UL 365

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Police Station Connected Burglar Alarm Units and Systems

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UL Standard for Safety for Police Station Connected Burglar Alarm Units and Systems, UL 365

Fourth Edition, Dated July 31, 1997

Revisions: This Standard contains revisions through and including March 8, 2005.

Summary of Topics

This revision of UL 365 is being issued to update ANSI status of the standard and to publish revisions to the scope, glossary, requirements for grades of service and line security, product function marking, two-way radio as a multiplex system, packet switched data networks, and miscellaneous editorial revisions.

Announcement Bulletin(s): This Standard contains the announcement bulletin(s) dated January 26, 2001. The announcement bulletin is located at the end of the Standard.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding item.

Future Effective Date	References
March 8, 2007	Paragraphs 1.4, 1.5, 1.7, 3.3, 43.4.2, 57.1, 58.1, 58.2, 58.3, 59.1, 59A.1, 59A.2, 59A.3, 63.1, 66.1.1, 67.1, 67.3, 68.8, 68.9, 68.10, 68.11, 68A.1, 68A.2, 68A.3, 69.1, 69.2, 70.1, 70.2, 72.1, 73.1, 76.5, 77.1, 78A.1, 80.1, 81.1, 81.2, 82.1, 82.2, 83.1, 83.1.1, 83.2, 108.2

The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated July 30, 2004 and September 29, 2003. The bulletin(s) is now obsolete and may be discarded.

The revisions dated March 8, 2005 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: http://ulstandardsinfonet.ul.com/ulforeword.html

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

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UL 365

Standard for Police Station Connected Burglar Alarm Units and Systems

First Edition – March, 1975
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Third Edition – June, 1993

Fourth Edition

July 31, 1997

The most recent designation of ANSI/UL 365 as an American National Standard (ANSI) occurred on October 4, 2004.

This ANSI/UL Standard for Safety, which consists of the Fourth Edition with revisions through March 8, 2005 is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at http://csds.ul.com.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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INTRODUCTION

1 Scope

1.1 These requirements cover construction, performance, and maintenance of police station connected burglar-alarm units and systems for use in mercantile premises, mercantile safes and vaults, and bank safes and vaults.

1.2 As covered by these requirements, a police station connected alarm system consists of protective circuits and devices, connected through control apparatus to an enclosed tamper-protected 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 (see 1.8 and 52.1). Intrusion into or disturbance of the units or wiring causes the sounding device to be actuated 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. 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.

1.3 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. See Mercantile Premises Alarm Systems, Maintenance, Section 65 and Bank Safe and Vault Alarm Systems, Maintenance, Section 75. 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 Police station connected mercantile burglar-alarm systems transmission means may be designated as standard line security or encrypted line security and are designated as to their acceptability for use either on mercantile premises or on mercantile safes and vaults. See Standard Line Security Equipment, Section 59, and Encrypted Line Security Equipment, Section 59A.

Revised 1.4 effective March 8, 2007

1.5 Police station connected bank burglar-alarm systems transmission means may be designated as standard line security or encrypted line security and are for use on bank safes and vaults. See Standard Line Security Equipment, Section 59, and Encrypted Line Security Equipment, Section 59A.

Revised 1.5 effective March 8, 2007

1.6 Equipment intended for combination burglar-alarm and fire-protective signaling systems is also expected to comply, with the Standard for Control Units for Fire-Protective Signaling Systems, UL 864.

1.7 Devices installed on individual properties are further classified as to extent of protection at each location. Rules covering installation and classification (of extent) of alarm equipment at individual locations are published in the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681, which should be consulted by burglar-alarm installers.

Revised 1.7 effective March 8, 2007

1.8 The connection to a police department may be:

a) Direct or

b) Through a central station or a residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

1.8 revised March 8, 2005

1.9 Deleted August 31, 2001

2 General

2.1 Terminology

2.1.1 The term ″product″ as used in this standard refers to all types of police station connected burglar alarm units and systems.

2.2 Components

2.2.1 Except as indicated in 2.2.2, 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 used in the products covered by this standard.

2.2.2 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.

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

2.2.4 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.

2.3 Units of measurement

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

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

2.4 Undated references

2.4.1 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.

