmitter systems	93
40.3.1	Code transmitter (McCulloh)	93
40.3.2	Digital Alarm Communicator Transmitter (DACT)	95
40.4	One-way radio (RF) systems	99
40.5	Two-way radio (RF) systems	99
40.6	Multiplex systems	99
40.7	Packet Switched Data Networks (PSDN)	102
40.8	Dual path transmission methods	103
40.9	Central/Proprietary/Police (Monitoring) station units	106
40.10	Automation system units	106
40.11	Satellite/Subsidiary stations	107
40.12	Private radio facilities	107
40.13	Acknowledgment signal	108
40.14	Standard line security equipment	108
40.15	Encrypted line security equipment	110
41	Electrical Supervision Test	110

COMMON TESTS

*UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM*



Documents

Document Sharing Hub

42	Incorrect Connection Test	112
43	Input Measurement Test	112
44	Output Measurement Test	112
45	Power-Limited Circuits Test	113
45.1	General	113
45.2	Maximum voltage	115
45.3	Maximum current	116
45.4	VA _{max} (not inherently limited circuits only)	116
46	Undervoltage Operation Test	116
47	Overvoltage Operation Test	117
48	Variable Ambient Test	117
49	Humidity Test	117
50	Leakage Current Test	118
51	Electric Shock Current Test	121
52	Overload Test	125
52.1	General	125
52.2	Separately energized circuits	126
52.3	Power supplies	126
53	Endurance Test	126
53.1	General	126
53.2	Police Station Connected and Local burglar alarm units	127
53.3	Power supplies	127
53.4	Integral operating devices	128
53.5	Separately energized circuits	128
54	Jarring Test	128
55	Dielectric Voltage-Withstand Test	130
56	Temperature Test	131
57	Power Failure Test	135
57.1	General	135
57.2	Rechargeable (secondary) batteries	136
57.3	Nonrechargeable (primary) batteries	137
57.4	Test method - general	137
57.5	Test method – proprietary burglar alarm	139
57.6	Test method – holdup alarm	139
57.7	Test method – power supplies	140
58	Abnormal Operation Test	140
59	Electrical Transient Tests	141
59.1	General	141
59.2	Supply line transients	141
59.3	Internally induced transients	142
59.4	Input/output circuit transients	142
60	Radio Frequency Interference (RFI) Test	148
61	AC Induction Test	148
62	Polymeric Materials Test	149
63	Battery Replacement Test	149
64	Drop Test	150
65	Strain Relief Test	150
65.1	Supply cord	150
65.2	Field-wiring leads	151
66	Mechanical Strength Tests for Enclosures	151
67	Attack Tests	152
67.1	General	152
67.2	Mercantile premises alarm applications	152

UL COPYRIGHTED MATERIAL –
 NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
 DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

67.2.1 Off-premises alarm communicator	152
67.2.2 Alarm sounding device	153
67.2.3 Test method	155
67.3 Bank safe and vault alarm applications	156
67.3.1 Off-premises alarm communicator	156
67.3.2 Alarm sounding device	156
67.3.3 Test method	157
68 Special Terminal Assemblies Tests	157
68.1 General	157
68.2 Disconnection and reconnection	158
68.3 Flexing test	158
68.4 Millivolt drop test	158
68.5 Temperature test	159
69 Short Range Radio Frequency (RF) Tests	159
69.1 General	159
69.2 Reference level determination	160
69.3 Interference immunity test	161
69.4 Frequency selectivity test	161
69.5 Clash test	162
69.6 Clash error test	163
69.7 Error (Falsing) rate test	163
69.8 Throughput rate test	164
69.9 Time to report alarm test	165
69.10 Inoperative transmitter reporting test	166
69.11 Battery status indication test	166
69.12 Tamper protection test	167
69.13 Interference protection test	167
69.14 Transmitter stability test	167
69.15 Transmitter accelerated aging test	168
69.16 Operability test – Holdup alarm	168
69.17 Drop test – Holdup alarm	168
69.18 Installation instructions and user manual	168
70 Long-Range Radio Frequency (RF) Devices	169

OUTDOOR USE EQUIPMENT

ASSEMBLY

71 General	169
72 Construction	169
72.1 General	169
72.2 Corrosion protection	170
73 Field-Wiring Connections	171
74 Internal Wiring	172
75 Components, Electrical Insulating Material	173

PERFORMANCE

76 Rain Test	173
77 Dust Test	177
78 Variable Ambient Test – Outdoor Use	177
79 Metallic Coating Thickness Test	177
80 Corrosion Tests	179

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM  Documents
Document Sharing Hub

80.1 General	179
80.2 Salt spray (fog)	179
80.3 Moist hydrogen sulfide (H ₂ S) - air mixture	180
80.4 Moist carbon dioxide (CO ₂) - sulfur dioxide (SO ₂) - air mixture	180
80.5 Alternate corrosion test (21-Day)	181
81 Ultraviolet Light and Water Exposure Tests	181
82 Accelerated Aging Tests for Gaskets, Sealing Compounds, and Adhesives	181

ACCESSORY EQUIPMENT

83 General	185
84 Construction	185
85 Performance (Installation) Test	185

MANUFACTURING AND PRODUCTION LINE TESTS FOR HIGH-VOLTAGE PRODUCTS

86 General	186
87 Production Line Dielectric Voltage-Withstand Test	186
88 Production Line Grounding Continuity Test	187

MARKINGS

89 General	188
90 Marking Permanency Tests	191

INSTALLATION AND OPERATING INSTRUCTIONS

91 General	192
92 Essential Information	193

APPENDIX A

Standards for Components	A196
--------------------------------	------

APPENDIX B(Informative)

B1 Power over Ethernet (PoE) Reference	198
B1.1 Definitions	198
B1.2 Publications	198

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents

Document Sharing Hub

PROPOSAL

INTRODUCTION

1 Scope

1.1 General

1.1.1 These requirements cover construction, performance, operation, and maintenance of:

- a) Central station burglar alarm systems intended and specifically designated for burglary-protection use at mercantile and banking premises, mercantile safes and vaults, and bank safes and vaults;
- b) Police station connected burglar alarm units and systems for use in mercantile premises, mercantile safes and vaults, and bank safes and vaults;
- c) Local burglar alarm units and systems for use in mercantile premises, mercantile safes and vaults, and bank safes and vaults;
- d) Proprietary burglar alarm units and systems;
- e) Holdup alarm systems of the remote-station type intended for installation in banks, stores, cashiers' cages, pay offices, and the like.
- f) Digital alarm communicator system units, interconnected to or integral, for use with central station burglar alarm systems, proprietary burglar alarm systems, police station-connected burglar alarm systems, and holdup alarm systems.
- g) Power supplies used to provide electrical power and standby power for burglar-alarm equipment in accordance with the following:
 - 1) The requirements of this standard;
 - 2) The Standard for Access Control System Units, UL 294;
 - 3) The Standard for Intrusion-Detection Units, UL 639;
 - 4) The Standard for Household Burglar-Alarm System Units, UL 1023;
 - 5) The Standard for Burglary-Resistant Electric Locking Mechanisms, UL 1034; and
 - 6) The Standard for Antitheft Alarms and Devices, UL 1037.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

1.2 Central Station Burglar Alarm

1.2.1 A central station burglar alarm system consists of electrical protection circuits and devices that are transmitted automatically to, recorded in, maintained from, and supervised from a central (monitoring) station that employs trained operators and alarm investigators who are in attendance at all times and take appropriate action in response to a received signal.

1.2.2 These requirements serve as the basis of classification of central station burglar alarm system transmission methods, however, the requirements covering the complete systems are contained in the Standard for Central-Station Alarm Services, UL 827.

1.3 Police Station Connected Burglar Alarm

1.3.1 A police station connected alarm system consists of protective circuits and devices, connected through control apparatus to an optional sounding device mounted on an outside or inside wall of the building in which the protected property is situated, and a constantly-manned police department or law enforcement center. The connection to a police department may be a) Direct, or b) Through a central (monitoring) station complying with the Standard for Central-Station Alarm Services, UL 827.

1.3.2 Intrusion into or disturbance of the units or wiring causes the sounding device to be actuated (if applicable) and a signal to be transmitted to the police department. The sounding device and signal to the police department continue to operate until it is stopped by using the proper control key, by exhaustion of the power supply, or by action of an automatic timing element that is preset for a definite operating period.

1.3.3 The operation of a police station connected alarm system is partially under the control and domination of the owner or others interested in the property. However, it is required that police station connected systems be maintained under the care and regular inspection service of the installing company. The installing company is expected to respond promptly to troubles or calls for service on report of the owner or police department. It is the responsibility of the owner to switch the system on and off duty and to report malfunctioning of the system to the service company.

1.4 Local Burglar Alarm

1.4.1 A local alarm system consists of protective circuits and devices, connected through control apparatus to an enclosed tamper-protected sounding device mounted on an outside wall of the building in which the protected property is situated. Intrusion into or disturbance of the units or wiring causes the sounding device to be actuated. The sounding device continues to operate until it is stopped by using the proper control key, by exhaustion of the power supply, or by action of an automatic timing element that is preset for a definite operating period. Local mercantile burglar-alarm systems are intended for the protection of mercantile premises or mercantile safes and vaults. Local bank burglar alarm systems are intended for the protection of bank safes and vaults.

1.4.2 The operation of a local alarm system is partially under the control and domination of the owners or others interested in the property. However, it is required that systems be maintained under the care and regular inspection service of the installing company. The installing company is expected to respond to troubles or calls for service promptly on report of the owner. It is the responsibility of the owner to switch the system on and off duty and to report malfunctioning of the system to the service company.

1.5 Proprietary Burglar Alarm

1.5.1 A proprietary burglar alarm system as referred to by these requirements is a system in which alarm initiating circuits and devices are installed at a property and are connected directly or indirectly to constantly monitored receiving equipment at a proprietary (monitoring) station. The proprietary (monitoring) station is located at the protected property and intended for operation by personnel responsible to the owner of the protected property.

1.5.2 The protected property may consist of a single property or of noncontiguous properties under a single ownership. The system is arranged so that a predetermined change in the alarm initiating circuits or devices automatically causes transmission of an alarm signal over a supervised signaling channel to the proprietary (monitoring) station.

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

1.6 Holdup Alarm

1.6.1 Holdup alarm systems of the remote-station type intended for installation in banks, stores, cashiers' cages, pay offices, and the like, are to provide a means of transmitting a silent call for help in the event of interior robbery.

1.6.2 A holdup alarm signal shall be transmitted directly to a constantly-manned police station equipped for broadcasting radio calls to cruising squad cars or to a central (monitoring) station with facilities for relaying calls to a law enforcement agency with such broadcasting facilities. The central (monitoring) station shall comply with the Standard for Central-Station Alarm Services, UL 827.

1.7 Digital Alarm Communicator Units

1.7.1 The operation of a digital alarm communicator system is under the control of the owner or others interested in the property, and/or the operators at the monitoring station. A need for off-premises transmission will activate the digital alarm communicator transmitter that contacts a digital alarm communicator receiver located at a monitoring station through the telephone company's switched network (dial system) and transmits a message identifying the change in condition at the protected premises.

1.7.2 A digital alarm communicator system may be classified as police station-connected if:

- a) It is used in combination with a protected premises control unit, an optional alarm sounding device, and an alarm housing that complies with this standard; and
- b) The signals are transmitted to a digital burglar-alarm communicator receiver located at a central station that complies with Standard for Central-Station Alarm Services, UL 827.

1.8 Burglar Alarm Power Supplies

1.8.1 These requirements cover power supplies for use as components in burglar-alarm system units. The input ratings of power supplies covered by these requirements are not more than 300 volts and the output ratings are low-voltage, power-limited. See 6.19 (c). Power supplies integral with a burglar alarm system unit, or separate power supplies intended for use with a specific unit, are covered in the applicable sections of this standard. These requirements may also be covered by the standards specified in 1.1.1(g), as applicable.

1.8.2 Police station connected burglar alarm units, local burglar alarm units, proprietary burglar alarm units, central station burglar alarm units, and digital alarm communicator system units, contain requirements for attack resistance against a power supply providing energy to a local audible alarm sounding device or to a device that will transmit a signal from the protected area to a remote location, such as a central (monitoring) station or police station. A power supply complying with the requirements of this standard that is to be used for any of these purposes shall be capable of being mounted inside an enclosure that will provide the required attack resistance, or shall be provided with an enclosure that will provide the required attack resistance. See Section 67 to determine the attack resistance requirements that will apply.

1.8.3 These requirements do not cover power supplies for use at a central (monitoring) station. Such power supplies are covered by the Standard for Central-Station Alarm Services, UL 827. These requirements do not cover power supplies for use in hazardous locations, as defined in the National Electrical Code, NFPA 70. These requirements do not cover power supplies covered by the Standard for Power Units Other Than Class 2, UL 1012, or battery chargers covered by the Standard for Battery Chargers for Charging Engine-Starter Batteries, UL 1236.

1.9 Common Requirements

1.9.1 Protective devices installed on individual properties are further classified as to extent of protection at each location. Requirements covering installation and classification (of extent) of alarm protective equipment at individual locations are published in the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681, which is intended to be referenced by burglar-alarm installers.

1.9.2 If equipment covered by these requirements is intended for use in a combination burglar-alarm and fire-protective signaling system, the portion of the equipment serving a fire-alarm function is covered by the Standard for Control Units and Accessories for Fire Alarm Systems, UL 864.

1.9.3 These systems usually operate within the limits of Class 2 remote control and signal circuits as defined by Article 725 of the National Electrical Code, NFPA 70.

1.9.4 A system that provides line security may be classified as either Standard Line Security or Encrypted Line Security. See Standard Line Security Equipment, 40.14, and Encrypted Line Security Equipment, 40.15.

1.9.5 Equipment used in a burglar alarm system shall comply with the requirements for that product and shall not be modified before, during, or after installation into the system, except for software/firmware upgrades as noted in Section 38.

1.9.6 Products intended for use in air-handling spaces in Accordance with Section 300.22, (C) of the National Electrical Code, NFPA 70, are additionally investigated to the Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043.

1.9.7 For equipment utilizing power over communications cables, refer to Section 36, Power Over Communications Cable Equipment. Compliance with the Standard for Ethernet, IEEE 802.3 (at or af) specifications shall not be verified as part of these requirements. Refer to Appendix B.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

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

4 Undated references

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Terminology

5.1 The term "product" as used in this standard refers to all types of units and systems for all burglar alarm applications noted.

6 Glossary

6.1 For the purpose of this standard, the following definitions apply.

6.2 **ACKNOWLEDGMENT SIGNAL** – An audible and/or visual signal that is sent to the subscriber by the monitoring station to notify the subscriber that the closing signal has been received, indicating that the protection system has been properly armed. The acknowledgment signal can be sent manually or automatically. Also referred to as "Ringback".

6.3 **ADMINISTRATOR** – An authorized entity that is in possession of the credentials necessary for the ability to perform an upgrade to a control unit's software and/or firmware.

6.4 **AIR-HANDLING SPACE** – Space not specifically fabricated for environmental air-handling purposes but used for air handling purposes as a plenum. (The space above a hung ceiling used for environmental air-handling is an example.)

6.5 **ALARM INITIATING DEVICE** – A device whose operation results in a burglar alarm signal at the control unit. Examples of alarm initiating devices are motion sensors, door/window contact switches, glass break detectors, or the like.

6.6 **ALARM SIGNAL** – An audible signal indicating a burglar alarm condition requiring immediate action, such as an alarm initiated from an intrusion detector, door switch, floor mat, or the like.

6.7 **ALARM SOUNDING DEVICE** – An audible signal appliance (bell, horn, siren, or speaker) complying with the requirements in the Standard for Audible Signal Appliances for General Signaling Use, UL 464, and this standard, that is used to signal unauthorized entry or attempted entry into a protected area or object.

6.8 **ALARM SOUNDING DEVICE HOUSING** – A housing, or the equivalent, that is used to protect an alarm sounding device from being silenced by physical attack. Also see Alarm Sounding Device, 67.2.2 and 67.3.2. There are two versions:

a) **Outside** – A housing intended to be located outside of the protected area. See 67.2.2.5 and 67.2.2.10.

b) **Inside** – A housing intended to be located within the protected area where it can be seen by an intruder. See 67.2.2.4, 67.2.2.10, and 67.2.2.11.

6.9 **ALARM SYSTEM** – Protective system consisting of control units, alarm initiating devices, alarm sounding devices, and off-premise communication devices, which emit and transmit remote and local notification of alarm and/or trouble conditions occurring at the protected premises.

6.10 **ANNUNCIATOR** – A unit containing one or more indicator lamps, alphanumeric displays, computer monitors, audible indicators, or other equivalent means in which each indication provides status information about a circuit, condition, system, or location.

6.11 **ARM** – The act of turning on the burglar alarm system and setting the protective circuits.

6.12 **ARMING STATION (KEYPAD)** – A means for manually arming, disarming, or controlling the alarm system. Provided with a visual-indicating device containing identified targets or indicator lamps, alphanumeric displays, audible indicators, or other equivalent means, in which each indication provides status information about a circuit, condition, and/or location.

6.13 AUTOMATION SYSTEM – A computer system that consists of hardware and software components, including the alarm-monitoring software, the operating system, and programming languages, required to make the system operational. An automation system may be configured as a computer system that is directly connected to hardware-based central-station receivers, software-based receivers, or is connected to remote receivers located in central stations other than the one where the automation system is located. It is used to automatically process change-of-status signals such as trouble, supervisory, opening (disarming) and closing (arming), and similar signals that it receives from the central station receiving equipment. Automation systems shall comply with the requirements in the Standard for Central-Station Automation Systems, UL 1981.

6.14 BANK SAFE AND VAULT ALARM SYSTEM – Burglar alarm system located in a bank or financial institution which includes protection for a safe and/or vault.

6.15 BASIC INSULATION – The insulation applied to live parts to provide basic protection against the risk of electric shock. Basic insulation does not necessarily include insulation used exclusively for functional purposes. See also the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097.

6.16 BIOMETRICS – Authentication of human physical characteristics used to identify an individual.

6.17 CENTRAL STATION – A physically protected building, distributed group of buildings, or an enclosed area within a building, whose ownership is not the same as that of the property(ies) being monitored, that is manned for the purpose of providing immediate attention to defined signals received from the protected property(ies). Also referred to as "Central Station", "Central Supervising Station", "Monitoring Station", or the like.

6.18 CHECK-IN SIGNAL – A signal that is periodically sent by the control unit/communicator to verify that the transmission equipment at the protected property, and the communication path, are operational. A unique signal that is initiated at a pre-established frequency, or an opening, closing, or any other signal sent by the alarm system that occurs within the pre-established frequency, may serve as a check-in signal.

6.19 CIRCUITS, ELECTRICAL:

a) **High-Voltage** – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage power limited circuit.

b) **Low-Voltage** – A circuit involving a potential of not more than 30 volts AC rms, 42.4 volts DC, or AC peak.

c) **Power Limited** – A circuit whose output is limited as specified in Article 725 of the National Electrical Code, and as noted in Tables 45.1 and 45.2. The power limitation shall be provided by the construction of the transformer, a fixed impedance, a non-interchangeable fuse, a nonadjustable manual reset circuit protective device, or a regulating network.

d) **Power over Communications Cable** – A limited energy circuit that meets the requirements of 36.4.

e) **Risk of Electric Shock** – A risk of electric shock is determined to exist within a circuit unless that circuit meets the following criteria:

- 1) The circuit is supplied by an isolating source such that the maximum open-circuit voltage potential available to the circuit is not more than 30 V AC rms, 42.4 V DC, or 42.4 V peak; and

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM  **Documents**
Document Sharing Hub

2) The circuit is supplied by an isolating source such that the current available through a 1500-ohm resistor connected across any potential in the circuit (including to ground) does not exceed 0.5 mA.

3) A limited energy, power over communications circuit that meets the requirements of 36.4.

f) Risk of Fire – A risk of fire is considered to exist at any two points in a circuit where:

1) The open circuit voltage is more than 30 V AC rms, 42.4 V DC, or 42.4 V peak, and the energy available to the circuit under any condition of load including short circuit, results in a current of 8 A or more after 1 minute of operation; or

2) A power of more than 15 watts can be delivered into an external resistor connected between the two points.

Exception: The product meets all of the requirements of 36.4 for equipment utilizing power over communications cables.

6.20 CLOSING SIGNAL – The transmission sent to the monitoring station upon the act of turning on (arming) the burglar alarm system and setting the protective circuits. This signal represents “closing” the business for the day.

6.21 CODE TRANSMITTER SYSTEM – A communication system, such as McCulloh, that provides for the connection of more than one protection system to a single alarm receiving unit at the monitoring station. The code transmitter sends a coded signal to the monitoring station, repeated not less than three times, if the subscriber’s protective circuit is disturbed by an intrusion or unauthorized opening.

6.22 COMMUNICATION CLOUD – The area in the communication path that is supported by providers of communication services in which signals travel between a protected property and a monitoring station. Depending on the type of transmission that is used, signals may travel on a single defined route or through various routes depending upon availability when the signal is initiated.

6.23 COMPUTER SYSTEM, FAULT TOLERANT – A computer system containing multiple power supplies, disk drives, processors, and controllers, each backing up and checking on the processes of others. In the event of a component failure, the other modules take over the function performed by the failed components without affecting the operation of the computer. In addition to the duplicating hardware, a fault-tolerant system includes the necessary software components consisting of the operating system, programming languages, and the alarm monitoring software required to make the system operational. A fault-tolerant computer system is considered to be redundant.

6.24 COMPUTER SYSTEM, REDUNDANT – Two or more computer systems maintained at a monitoring station, either of which can be quickly connected and operational for handling alarm signals in the event that the other computer fails to operate. See 6.23 for the definition of a fault-tolerant computer system. A fault-tolerant computer system is considered to be redundant.

6.25 CONTIGUOUS PROPERTY – A single owner or single user on a continuous plot of ground, including any buildings thereon, that is not separated by a public thoroughfare, transportation right-of-way, property owned or used by others, or body of water not under the same ownership.

6.26 CONTROL UNIT – A unit that directly or indirectly monitors the status of initiating devices, processes any status-change signals, and performs logical control to generate output signals and/or off-premises communication as required by the system type.

6.27 CONTROL UNIT ACCESSORY – A device or appliance externally connected to a control unit that is employed to assure the intended operation of a system or to provide supplementary signaling, annunciation, or both. Examples of control unit accessories are: annunciators, auxiliary relays, end-of-line resistors or diodes, keypads, or remote switches.

6.28 CONTROL UNIT SYSTEM TYPES:

- a) Central Station – A system for use with mercantile premises, mercantile safes and vaults, and bank safes and vaults, in which status-change signals at a protected premises are automatically transmitted to a central (monitoring) station where competent and experienced personnel take appropriate action in response to a received signal. The central (monitoring) station is controlled and operated by a person, firm, or corporation whose business includes the furnishing, maintaining, or monitoring of supervised burglar alarm systems.
- b) Holdup – Holdup alarm systems of the remote-station type are intended for installation in banks, stores, cashiers' cages, pay offices, and the like, to provide a means of transmitting a silent call for help in the event of interior robbery. Holdup alarms are dispatched upon immediately without the need for any type of alarm verification.
- c) Local – A system for use with mercantile premises, mercantile safes and vaults, and bank safes and vaults, which indicates alarm and trouble conditions via alarm sounding devices located at the protected premises.
- d) Police Station Connected – A system for use with mercantile premises, mercantile safes and vaults, and bank safes and vaults, in which status-change signals are automatically transmitted to a constantly-manned police station where police authorities take appropriate action in response to a received signal, or to a constantly-manned law enforcement center which dispatches to a police station.
- e) Proprietary – A system installed at the protected premises in which status-change signals occurring at the protected premises are automatically transmitted to a constantly manned on-premises proprietary (monitoring) station where trained, competent personnel take appropriate action in response to a received signal. The protected property may be contiguous or noncontiguous but must be under a single ownership.

6.29 CORD-CONNECTED UNIT – A unit intended for connection to the power source by means of a supply cord. Such a unit is intended to be moved for reasons of interchange or realignment of the units of a system.