3 Glossary

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

3.1.1 ACKNOWLEDGMENT SIGNAL – An audible and/or visual signal that is sent to the subscriber by the central station to notify the subscriber that a signal has been received indicating that the protection system has been properly armed. The acknowledgment signal can be sent manually or automatically.

3.1.1 added March 8, 2005

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

3.3 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 Devices, Section 68A. There are two versions:

a) Outside – A housing intended to be located outside of the protected area. See 68.4 and 68.10.

b) Inside – A housing intended to be located within the protected area where it can be seen by an intruder. See 68.8, 68.10 and 68.11.

c) Deleted

Exception: These requirements are for alarm sounding device housings used in mercantile burglar alarm systems. For requirements for alarm sounding device housings used in bank alarm systems, see the Attack Test, Section 76; Tamper Protection, Section 78; and Alarm Sounding Devices, Section 78A.

Revised 3.3 effective March 8, 2007

3.4 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 Tables 3.1 and 3.2. The power limitation shall be provided by the construction of the transformer, a fixed impedance, a noninterchangeable fuse, a nonadjustable manual reset circuit protective device, or a regulating network.

3.5 CORD-CONNECTED – 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.

3.5.1 DIGITAL ALARM COMMUNICATOR (DAC) – A transmission method as outlined in the Standard for Digital Alarm Communicator System Units, UL 1635, by cellular and/or telephone landline transmission.

3.5.1 added March 8, 2005

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

3.5.2 added March 8, 2005

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

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

3.8 POLICE DEPARTMENT – Any government-related law enforcement agency.

3.9 PRIMARY BATTERY – A battery that by construction is not intended to be recharged.

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

Table 3.1
Power limitations for inherently limited power source (overcurrent protection not required)

Circuit voltage V_{max}[a] AC-DC (volts)	Maximum nameplate ratings		Current limitation I_{max}[b] (amperes)
	VA (volt amperes)	Current (amperes)	
0 to 20	5.0 x V_{max}[a]	5.0	8.0
Over 20 to 30	100	100/V_{max}[a]	8.0
Over 30 to 100	100	100/V_{max}[a]	150/V_{max}[a]
Over 100 to 250 DC[a] only	0.030 x V_{max}[a]	0.030	0.030

NOTE – Reproduced from the National Electrical Code (ANSI/NFPA 70), 1993 Edition, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

[a] V_{max}: Maximum output voltage regardless of load with rated input applied. 0 – 20 V-rms, 0 – 28.3 V DC or AC peak; 20 – 30 V-rms, 28.3 – 42.4 V DC or AC peak.

[b] I_{max}: Maximum output current after 1 minute of operation under any noncapacitive load, including short circuit.

Table 3.2
Power limitations for power sources not inherently limited (overcurrent protection required)

Circuit voltage V_{max}[a] AC-DC (volts)	Maximum nameplate ratings		Current limitation I_{max}[b] (amperes)	Power limitation $(VA)_{max}$[c] (volt amperes)	Maximum overcurrent protection (amperes)
	VA (volt amperes)	Current (amperes)			
0 to 20	5.0 x V_{max}[a]	5.0	1000/V_{max}[a]	250[d]	5.0
Over 20 to 100	100	100/V_{max}[a]	1000/V_{max}[a]	250[d]	100/V_{max}[a]
Over 100 to 150	100	100/V_{max}[a]	1.0	NA	1.0

NOTE – Reproduced from the National Electrical Code (ANSI/NFPA 70), 1993 Edition, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

[a] V_{max}: Maximum output voltage regardless of load with rated input applied. (See note a, Table 3.1)

[b] I_{max}: Maximum output after 1 minute of operation under any noncapacitive load, including short circuit, and with overcurrent protection bypassed.

[c] $(VA)_{max}$: Maximum volt-ampere output regardless of load with overcurrent protection bypassed.

[d] If the power source is a transformer $(VA)_{max}$ is 350 or less when V_{max} is 15 or less.

3.11 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).

3.12 SECONDARY BATTERY – A battery that, by construction, is intended to be recharged.

3.13 SERVICE CENTER – A location that may be separate from the alarm service company's main business location providing installation, maintenance, and repair service to systems served by the company. The service center is to keep maintenance records for the systems that it serves unless the records can be accessed from another location.