6.30 CREDENTIAL – A mechanism that defines or distinguishes the identity of an entity (e.g. a password, PIN, or biometric means).

6.31 CRITICAL COMPONENT – A critical component is one whose malfunctioning will impair the normal operation of the product, or create a risk of fire or electrical shock.

6.32 CROSS ZONING – A means of installing and programming the burglar alarm system in such a way that two or more zones are interdependent in creating an alarm condition. The control panel will not annunciate and/or send an alarm to the monitoring station unless the system detects an alarm condition from two or more zones in a particular area within a preset time window.

6.33 CRYPTOGRAPHIC AUTHENTICATION – Algorithms intended to ensure the secrecy and/or authenticity of messages.

6.34 DEAD METAL PART – A metal or other electrically conductive part, accessible or inaccessible, that is not conductively connected to a live part.

6.35 DIGITAL ALARM COMMUNICATOR RECEIVER (DACR) – A unit located at a monitoring station that will receive and display signals from a digital alarm communicator transmitter (DACT).

6.36 DIGITAL ALARM COMMUNICATOR SYSTEM (DACS) – A system in which signals are transmitted from a digital alarm communicator transmitter (DACT), by cellular and/or telephone landline transmission, to a digital alarm communicator receiver (DACR) located at the monitoring station.

6.37 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT) – A unit located at the protected premises that will contact the digital alarm communicator receiver (DACR) through the public switched telephone network. The DACT seizes the connected telephone line, dials a pre-selected number to connect to a DACR, and transmits the necessary data to identify the DACT and the change of status at the protected premises. As covered by these requirements, the DACT either:

- a) Provides all alarm or monitoring control functions; or
- b) Interfaces with an alarm or monitoring control unit that provides this function (a slave unit).

6.38 DISARM – The act of turning off the burglar alarm system so that it will no longer annunciate an alarm event (unless a particular circuit is programmed as a "24-hour zone").

6.39 DURESS ALARM – A silent alarm signal generated by the manual entry of a designated code at the system keypad in the event that the user needs assistance, such as when being forced to disarm the burglar alarm system and enter the premises. Duress alarms are typically treated as holdup alarms by monitoring station personnel and are dispatched upon immediately without the need for any type of alarm verification.

6.40 ENCRYPTION – The process of transforming information/data using an algorithm to make it unreadable to anyone except those authorized, usually referred to as a key.

6.41 END-OF-LINE DEVICE – A device installed at the end of a circuit for the purpose of monitoring the circuit for fault conditions.

6.42 ENDSPAN – A device that is typically a network switch capable of supplying power over a communications circuit.

6.43 ENTITY – Person, device, and/or appliance or service which interacts with a control unit.

6.44 ENTRY/EXIT DELAY – A time delay on an entry/exit zone of a burglar alarm system that enables the user to enter the protected premises and disarm the system, or arm the system and exit the protected premises, without creating an alarm condition.

6.45 ETHERNET CABLING – A structured cabling system using 4 pair unshielded or shielded twisted pair cable, meeting Category 5e performance or higher and conforming to the Standard for Balanced Twisted-Pair Telecommunications Cabling and Components, ANSI/TIA-568C.2, requirements. The extent of the cabling is taken to be the channel that connects the appropriate port of the network switch to the powered device.

6.46 EVENT LOG – A comprehensive data record, maintained at the monitoring station and/or control unit, of the events that are associated with remote access.

6.47 FALSE ALARM – An annunciation and/or transmission by the burglar alarm system indicating the occurrence of an alarm condition when no evidence of the event that the alarm signal was designed to report is found.

6.48 FAULT – An open, ground, or short-circuit condition on any line extending from a product.

6.49 FIELD WIRING – Conductors to be installed by qualified personnel to connect a product to source(s) of supply, devices, other products, and loads.

6.50 FIRMWARE – A software program or set of instructions programmed on a hardware device (e.g. Flash ROM, EPROM).

6.51 FIXED EQUIPMENT – A device intended to be permanently connected electrically.

6.52 GROUND FAULT – A circuit impedance to ground sufficient to result in the annunciation of a trouble condition.

6.53 HANDSHAKE SIGNAL – For Digital Alarm Communicator Systems (DACS), upon the occurrence of an event requiring off-premises signaling, the phone line is seized and automatically dials the monitoring station receiver. Upon answering, the receiver sends out a special tone ("handshake") which lets the DACT know that the DACR is ready to receive data transmission.

6.54 HARDWARE – Physical equipment that constitutes the components of a burglar alarm system.

6.55 HARDWARE KEY DEVICE – A mechanical or electronic device employed to enable the remote programming mode.

6.56 HOLDUP ALARM INITIATING DEVICE – A switch operated by hand or foot, by key, by removal of currency bills, or by other means to initiate a holdup alarm signal.

6.57 HOLDUP ALARM – A silent alarm generated by the manual or semiautomatic activation of a designated device intended to signal a robbery in progress (panic). Holdup alarms are dispatched upon immediately without the need for any type of alarm verification.

6.58 HOSTED CENTRAL STATION – A hosted central station consists of services not limited to the storage of data from alarm monitoring software, data center equipment co-location, housing the automation system running alarm monitoring software, housing the receivers and automation system, or any combination thereof. Hosted central stations shall comply with the requirements of the Outline of Investigation for Hosted Central Station Services, UL 827A, the Standard for Central-Station Services, UL 827, and/or the Standard for Central-Station Automation Systems, UL 1981, as appropriate.

6.59 HVAC SYSTEM – Heating, Ventilating, and Air-Conditioning system.

6.60 INTERIOR ZONE – A protective circuit connected to a sensing device, such as a motion detector, which only monitors the interior of the premises.

6.61 KISS-OFF SIGNAL – For Digital Alarm Communicator Systems (DACS), after the monitoring station receives the transmission data, it sends a sign-off tone ("kiss-off") to the DACT to end the call and release the phone line.

6.62 LINE SECURITY, ENCRYPTED – In addition to Standard Line Security as noted below, Encrypted Line Security utilizes encryption algorithms with a minimum of 128 bits of security strength to provide data protection against a compromise attempt. Also see Encrypted Line Security Equipment, 40.15.

6.63 LINE SECURITY, STANDARD – Methods of supervising the communication channel used to transmit signals between the protected premises and the monitoring station. This supervision serves to detect compromise attempts on the communication channel that are intended to prevent signals from being annunciated at the monitoring station and which may allow entry into the protected premises without initiating a signal at the monitoring station. Also see Standard Line Security Equipment, 40.14.

6.64 LINE VOLTAGE – The voltage at any field connected source of supply, nominally 50 – 60 hertz, and either 115, 208, or 230 volts.

6.65 LIVE PART – A part:

a) That is conductively connected either:

1) To the power-supply circuit; or

2) To a secondary circuit that operates at more than 42.4 volts peak with reference to ground or accessible metal; and

b) In which the available current measured through a 1500-ohm resistor shunted with a 0.15-μF capacitor connected from the part to ground or to any other accessible part exceeds 0.25 mA.

6.66 LOCAL ALARM – An alarm annunciation at the protected premises caused by activation of an alarm sounding device.

6.67 LOCAL AREA NETWORK (LAN) – A combination of personal computers, servers, and communication devices that are connected to share data files, resources and applications located in close proximity, such as on the same floor or in the same or nearby building(s).

6.68 LONG-RANGE RADIO-FREQUENCY DEVICES – Any device that communicates between a protected premises and a monitoring station, subsidiary station, or another protected premises using a private radio network.

6.69 MANAGED FACILITIES-BASED VOICE NETWORK (MFVN) – A physical facilities based network capable of transmitting real-time packet switched data network (PSDN) signals with unchanged formats, that is managed, operated, and maintained by the service provider to ensure service quality and reliability from the subscriber location to public switched telephone network (PSTN) interconnection points or other MFVN peer networks. Also referred to as "Voice over IP (VoIP)".

6.70 MERCANTILE PREMISES SYSTEM – Burglar alarm system located in a place of business primarily under the control of the owner or others interested in the property.

6.71 MERCANTILE SAFE AND VAULT SYSTEM – Burglar alarm system located in a mercantile establishment which includes protection for a safe and/or vault.

6.72 MESSAGE(S) – Communicated data that contains specific information relating to the product and is transmitted via a wired or wireless pathway from an origin to a destination.

6.73 MIDSPAN – A midspan device is Power Sourcing Equipment (PSE) that injects power onto communications cable. It is located between the network switch and the Powered Device (PD).

6.74 MONITORING STATION – Term used throughout the standard to represent one of more of the following applications: Central Station (see 6.17), Police Station (see 6.90), or Proprietary Station (see 6.99).

6.75 MULTIPLEXING – A signaling method using wire path, cable carrier, radio, or combinations of these methods characterized by the simultaneous and/or sequential transmission and reception of multiple signals in a communication channel including means for positively identifying each such signal.

6.76 NETWORK SWITCH – Active electronic equipment that selects a path or circuit for sending a unit of data to its next destination.

6.77 NORMAL STANDBY CONDITION – The ready-to-operate condition of the product existing prior to its being tripped or operated by an intrusion.

6.78 OFF-HOOK – The condition in which a connection has been established with the Public Switched Telephone Network (PSTN) in preparation for dialing a telephone number.

6.79 ON-HOOK – The condition causing the equipment to disconnect from (hang up) the Public Switched Telephone Network (PSTN).

6.80 ONE-WAY RADIO (RF) – A system in which alarm system signals are transmitted from a radio alarm transmitter through a radio channel to at least two independently-powered, independently-operating, and separately-located radio repeaters or radio alarm monitoring station receivers, or by one of each. At least two separate paths shall be provided from the radio alarm transmitter to the ultimate radio alarm monitoring station receiver.

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

6.82 OPENING SIGNAL – The transmission sent to the monitoring station upon the act of turning off (disarming) the burglar alarm system and protective circuits. This signal represents "opening" the business for the day.

6.83 PACKET SWITCHED DATA NETWORK (PSDN) – A type of data transmission in which data is divided into packets, each of which has a destination address. Each packet is then routed across a computer network. A packet may travel a different route than packets related to it. Internet Protocol (IP), Global System for Mobile (GSM), and General Packet Radio Service (GPRS) are examples of PSDN technology.

6.84 PANIC ALARM – A silent alarm generated by the manual activation of a designated device intended to signal a response to a threat. Panic alarms are dispatched upon immediately after alarm verification.

6.85 PARTITION – Segmented section of a burglar alarm system that can be armed and disarmed independent of other areas, but operated under a single system control.

6.86 PERIMETER ZONE – A protective circuit connected to a sensing device, such as a door/window contact switch, which monitors an entry point of the protected premises.

6.87 PLAINTEXT – A character representation that is plainly readable as text and not masked and/or hidden.

6.88 POLICE DEPARTMENT – Any local or government-related law enforcement agency.

6.89 POLICE STATION – A physically protected building, distributed group of buildings, or an enclosed area within a law enforcement agency, that is constantly manned by police authorities for the purpose of providing immediate attention to defined signals received from the protected property(ies).

6.90 POLLING DATA LOOPS – An installation wiring circuit in which each device or component of an alarm system that is attached to the loop is polled to verify the continuity of the circuit.

6.91 POLLING SIGNAL – A signal that is periodically sent by the central/proprietary (monitoring) station to verify that the protected premises communication equipment, and the communication path, are operational.

6.92 PORTABLE EQUIPMENT – Cord- and plug-connected equipment that is capable of being carried or moved about.

6.93 POWER INJECTOR (INJECTOR/POWER BRICK) – A powered device similar to a midspan device, comprising three ports. These are:

- a) Data in, typically from the network switch,
- b) Data and power – nominal 48 or 53 VDC out, and
- c) Line voltage from a utility supply.

6.94 POWER OVER COMMUNICATIONS CABLES – A means to supply DC power to a network device over communications cabling. The power supplied to the device may or may not be on the same conductors supporting data. Typical technologies include PoE (see Appendix B) and USB.

6.95 POWER SOURCING EQUIPMENT (PSE) – The power supply that provides DC power to the powered device (PD) through the communications cabling. It may be an endspan device, such as an enabled network switch, or a midspan device that is located in between the network switch and the powered device.

6.96 POWERED DEVICE (PD) – A device that receives DC power from the power sourcing equipment (PSE) through communications cabling. Also referred to as the load.

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

6.98 PRIMARY POWER – Power provided by a commercial source available at the protected premises.

6.99 PROPRIETARY STATION – A physically protected building, distributed group of buildings, or an enclosed area within a building, having the same ownership as that of the properties being monitored, that is constantly manned for the purpose of providing immediate attention to all signals received from the protected property(ies). Also referred to as “Central Supervising Station”, “Central Supervisory Station”, or the like.

6.100 PROTECTED PREMISES – Any building or part of a building that has a complete physical boundary. Examples of premises include stores, banks, offices, manufacturing facilities, warehouses, lofts, and stockrooms, and similar locations, used for the storage, manufacturing, sale, or handling of merchandise, valuables, and the like.

6.101 PUBLIC SWITCHED TELEPHONE NETWORK (PSTN) – An assembly of communications equipment and telephone service providers that may utilize Managed Facilities-Based Voice Networks (MFVN) to provide the general public with the ability to establish communications channels via discrete dialing codes. (Source NFPA 72, 2010 edition).

6.102 RADIO FREQUENCY – Electromagnetic radiation, nominally above 20 kilohertz.

6.103 REINFORCED INSULATION – An improved basic insulation with such mechanical and electrical qualities that it, in itself, provides the same degree of protection against the risk of electric shock as double insulation. It may consist of one or more layers of insulating material. See, also, the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097.

6.104 REMOTE ACCESS – The act of accessing a control unit at a distance from the protected premises, whereby the user does not have visual contact of the premises. Key FOB's are not included in this definition because they are intended to be used when in visual contact with the protected premises and are very limited in the distance they may be used.

6.105 REMOTE COMMUNICATION – Data exchange in which information is exchanged between the control unit and an authorized entity. Information exchanges such as remote monitoring and software downloading would also be considered remote communication.

6.106 REMOTE OPERATION – The function or actuation of the protected premises control unit via remote communication.

6.107 RESET – A control function that attempts to return a system or device to its Normal Standby Condition or non-alarm state.

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

6.109 SATELLITE/SUBSIDIARY STATION – A normally unattended physically secure facility linked by communication channels to a central (monitoring) station. Signals from protected properties are transmitted to the subsidiary station and then relayed to the central (monitoring) station. If the communication link between the subsidiary station and the central (monitoring) station is out of service, the subsidiary station can be staffed and operated as a central (monitoring) station.

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

6.111 SECONDARY/STANDBY POWER – Power provided from a secondary source, such as a battery, upon the loss of primary power.

6.112 SHORT CIRCUIT FAULT – A short circuit (wire-to-wire) fault is determined to be a resistance of 0.1 ohm or less across the circuit.

6.113 SHORT-RANGE RADIO-FREQUENCY DEVICES – Any device that communicates with control/receiving equipment at the protected premises by low-power radio signals in accordance with the Code of Federal Regulations (CFR) 47, Part 15.

6.114 SOFTWARE – Programs, instructions, procedures, data, and the like that are temporarily or permanently stored in the computer's memory or central processing unit (CPU) of a product, and are used to provide function and control of the computer's components, or are executed by the CPU of a product to influence the functional performance of that product.

6.115 SOFTWARE-BASED RECEIVING EQUIPMENT – Software packages that are installed in UL 60950-1 or UL 62368-1 evaluated Information Technology Equipment (ITE) network servers, configured to store messages in a compatible database. The software and hardware combination is intended to serve the same function as a traditional dedicated hardware receiving unit at the monitoring station. The software supports all of the signal-receiving, -recording and -supervision functions necessary for the normal operation of the associated subscriber's control units installed within a protected property.

6.116 STATIONARY EQUIPMENT – Cord- and plug-connected equipment that is intended to be fastened in place, or located in a dedicated space.

6.117 SUBSCRIBER – The user of the premises or item protected by a burglar alarm system. An authorized representative of the user may also be considered a subscriber.

6.118 SUPPLEMENTARY INSULATION – An independent insulation provided in addition to the basic (formerly functional) insulation to protect against the risk of electric shock in case of mechanical rupture or electrical breakdown of the basic insulation. An enclosure of insulating material may form a part or the whole of the supplementary insulation. See, also, the requirements for the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097.

6.119 SYSTEM DATABASE – Information entered into the computer by authorized personnel including items such as, but not limited to, names, addresses, telephone numbers, security information for system users, graphics and the like.

6.120 TRANSMISSION METHODS – Any of the following communication methods: code transmitter, DACT (telephone line, cellular, or MFVN), multiplex, one-way radio (RF), packet switched data network, or two-way radio (RF).

6.121 TRANSMISSION PATH, DUAL – Communication signals from a protected property to a remote monitoring station are sent by different transmission techniques, which pass through separate demarcation points as they leave the protected property.

6.122 TRANSMISSION PATH, SINGLE – Communication signals from a protected property to a remote monitoring station are sent by a single transmission technique and pass through a single demarcation point as they leave the protected property.

6.123 TRANSMISSION PATH (SINGLE/DUAL), ALTERNATE PRIMARY – A method of activating one or more transmission paths to maintain the same level of supervision without interruption.

6.124 TROUBLE SIGNAL – A visual or audible signal indicating a fault condition of any nature, such as an open circuit, ground fault or other trouble condition, occurring in the product or connected wiring.

6.125 TRUSTED PHYSICAL PATH – A contiguous and direct path for communications constructed of physical media. A directly connected crossover network cable, USB cable, or vendor approved cable would be considered a trusted path.

6.126 TWO-WAY RADIO (RF) – A system in which alarm system signals are transmitted and received through a radio channel between a radio alarm transmitter/receiver and a radio alarm monitoring station. The signals may or may not be relayed through a radio repeater. A two-way radio system shall be considered as a multiplex system.

6.128 UNINTERRUPTIBLE POWER SUPPLY (UPS) – Equipment that will continue to provide alternating current (AC) power to a load in the event of failure of the normal AC power source. A UPS may also provide a more constant voltage and frequency supply to the load. When the normal source of AC fails, the UPS is powered by a DC source from batteries, an uninterruptible battery system (UBS), or both.

6.129 USER – A person who has authorized access to the control unit or system.

6.130 USER VALIDATION – The act of an electronic device, upon the input of “user credentials”, validating that the credentials are legitimate, allowing the user to proceed to access the system, or upon failure to match the credentials, deny access to the system.

6.131 WIDE AREA NETWORK (WAN) – A WAN differs from a LAN in that a WAN makes data connection across a broad geographic area. Companies use a WAN to connect to various company sites so that information can be exchanged between distant offices.

6.132 ZONE – A defined area within the protected premises. A zone defines an area from which a status indication can be received or an area in which a form of control can be executed.

7 Information Required for Assessment

7.1 The following documentation shall be required as applicable to determine compliance, and shall be furnished with the sample(s) submitted for investigation:

- a) Installation and operating instructions intended to accompany each product or component as produced (see Section 91);
- b) Schematic diagrams of all circuits;
- c) Printed wiring board construction drawings (e.g. component layouts, foil patterns);
- d) Bill of Materials (BOM)/parts list;
- e) Mechanical drawings; and
- f) Markings to be applied to the product as required in Markings, Section 89.

8 Version Number

8.1 If reprogrammable, a unit, system, or equipment shall provide some method to identify the current version of the software, firmware, and/or programming logic code being used. Subversions that are used to distinguish non-critical logic changes are not required to be identified. This information shall also appear in the product installation instructions.

CONSTRUCTION

ASSEMBLY

9 General

9.1 Specific product requirements

9.1.1 Products that currently meet all the requirements of the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, fulfill the requirements of 9.3 (Electrical Protection), 10 (Servicing Protection), 11.1, 11.3 – 11.10 (Enclosure), 12 (Electric Shock), 13 (Corrosion Protection), 14 (Field Wiring Connections, General), 15 (Cord Connected Products), 18 (Grounding), 19 (Internal Wiring, General), 20 (Wiring Methods), 22.1 (Mounting of Components), 22.2 (Insulating Materials), 22.3 (Current-Carrying Parts), 24 (Printed-Wiring Boards), 25 (Transformers and Coils), 27 (Across-the-Line Components), 30 (Switches), and 33 (Spacings).

9.2 Product assembly

9.2.1 A product shall use materials that have been determined to comply with the requirements for the particular use, as indicated by the performance requirements of this standard.

9.2.2 The product shall be factory-built as a complete assembly and shall include all the components necessary for its intended function when installed and used as intended. The product may be shipped from the factory as two or more major subassemblies. See 9.2.3.

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

9.3 Electrical protection

9.3.1 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with uninsulated high-voltage live parts or film-coated wire. In determining compliance with this requirement, parts such as covers, panels, and grilles used as part of the enclosure are to be removed unless tools are required for their removal or an interlock is provided. See also Servicing Protection, Section 10.

9.3.2 Uninsulated high-voltage live parts shall be located, guarded, or enclosed as indicated in 11.3.1.1 – 11.3.1.3.

9.3.3 Knockouts or openings in an alarm sounding device housing for the connection of circuits shall be in the mounting surface only.

9.3.4 If provision is made for testing the condition of a product, such as a power supply, the means provided shall not result in a risk of electric shock, fire, or injury to persons.

10 Servicing Protection

10.1 General

10.1.1 Uninsulated live parts of high-voltage circuits, hazardous moving parts, and sharp corners and projections within the enclosure, shall be formed, located, guarded, or enclosed so as to reduce the risk of unintentional contact by persons performing service functions that may be performed while the equipment is energized.

10.1.2 During the examination of a product in connection with the requirements in 10.1.1, a part of the outer enclosure that may be removed without the use of tools, or part of the outer enclosure that may be removed by the user to allow access for making routine operating adjustments, shall be disregarded; and it shall be assumed that the removable part in question does not afford protection against the risk of electric shock.

10.1.3 The following are not considered to be uninsulated live parts:

- a) Coils of relays and solenoids, and transformer windings, if the coils and windings are provided with insulating overwraps rated for the potentials encountered;
- b) Terminals and splices with insulation rated for the potential encountered; and
- c) Insulated wire.

10.2 Trained service personnel

10.2.1 When the linear distance from a component requiring servicing or an operating switch and any uninsulated current-carrying parts of high-voltage circuits is less than 6 inches (152 mm), then protection by properly applied insulating tape, barriers, or equivalent, shall be provided.

Exception: Not applicable for products complying with the Electric Shock Current Test, Section 51.

10.2.2 Insulating barriers, or equivalent required by 10.2.1 shall be permanently and prominently marked with the cautionary marking "CAUTION – High Voltage" or equivalent.

10.2.3 In lieu of the minimum 6 inches (152 mm) requirement only for serviceable components, the product shall comply with one of the following:

- a) An interlock shall be provided on the cover to de-energize all live parts in the enclosure; or
- b) The following permanent and prominent marking shall be provided on the cover front:
"CAUTION – De-Energize Unit Prior To Servicing."

10.3 Antenna terminal discharge assembly

10.3.1 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 1/2 W, and shall be effective with the power switch in either the on or off position.

Exception No. 1: The conductive connection need not be provided when:

- 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 using an isolating power transformer, the resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 MΩ.*

Exception No. 2: A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements for antenna-isolating capacitors is to be rated a minimum of 1/4 W.

10.3.2 The maximum value of 5.2 MΩ specified in 10.3.1 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.

11 Enclosures

11.1 General

11.1.1 All electrical parts of a product shall be enclosed to provide protection of internal components and prevent contact with uninsulated live parts.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

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

11.1.3 The enclosure of a product shall have the strength and rigidity to resist total or partial collapse and the attendant reduction of spacings, loosening or displacement of parts, or other defects. See the Mechanical Strength Tests for Enclosures, Section 66.

11.1.4 Internal parts such as the printed wiring board, power supply, etc., shall be provided with a means for mounting.

11.1.5 An enclosure containing other than power-limited circuits shall be constructed to reduce the possibility of emission of flame, molten metal, flaming or glowing particles, or flaming drops. See the Abnormal Operation Test, Section 58, and/or the Ignition Test Through Bottom-Panel Openings per the Standard for Control Units and Accessories for Fire Alarm Systems, UL 864.