3.14 SERVICE VEHICLE – A vehicle used to provide installation, maintenance, and repair service to systems served by the company.

3.15 SIGNAL TRANSMISSION METHODS – Any of the following methods: direct wire, multiplex, derived channel, two way radio (RF), DACT/DACR, one way radio (RF), packet switched data network, or code transmitter.

3.15 added March 8, 2005

4 Installation and Operating Instructions

4.1 A copy of the installation and operating instructions intended to accompany each product or component as produced, the related schematic wiring diagrams, and the installation drawings is to be furnished with the sample submitted for investigation, to be used as a guide in the examination and test of the product or component. For this purpose, a final printed edition is not required.

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

a) Typical installation drawing layouts and a complete representative installation wiring diagram(s) for the product(s) indicating recommended locations and wiring methods that shall be in accordance with the National Electrical Code, ANSI/NFPA 70, and the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681. Locations where installations are not recommended shall also be included.

b) Concise description of the operation, testing, and maintenance procedures for the product(s), and recommended testing frequency (that shall be at least once a year).

c) Identification of replacement parts, such as lamps or batteries, by a part number, manufacturer's model number, or the equivalent.

d) A description of the conditions that might be expected to result in false alarms or impaired operation of the product(s).

e) A description of any features provided to reduce the risk of fire, electric shock, or injury to persons and a warning against bypassing such features.

4.3 The instructions may be incorporated on the inside of the product, on a separate sheet, or as part of a manual. If not included directly on the product, the instructions or manual shall be referenced in the marking information on the product. See Marking, General, Section 108.

CONSTRUCTION

ASSEMBLY

5 General

5.1 Product assembly

5.1.1 The product shall be factory-built as a complete assembly and shall include all the components necessary for its intended function when installed (used) as intended. The product may be shipped from the factory as two or more major subassemblies. See 5.1.2.

5.1.2 If the product is not assembled by the manufacturer as a complete unit, it shall be arranged in major subassemblies. Each subassembly shall be capable of being incorporated into a 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 without need for alteration or alignment, or such subassemblies shall be assembled, tested, and shipped from the factory as one element.

5.2 Electrical protection

5.2.1 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. 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 Protection of Service Personnel, Section 6.

5.2.2 Uninsulated high-voltage live parts shall be located, guarded, or enclosed as indicated in 5.2.3 – 5.2.5.

5.2.3 Openings directly over uninsulated high voltage live parts shall not exceed 0.187 inch (4.75 mm) in any dimension, or shall be of a configuration as illustrated by Figure 7.2 for top cover designs and Figure 7.3 for side openings, or the equivalent.

5.2.4 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 5.1, cannot be made to contact any uninsulated live part (other than low-voltage) when inserted through the opening in a straight or articulated position.

5.2.5 An opening that permits entrance of a 1 inch (25.4 mm) diameter rod is acceptable under the conditions described and illustrated in Figure 5.2.

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

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Figure 5.1
Accessibility probe