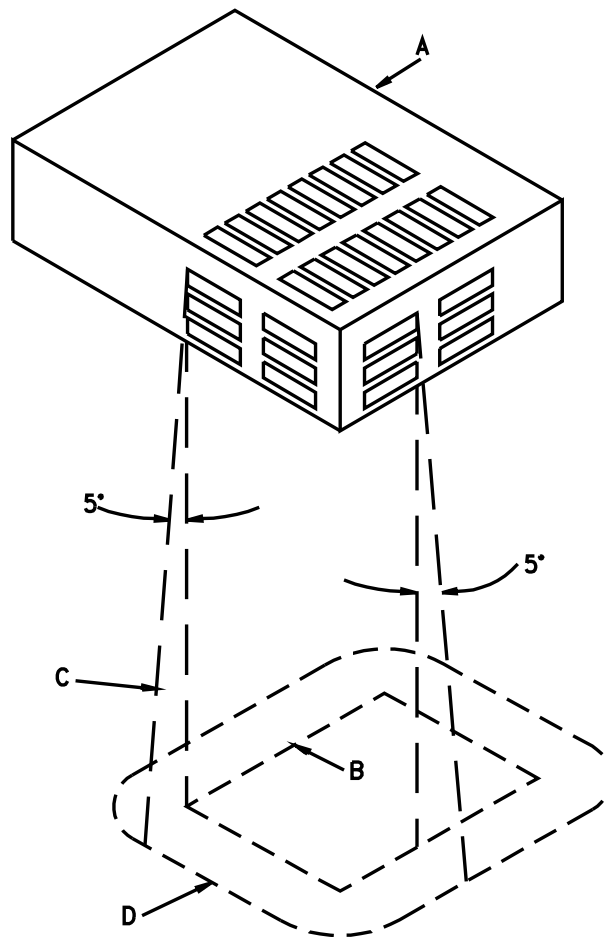
11.1.6 The requirement in 11.1.5 necessitates either a nonflammable bottom in accordance with the requirements in 11.3.4.2, or a protective barrier as illustrated in Figure 11.1 under all areas containing combustible materials.

Exception: Openings not larger than 1/16 square inch (40.3 mm²) may be provided for the bottom of the enclosure under areas containing only materials rated V-1 or less flammable. See 11.3.4.3.

11.1.7 A construction employing individual barriers under components, groups of components or assemblies, as illustrated in Figure 11.1, is considered to comply with the requirement in 11.1.5.

11.1.7

Figure 11.1
Enclosure bottom



S2600

A – The entire component under which an enclosure (flat or dished with or without a lip or other raised edge) of noncombustible material is to be provided. The sketch is of an enclosed component with ventilation openings showing that the enclosure is required only for those openings through which flaming parts are to be emitted. When the component or assembly does not have its own noncombustible enclosure, the area to be protected is the entire area occupied by the component or assembly.

B – Projection of the outline of the area of A that requires a bottom enclosure vertically downward onto the horizontal plane of the lowest point on the outer edge D of the enclosure.

C – Inclined line that traces out an area D on the horizontal plane of the enclosure. Moving around the perimeter of the area B that requires a bottom enclosure, this line projects at a 5° angle from the line extending vertically at every point around the perimeter of A and is oriented to trace out the largest area; except that the angle shall be less than 5° when the enclosure bottom contacts a vertical enclosure or side panel, or when the horizontal extension of the enclosure B to D exceeds 6 inches (152 mm).

D – Minimum outline of the enclosure, except that the extension B to D is not required to exceed 6 inches (152 mm), flat or dished with or without a tip or other raised edge. The bottom shall either be flat or formed in any manner when every point of area D is at or below the lowest point on the outer edge of the enclosure.

11.2 Doors and covers

11.2.1 An enclosure cover shall be hinged, sliding, pivoted or similarly attached so it cannot be removed if it:

- a) Gives access to fuses or any other overcurrent protective device, the intended functioning of which requires renewal or resetting; or
- b) Is necessary to open the cover in connection with the intended operation of the unit.

Exception No. 1: If the cover position is supervised by a tamper contact that is connected in the closed protective circuit, an enclosure need not comply with the requirements of this paragraph. See also 41.10.

Exception No. 2: These requirements do not apply to a product located at a monitoring station.

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

Exception: This requirement does not apply to a product located at a monitoring station.

11.2.3 The cover of an enclosure shall be provided with a supervisory contact, connected in the closed protective wiring circuit, if it gives access to any relays, terminals, controls, or related components that might be subject to tampering without causing an alarm signal.

Exception: An enclosure located inside of a completely protected safe or vault does not require tamper protection.

11.3 Enclosure openings

11.3.1 General

11.3.1.1 Openings in the enclosure shall be constructed and of such size so that direct entry of foreign objects is prevented. See also 11.3.2.1. See Figure 11.4 for examples of acceptable top cover constructions that are deemed to prevent direct entry. See also Figure 11.5 for acceptable side opening constructions.

11.3.1.2 An opening in an electrical enclosure that does not permit entrance of a 1 inch (25.4 mm) diameter rod shall be sized and arranged so that a probe, as illustrated in Figure 11.2, cannot be made to contact any uninsulated live part (other than low-voltage) when inserted through the opening in a straight or articulated position. The probe illustrated shall be applied to any depth that the opening will permit and rotated or angled before, during, or after insertion through the opening to any position that is required in order to examine the enclosure.

11.3.1.3 An opening that permits entrance of a 1 inch (25.4 mm) diameter rod is acceptable under the conditions described and illustrated in Figure 11.3.

Figure 11.2
Accessibility probe with web stop

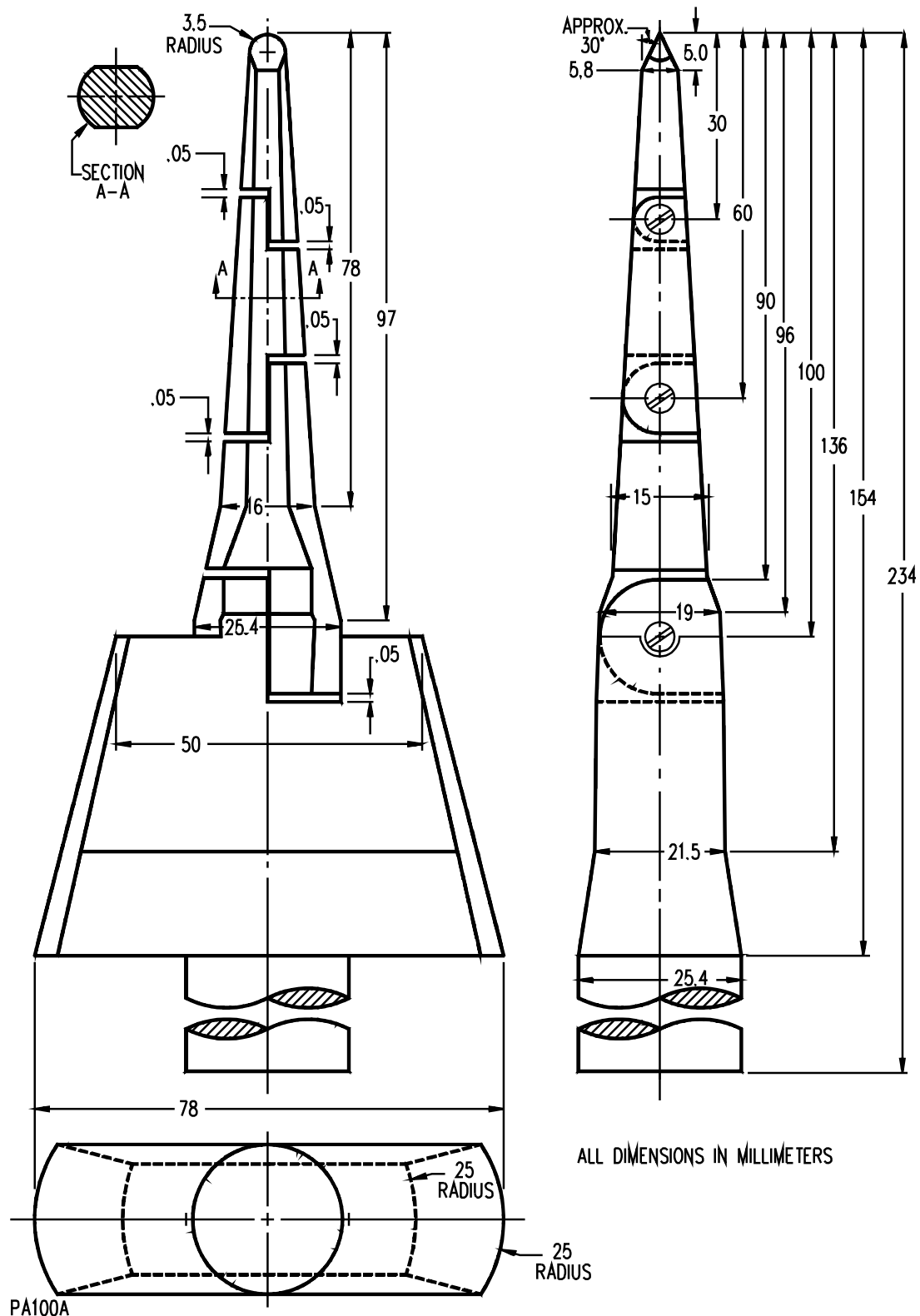
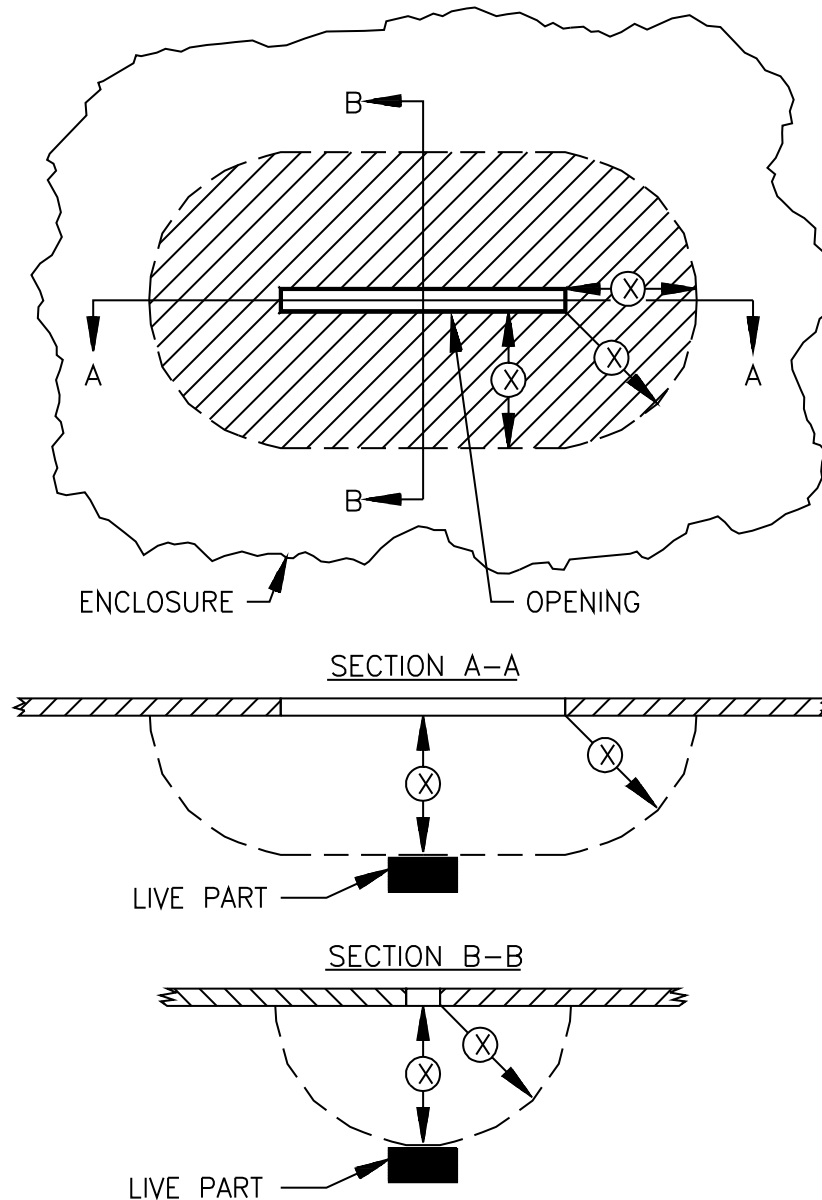


Figure 11.3
Opening in enclosure



EC100A

NOTE – The opening may be used if, within the enclosure, there is no uninsulated live part or film coated wire:

- a) Less than X inches (mm) from the perimeter of the opening, as well as;
- b) Within the volume generated by projecting the perimeter X inches (mm) normal to its plane.

X equals five times the diameter of the largest diameter rod that can be inserted through the opening, but not less than 6-1/16 inches (154 mm).

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

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

11.3.1.5 Openings in the enclosure shall not give access to relays, terminals, controls, or related components that might be subject to tampering by hand or with tools without causing an alarm or trouble signal.

11.3.1.6 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.

Exception: Not applicable for products supplied solely from power-limited sources and controlling only power-limited loads.

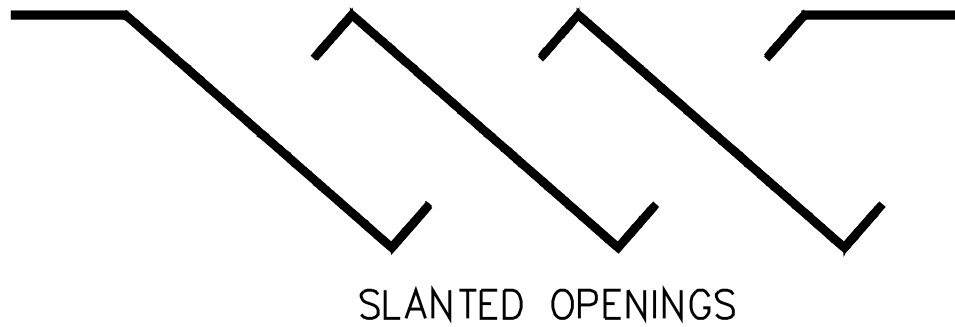
11.3.1.7 The requirement in 11.3.1.6 does not apply to an opening for a mounting screw or nail or for a manufacturing operation (such as paint drainage) when:

- a) An opening for non-mounting purposes does not have a dimension greater than 17/64 inch (6.75 mm) or an area greater than 0.055 ft² (35.5 mm²); and
- b) An opening for mounting does not have a dimension greater than 0.75 inch (19.05 mm) or an area greater than 0.7 inch² (430 mm²) and there are no more holes than are needed to mount the product.

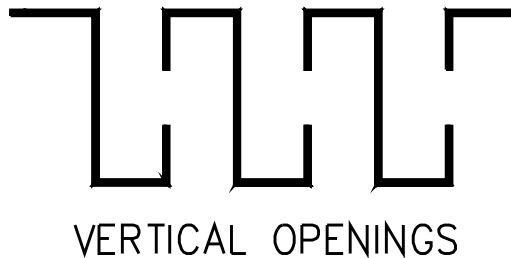
11.3.2 Enclosure top openings

11.3.2.1 Openings directly over uninsulated high voltage live parts shall not exceed 0.20 inch (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. For examples complying with the intent of this requirement, see Figure 11.4 for top cover designs.

Figure 11.4
Cross sections of top cover designs



EC500



11.3.3 Enclosure side openings

11.3.3.1 An opening in the side of the enclosure shall:

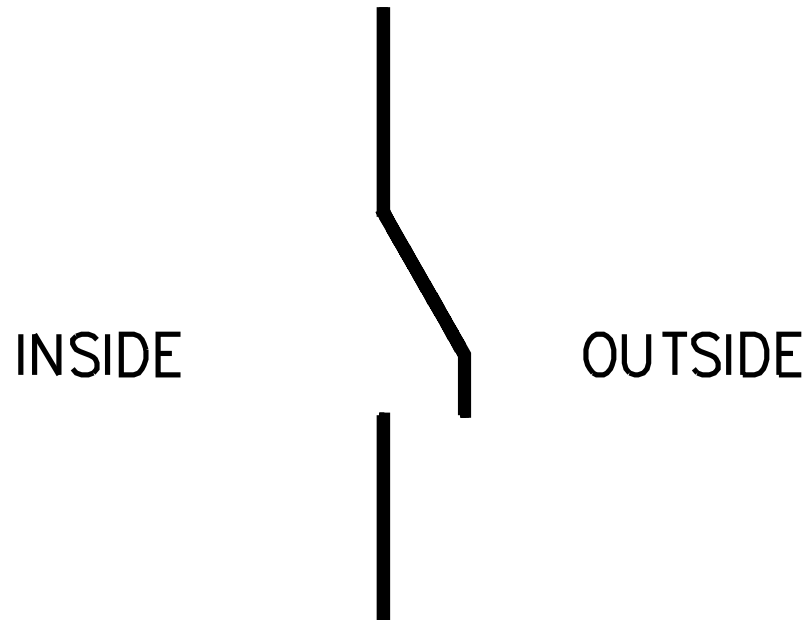
- a) Not exceed 0.20 inch (5.0 mm) in any dimension;
- b) Be provided with louvers shaped to deflect an external falling object outward (see Figure 11.5 for examples of louver designs complying with the requirement); or
- c) Be located and sized so that objects which are present cannot drop into the 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 11.6).

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

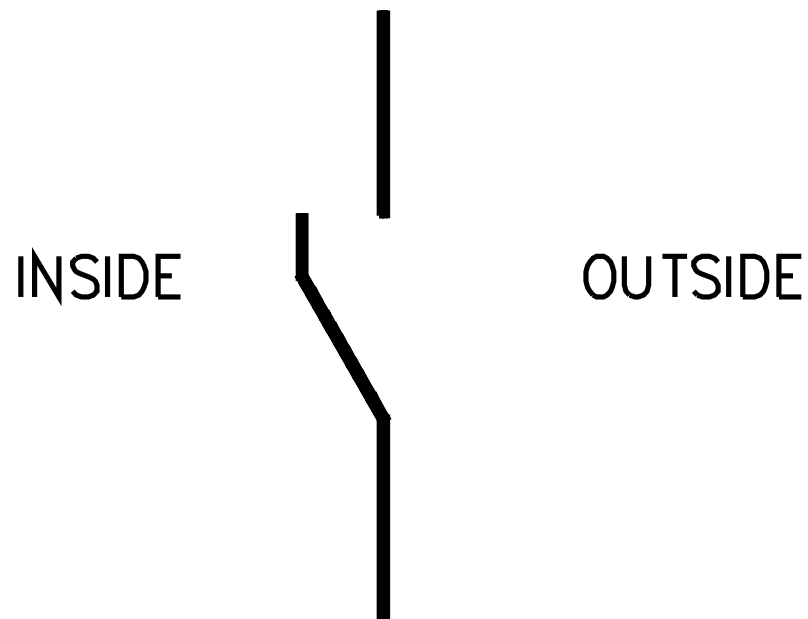


Documents
Document Sharing Hub

Figure 11.5
Louvers



OUTWARD PROJECTION



EC510 INWARD PROJECTION

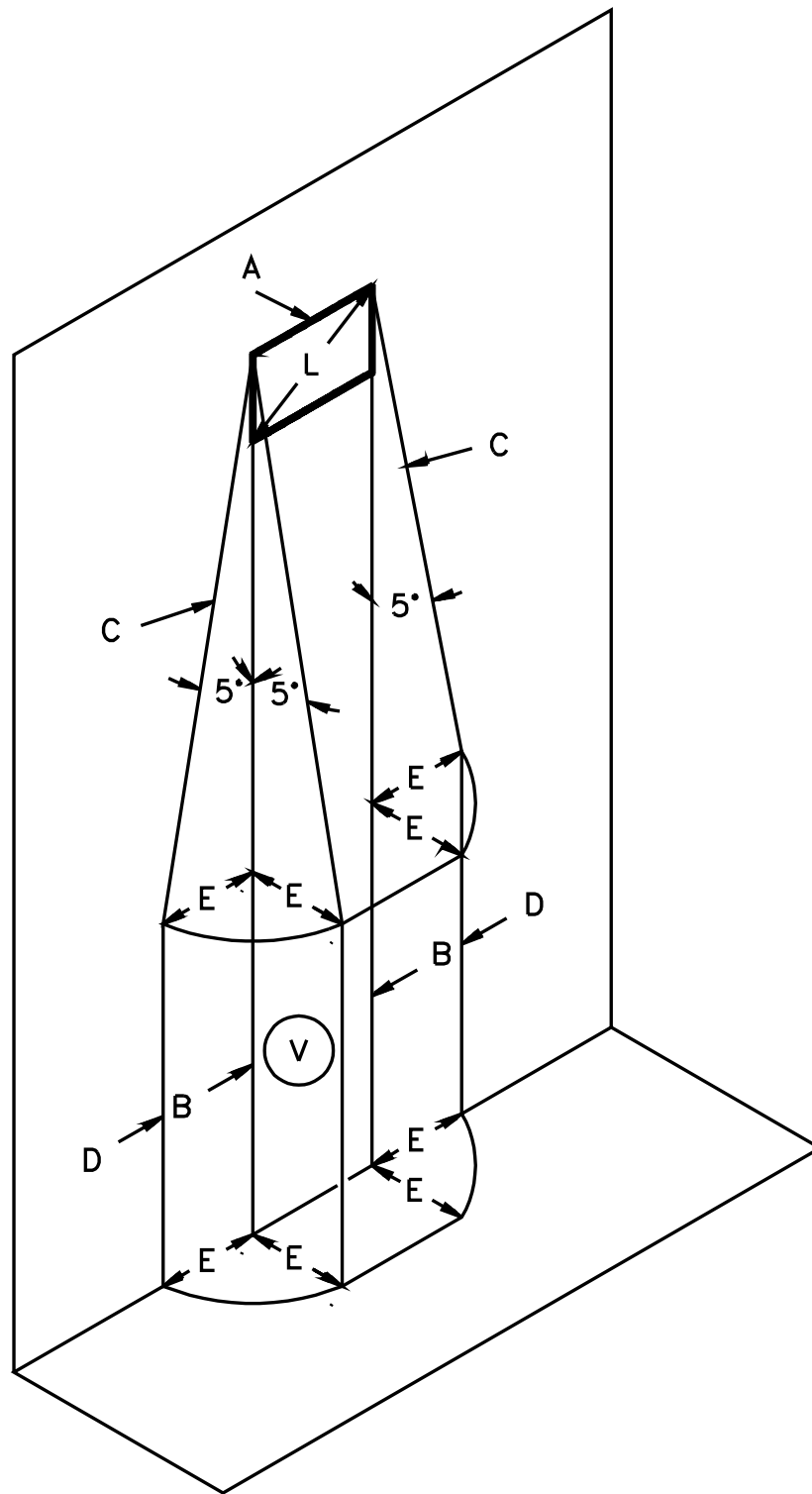
UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

Figure 11.6
Example of enclosure side opening



S3162A

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

11.3.3.2 When a portion of a side panel falls within the area traced out by the 5° angle in Figure 11.1, that portion of the side panel shall be investigated as a bottom enclosure in accordance with 11.3.4.1 – 11.3.4.3.

11.3.4 Enclosure bottom openings

11.3.4.1 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 11.1, that complies with the ventilation opening requirements in 11.3.4.2 and 11.3.4.3 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.

11.3.4.2 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 11.1, or a galvanized or stainless-steel screen having a 14 by 14 mesh per 1 inch (25.4 mm) constructed of wire with a minimum diameter of 1/64 inch (0.4 mm). Other constructions are to be used only when they comply with the Ignition Test Through Bottom-Panel Openings per the Standard for Control Units and Accessories for Fire Alarm Systems, UL 864.

Table 11.1
Perforated metal plates

Minimum thickness,		Maximum diameter of holes		Minimum spacing of holes center-to-center	
inch	(mm)	inch	(mm)	inch	(mm)
0.026	(0.66)	0.045	(1.14)	0.067	(1.70)
				[233 holes per in ²]	[36 holes per cm ²]
0.026	(0.66)	0.047	(1.19)	0.093	(2.36)
0.032	(0.81)	0.075	(1.91)	0.125	(3.18)
				[72 holes per in ²]	[11 holes per cm ²]
0.036	(0.91)	0.063	(1.60)	0.109	(2.77)
0.036	(0.91)	0.078	(1.98)	0.125	(3.18)

11.3.4.3 The bottom of the enclosure under areas containing only materials rated V-1 or less flammable shall have openings not larger than 1/16 square inch (40.3 mm²).

11.4 Screens and expanded metal

11.4.1 Screens or expanded metal used as a guard, enclosure, or part of an enclosure, shall comply with the requirements in 11.4.3 and 11.5.1 and with the Mechanical Strength Tests for Enclosures, Section 66.

11.4.2 Perforated sheet steel and sheet steel employed for expanded metal mesh shall be not less than 0.042 inch (1.07 mm) thick [0.045 inch (1.17 mm) if zinc coated] if the mesh openings or perforations are 1/2 inch² (323 mm²) or less in area, and shall be not less than 0.080 inch (2.03 mm) thick [0.084 inch (2.13 mm) if zinc coated] for larger openings. The largest dimension of this material shall not exceed 4 inches (102 mm).

Exception: If the indentation of a guard or the enclosure will not alter the clearance between uninsulated live parts and grounded metal so as to impair performance or reduce spacings below the minimum required values (see Spacings, General, Section 33, and the Mechanical Strength Tests for Enclosures, Section 66), 0.020 inch (0.51 mm) expanded steel mesh or perforated sheet steel [0.023 inch (0.58 mm) if zinc coated] may be employed, when:

- a) The exposed mesh on any one side or surface of the product so protected has an area of not more than 72 inches² (464 cm²) and has no dimension greater than 12 inches (305 mm); or*
- b) The width of the opening covered by this material is not greater than 3-1/2 inches (89 mm).*

11.4.3 The wires of a screen shall be not less than 16 AWG (1.3 mm diameter) steel if the screen openings are 1/2 inch² (323 mm²) or less in area, and shall be not less than 12 AWG (2.1 mm diameter) steel for larger screen openings.

11.5 Cast metal

11.5.1 The minimum thickness of cast metal for an enclosure shall be as indicated in Table 11.2.

Exception: Cast metal of lesser thickness may be employed if, after consideration has been given to the shape, size, and function of the enclosure, it is determined to provide equivalent mechanical strength. See the Drop Test, Section 64, and the Mechanical Strength Tests for Enclosures, Section 66.

Table 11.2
Cast-metal enclosures

Use, or dimensions of area involved ^a	Minimum thickness			
	Die-cast metal,		Cast metal of other than the die-cast type,	
	inch	(mm)	inch	(mm)
Area of 24 square inches (155 cm ²) or less and having no dimension greater than 6 inches (152 mm)	1/16	(1.6)	1/8	(3.2)
Area greater than 24 square inches (155 cm ²) or having any dimension greater than 6 inches (152 mm)	3/32	(2.4)	1/8	(3.2)
At a threaded conduit hole	1/4	(6.4)	1/4	(6.4)
At an unthreaded conduit hole	1/8	(3.2)	1/8	(3.2)

^a The area limitation for metal 1/16 inch (1.6 mm) thickness may be obtained by the provision of reinforcing ribs subdividing a larger area.

11.5.2 If threads for the connection of conduit are tapped through a hole in an enclosure wall, or if an equivalent construction is employed, there shall not be less than 3-1/2 nor more than five threads in the metal, and the construction shall be such that a standard conduit bushing can be attached as intended.

11.5.3 If threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall not be less than 3-1/2 full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors that has been determined to provide the same level of protection to the conductors as that of a standard conduit bushing.

11.6 Sheet metal

11.6.1 The thickness of sheet metal for an enclosure shall not be less than that indicated in Table 11.3 or 11.4, whichever applies.

Exception: Sheet metal of lesser thickness may be employed if, after consideration has been given to the shape, size, and function of the enclosure, it is determined to provide equivalent mechanical strength. See the Drop Test, Section 64, and the Mechanical Strength Tests for Enclosures, Section 66.

11.6.2 A sheet metal member to which a wiring system is to be connected in the field shall have a thickness of not less than 0.032 inch (0.81 mm) if of uncoated steel, not less than 0.034 inch (0.86 mm) if of galvanized steel, and not less than 0.045 inch (1.14 mm) if of nonferrous metal.

11.6.3 If additional mechanical protection is required by other sections of this standard, the metal thicknesses required by those sections shall take precedence over those shown in Tables 11.2– 11.4.

11.6.4 A plate or plug closure for an unused conduit opening or other hole in the enclosure shall have a thickness not less than 0.027 inch (0.69 mm) if of steel or 0.032 inch (0.81 mm) if of nonferrous metal for a hole having a 1-3/8 inch (34.9 mm) diameter maximum dimension.

11.6.5 A closure for a hole larger than 1-3/8 inch (34.9 mm) diameter shall have a thickness equal to that required for the enclosure of the product or a standard knockout seal shall be used. Such plates or plugs shall be securely mounted.

11.6.6 A knockout in a sheet metal enclosure shall be capable of being removed without excess deformation of the enclosure.

11.6.7 A knockout shall be provided with a surrounding surface of sufficient area to provide for seating of a conduit bushing and shall be located so that installation of a bushing 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 specified under Spacings, General, Section 33.

Table 11.3
Minimum thickness of sheet metal for electrical enclosures - carbon steel or stainless steel

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness			
Maximum width, ^b		Maximum length, ^c		Maximum width, ^b		Maximum length, ^c	
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited	
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited	
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited	
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited	
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)
18.0	(45.7)	Not limited		27.0	(68.6)	Not limited	
20.0	(50.8)	25.0	(63.5)	29.0	(73.7)	36.0	(91.4)
22.0	(55.9)	Not limited		33.0	(83.8)	Not limited	
25.0	(63.5)	31.0	(78.7)	35.0	(88.9)	43.0	(109.2)
25.0	(63.5)	Not limited		39.0	(99.1)	Not limited	
29.0	(73.7)	36.0	(91.4)	41.0	(104.1)	51.0	(129.5)
33.0	(83.8)	Not limited		51.0	(129.5)	Not limited	
38.0	(96.5)	47.0	(119.4)	54.0	(137.2)	66.0	(167.6)
42.0	(106.7)	Not limited		64.0	(162.6)	Not limited	
47.0	(119.4)	59.0	(149.9)	68.0	(172.7)	84.0	(213.4)
52.0	(132.1)	Not limited		80.0	(203.2)	Not limited	
60.0	(152.4)	74.0	(188.0)	84.0	(213.4)	103.0	(261.6)
63.0	(160.0)	Not limited		97.0	(246.4)	Not limited	
73.0	(185.4)	90.0	(228.6)	103.0	(261.6)	127.0	(322.6)

^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

- 1) Single sheet with single formed flanges (formed edges);
- 2) A single sheet which is corrugated or ribbed; and
- 3) An enclosure surface loosely attached to a frame; for example, with spring clips.

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

^cFor panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

Table 11.4
Minimum thickness of sheet metal for electrical enclosures - aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness,	
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	Maximum width, ^b inches (cm)	Maximum length, inches (cm)	inch	(mm)
3.0 (7.6)	Not limited	7.0 (17.8)	Not limited	0.023	(0.58)
3.5 (8.9)	4.0 (10.2)	8.5 (21.6)	9.5 (24.1)		
4.0 (10.2)	Not limited	10.0 (25.4)	Not limited	0.029	(0.74)
5.0 (12.7)	6.0 (15.2)	10.5 (26.7)	13.5 (34.3)		
6.0 (15.2)	Not limited	14.0 (35.6)	Not limited	0.036	(0.91)
6.5 (16.5)	8.0 (20.3)	15.0 (38.1)	18.0 (45.7)		
8.0 (20.3)	Not limited	19.0 (48.3)	Not limited	0.045	(1.14)
9.5 (24.1)	11.5 (29.2)	21.0 (53.3)	25.0 (63.5)		
12.0 (30.5)	Not limited	28.0 (71.1)	Not limited	0.058	(1.47)
14.0 (35.6)	16.0 (40.6)	30.0 (76.2)	37.0 (94.0)		
18.0 (45.7)	Not limited	42.0 (106.7)	Not limited	0.075	(1.91)
20.0 (50.8)	25.0 (63.5)	45.0 (114.3)	55.0 (139.7)		
25.0 (63.5)	Not limited	60.0 (152.4)	Not limited	0.095	(2.41)
29.0 (73.7)	36.0 (91.4)	64.0 (162.6)	78.0 (198.1)		
37.0 (94.0)	Not limited	87.0 (221.0)	Not limited	0.122	(3.10)
42.0 (106.7)	53.0 (134.6)	93.0 (236.2)	114.0 (289.6)		
52.0 (132.1)	Not limited	123.0 (312.4)	Not limited	0.153	(3.89)
60.0 (152.4)	74.0 (188.0)	130.0 (330.2)	160.0 (406.4)		

^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

- 1) Single sheet with single formed flanges (formed edges);
- 2) A single sheet which is corrugated or ribbed; and
- 3) An enclosure surface loosely attached to a frame, for example, with spring clips.

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

^c For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

11.7 Polymeric materials

11.7.1 Polymeric materials used as an enclosure shall comply with the applicable portion of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and also with the additional requirements specified in this standard.

11.7.2 Conductive coatings applied to nonmetallic surfaces such as the inside surface of an enclosure, shall comply with the appropriate requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, unless flaking or peeling of the coating cannot result in the reduction of spacings or the bridging of live parts.

11.7.3 Among the factors taken into consideration when judging the acceptability of a nonmetallic enclosure are:

- a) The mechanical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Flammability and resistance to ignition from electrical sources;
- e) Dielectric strength, insulation resistance, and resistance to arc tracking; and
- f) Resistance to distortion and creeping at temperatures to which the material may be subjected under any conditions of use.

All these factors are considered with respect to aging in accordance with the Polymeric Materials Test, Section 62, and the Mechanical Strength Tests for Enclosures, Section 66.

11.8 Internal materials

11.8.1 Polymeric materials used within an enclosure shall be evaluated in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: Unrated resistors, capacitors, semiconductors, integrated circuit packages, optical isolators, and similar electrical components meet the intent of the requirement when they are mounted on a material with a minimum flammability rating of V-1.

11.8.2 All combustible material used within an enclosure shall be V-2, HF-2, or better.

Exception No. 1: Motors, relays, capacitors, semiconductors, transformers, switches, insulating tubing or tape, and other electrical elements are exempt from the above requirement when they comply with the flame test applicable to the component. Meter faces and cases (when determined capable for mounting live parts) and indicator lamps or jewels, or both, are exempt from flammability requirements. The following requirements apply to parts that are isolated either by at least 0.5 inch (12.5 mm) of air, or a solid barrier of V-1 or less-flammable material from uninsulated electrical parts that involve a risk from electrical energy-high current levels:

- a) Gears, cams, belts, bearings, strain-relief bushings applied over PVC-jacketed cords, and other small parts that contribute negligible fuel to a fire is not required to be investigated.*

b) Tubing for air or fluid systems, and plastics, shall not be more flammable than HB. Foamed plastics classed HBF in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are determined as complying with this requirement.

Exception No. 2: Combustible material used within an enclosure is not prohibited from being HB when the power sources to the enclosure meet the criteria for no risk of fire as defined in 6.19 (e).

11.9 Product enclosure mounting

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

11.10 Battery compartments

11.10.1 A compartment for vented storage batteries shall have a total volume at least twice the volume occupied by the batteries. Ventilating openings shall be provided and so located as to permit circulation of air for dispersion of gas while the battery is being charged at the highest rate permitted by the means incorporated in the control unit.

11.10.2 The interior of a storage battery compartment shall be protected so that it will be resistant to detrimental action by the electrolyte, such as two coats of acid-resistant and alkali-resistant paint or by baked enamel.

12 Electric Shock

12.1 Any part that is exposed during operator servicing shall not present the risk of electric shock. See the Electric Shock Current Test, Section 51.

12.2 The replacement of any component used in the product shall not result in a risk of electric shock.

13 Corrosion Protection

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

13.2 The requirement of 13.1 applies to all enclosures of sheet steel or cast iron, and to all springs and other parts upon which intended mechanical operation may depend.

Exception No. 1: This requirement does not apply to parts, such as washers, screws, bolts, and the like, if corrosion of such unprotected parts would not be likely to result in a risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons, or to impair the operation of the unit.

Exception No. 2: Parts made of stainless steel, polished or treated, if necessary, do not require additional protection against corrosion.

13.3 Metals shall be galvanically compatible.

Exception: If galvanic action does not impair intended operation of the product, or result in the risk of fire, electric shock, or unintentional contact with moving parts that may cause a risk of injury to persons, this requirement does not apply.

13.4 Hinges and other attachments shall be resistant to corrosion.

13.5 For outdoor use products, also refer to the Corrosion Tests in Section 80.

FIELD WIRING CONNECTIONS

14 General

14.1 Wiring terminals or leads shall be provided for connection of conductors of at least the size required by the National Electrical Code, ANSI/NFPA 70.

15 Cord-Connected Products

15.1 A portable product that is intended to be connected to high-voltage or line voltage branch-circuit supply shall be provided with not less than 6 feet (1.8 m) of flexible cord and grounded attachment plug of acceptable type and rated for connection to the supply circuit.

Exception No. 1: The cord may be less than 6 feet (1.8 m) in length if it is evident that the use of the longer cord may result in damage to the cord or product, or result in a risk of fire, electric shock, or injury to persons, impair intended operation of the product, or is not required for the intended operation of the product.

Exception No. 2: A polarized attachment plug, rather than a grounded attachment plug, is acceptable when the product has no accessible dead-metal parts likely to be energized.

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

15.3 The flexible cord shall have a voltage rating not less than the rated voltage of the product, and shall have an ampacity that is not less than the current rating of the product.

15.4 The flexible cord on a cord-connected unit shall be as indicated in Table 15.1 or shall be of a type at least as serviceable for the particular application. Table 15.2 specifies cord types determined to be equivalent to those specified in Table 15.1.

Table 15.1
Power supply cords

Type of appliance	Type of cord
Table-model products (for use on a table, desk, and the like) that are not frequently moved	SV, SP-2, SP-3
Products that are intended for use on desks, counters, or tables and are moved frequently	SV, SP-2
Hand-held products	TS ^a , SV ^b
Floor-mounted products	SJ, S
Wall-mounted products	SV ^c , SP-2 ^c , SP-3 ^c , SJ, S
^a A tinsel cord shall be used when all of the following conditions are met: 1) The cord is no longer than 8 feet (2.4 m); 2) The cord is attached to the product directly or by means of a plug intended for that purpose; 3) The product rating is not higher than 50 W; and 4) The intended use of the appliance requires an extremely flexible cord. ^b Type SV and similar cords shall be used when each conductor is made up of 36 AWG (0.01 mm ²) strands. ^c Type SV, SP-2, SP-3, and similar cords shall be used only when the cord is no longer than 5 feet (1.5 m).	

Table 15.2
Equivalent cords

Basic cord type	Equivalent types
TS	TST
SP-2	SPE-2, SPT-2
SP-3	SPE-3, SPT-3
SV	SVE, SVO, SVOO, SVT, SVTO, SVTOO
SJ	SJE, SJO, SJOO, SJT, SJTO, SJTOO
S	SE, SO, SOO, ST, STO, STOO

15.5 The current rating of the attachment plug shall not be less than 125% of the product nameplate rating.

15.6 The voltage rating of the attachment plug shall correspond to the rated voltage of the product. When a product is intended for use on two or more different values of voltage by internal connections, the attachment plug provided with the product shall be rated for the voltage for which the product is wired when shipped from the factory.

15.7 A plug-in transformer shall be attached permanently to the power receptacle so as to prevent accidental removal.

Exception: This requirement is not applicable if a local audible trouble signal is annunciated upon loss of primary power.

15.8 The power supply cord shall be provided with strain relief means so that a stress on the cord will not result in strain being transmitted to terminals, splices, or internal wiring. See the Strain Relief Test, Section 65.

15.9 A knot shall not be used to provide strain relief.

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

15.11 The supply cord or supply leads shall be prevented from being pushed into the unit through the cord-entry hole if such displacement is likely to:

- a) Subject the cord or supply leads to mechanical damage or to exposure to a temperature higher than that for which the cord or supply leads are rated;
- b) Reduce spacings (such as to a metal strain-relief clamp) below the minimum acceptable values; or
- c) Damage internal connections or components.

16 Permanently-Connected Products

16.1 A fixed product shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA 70, would be acceptable for it.

16.2 A product intended for permanent connection to the branch-circuit supply shall have provision for installing the supply conductors in rigid metallic or non-metallic conduit.

16.3 A knockout or other supply-connection opening located where temperatures in excess of 140°F (60°C) have been measured during the Temperature Test, Section 56, and not having qualifying marking as specified in 89.13, shall be sealed by welding or the equivalent or be permanently marked adjacent to the opening with: "Do Not Use".

16.4 A knockout provided for connection of a field-wiring system to a field-wiring compartment shall accommodate conduit of the trade size determined as specified in Table 16.1.

Table 16.1
Trade size of conduit in inches (mm OD)

Wire size		Number of wires									
AWG	(mm ²)	2		3		4		5		6	
14	2.1	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)
12	3.3	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	3/4	(26.7)	3/4	(26.7)
10	5.3	1/2	(21.3)	1/2	(21.3)	1/2	(21.3)	3/4	(26.7)	3/4	(26.7)
8	8.4	3/4	(26.7)	3/4	(26.7)	1	(33.4)	1	(33.4)	1-1/4	(42.3)
6	13.3	3/4	(26.7)	1	(33.4)	1	(33.4)	1-1/4	(42.3)	1-1/4	(42.3)

NOTE - This table is based on the assumption that all conductors will be of the same size and there will not be more than six conductors in the conduit. If more than six conductors will be involved or if all of them are not of the same size, the internal cross-sectional area of the smallest conduit that may be used is determined by multiplying by 2.5 the total cross-sectional area of the wires, based on the cross-sectional area of Type THW wire.

16.5 The location of a terminal box or compartment in which branch-circuit connections to a permanently-wired product are to be made shall be such that the connections can be readily inspected without disturbing the wiring or the product after the product has been installed as intended.

16.6 A terminal compartment intended for the connection of a supply raceway shall be secured in position and attached to the product to prevent turning.

16.7 The field-wiring compartment area of a product shall be of sufficient size for completing all wiring connections as specified by the installation wiring diagram.

16.8 Where damage to field-wiring insulation may be caused by internal components or sharp edges in the wiring compartment, insulating or metal barriers having smooth, rounded edges shall be provided, or the following or equivalent wording marked in the wiring area shall be present: "CAUTION - When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, and Internal Components".

16.9 The wiring terminals of a product intended for mounting in an outlet box shall be located or protected so that, upon installation, the wiring in the outlet box is not forced against the terminals or other sharp edges so as to damage the conductor insulation, and/or the terminals or stripped leads do not come into contact with the walls of the outlet box.

16.10 The product shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity not less than 125% of the current input of the product when connected to a rated source of supply. It is assumed that branch circuit conductors rated 60°C (140°F) will be used.

16.11 The free length of a lead inside a terminal box or compartment shall be 6 inches (152 mm) or more, provided with strain relief, shall not be smaller than 18 AWG (0.82 mm²), and the insulation, when of rubber or thermoplastic, shall not be less than 0.030 inch (0.76 mm) minimum average and 0.027 inch (0.69 mm) minimum at any point when the lead is intended for field connection to an external circuit.

Exception: The lead shall be less than 6 inches (152 mm) long when it is evident that the use of a longer lead results in a risk of fire or electric shock.

16.12 A field-wiring terminal shall be kept from turning or shifting in position by means other than friction between surfaces. This shall be accomplished by two screws or rivets, by square shoulders or mortises, by a dowel pin, lug or offset, by a connecting strap or clip fitted into an adjacent part, or by some other method determined to be the equivalent.

16.13 A field-wiring terminal shall comply with the requirements in 17.2 for field-wiring terminals (general application) except a wire-binding screw shall not have a diameter smaller than No. 8 (4.2 mm).

16.14 A terminal intended for the connection of a grounded supply conductor (neutral) shall be composed of or plated with metal that is white in color and shall be distinguishable from the other terminals, or identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram.

16.15 A lead intended for the connection of a grounded supply conductor (neutral) shall be finished white or gray color and shall be distinguishable from the other leads.

16.16 A means of strain relief shall be provided for the field supply leads of a product to prevent any mechanical stress from being transmitted to terminals and internal connections. Inward movement of the leads provided with a ring-type strain relief or means determined to be the equivalent shall not damage internal connections or components, or result in a reduction of electrical spacings. See the Strain Relief Test, Section 65.

17 Other Field-Wiring Connections

17.1 General

17.1.1 A product shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the National Electrical Code, ANSI/NFPA 70, corresponding to the rating of the circuit.

17.1.2 All field-wiring connections shall be contained in either an enclosed field wiring compartment integral with the product or in a separate outlet box to which the product is to be mounted.

17.1.3 Duplicate terminals or leads, or an equivalent arrangement, shall be provided for circuits of products intended to be connected to initiating-device circuits, notification appliance circuits, or non-addressable signaling line circuits of a control unit; one for each incoming and one for each outgoing wire. It is not prohibited that a common terminal be used in lieu of duplicate terminals when it is intended to prevent the looping of an unbroken wire around or under a terminal screw in a manner that permits the looped wire to remain unbroken during installation, thereby precluding supervision in the event the wire becomes dislodged from under the terminal. A notched clamping plate under a single securing screw, where separate conductors are intended to be inserted in each notch, is an equivalent arrangement.

17.1.4 There shall be adequate space within a terminal or wiring compartment to permit the use of a standard conduit bushing when a bushing is required for installation.

17.1.5 The field-wiring compartment area of a product to which connections are to be made is to be of sufficient size for completing all wiring connections as specified by the installation wiring diagram.

17.1.6 The wiring terminals of a product intended for mounting in an outlet or junction type box shall be located or protected so that, upon installation:

- a) The wiring in the outlet box is not forced against the product, product's terminals, or sharp edges so as to damage the conductor insulation or product's unprotected components; and/or
- b) A product with exposed wiring terminals shall be held in its intended mounting location inside the box by mechanical means.

17.2 Field-wiring terminals (general application)

17.2.1 As specified in these requirements, field-wiring terminals are those terminals to which power, signal, or communication circuits (including equipment grounding) will be made in the field when the product is installed as intended.

17.2.2 A field-wiring terminal shall comply with the requirements in:

- a) 17.2.4 – 17.2.7;
- b) The field wiring requirements in the Standard for Electrical Quick-Connect Terminals, UL 310;
- c) The Standard for Wire Connectors, UL 486A-486B;
- d) The Standard for Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors, UL 486E; or
- e) The Standard for Terminal Blocks, UL 1059, rated for field-wiring (FW) Code 2 applications and also suitable for the voltage, current, wire range, and wire type of the intended application.

The current-carrying parts shall be silver, copper, a copper alloy, or a similar nonferrous conductive material. Securing screws and the like may be plated steel. Equipment provided with quick-connect terminals intended for field termination of electrical conductors to the equipment and complying with the Standard for Electrical Quick-Connect Terminals, UL 310, shall be provided with strain relief, and the installation instructions shall include instructions for effecting the strain relief and include reference to the specific connectors to be used.

Exception: In the case where power is supplied to the burglar alarm unit from a power over communications cable source that has been tested and is in compliance with Section 36, then the field wiring minimum permissible wire size to be used shall not be less than 26 AWG for patch cords; 24 AWG for horizontal or riser cable.

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

17.2.4 Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for 10 AWG (5.3 mm²) and larger wires. When the connectors or lugs are secured to a plate, the plate thickness shall not be less than 0.050 inch (1.3 mm) thick. Securing screws may be plated steel.

17.2.5 A wire binding screw used at a wiring terminal shall not be smaller than No. 8 (4.2 mm diameter). Plated screws are not prohibited.

Exception: A No. 6 (3.5 mm diameter) screw may be used for the connection of one 14 AWG (2.1 mm²) or smaller conductor and a No. 4 (2.8 mm diameter) screw may be used for the connection of one 19 AWG (0.65 mm²) or smaller conductor.