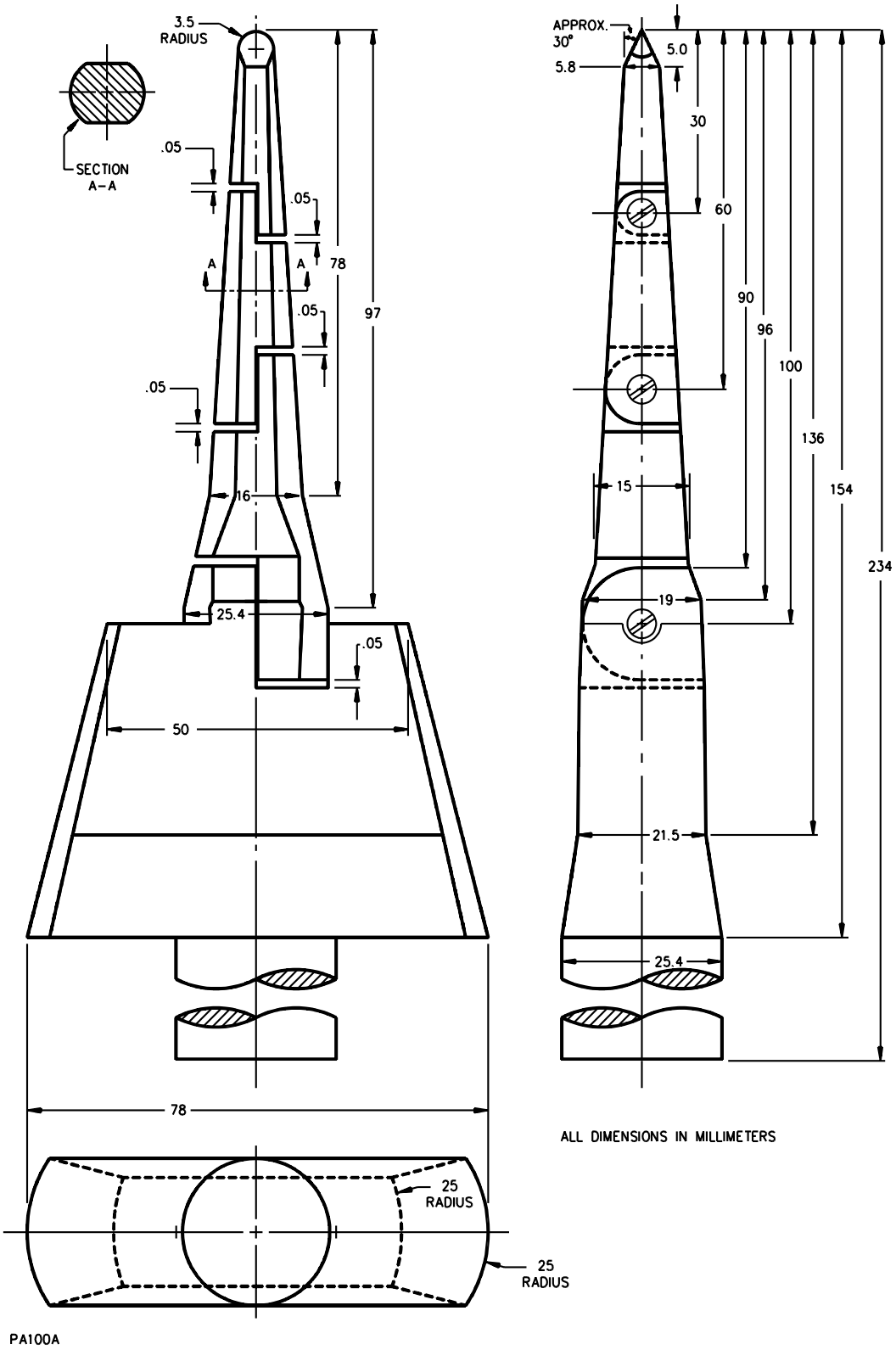
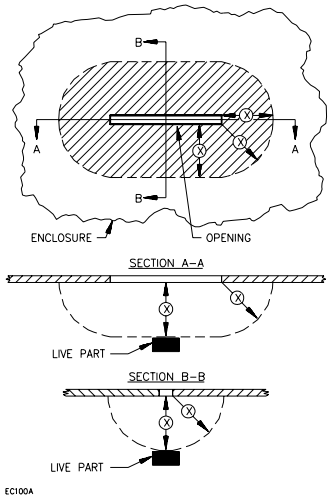


Figure 5.2
Opening in enclosure



The opening is acceptable if, within the enclosure, there is no uninsulated live part or enamel-insulated wire less than X inches (mm) from the perimeter of the opening, as well as 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).

6 Protection of Service Personnel

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

6.2 During the examination of a product in connection with the requirements in 6.1, 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, is to be disregarded; and it is to be assumed that the part in question does not afford protection against the risk of electric shock.

6.3 An electrical component that may require examination, replacement, adjustment, servicing, or maintenance while the product is energized shall be located and mounted with respect to other components and with respect to grounded metal so that:

a) The component is accessible for such service and

b) The risk of electric shock to the service person from adjacent uninsulated high-voltage live parts is reduced.

6.4 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.

7 Enclosures

7.1 General

7.1.1 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 50.

7.1.2 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.

7.1.3 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 Ignition Through Bottom-Panel Openings Tests, Section 49.

7.1.4 The requirement in 7.1.3 necessitates either a nonflammable bottom in accordance with the requirements in 7.3.2, or a protective barrier as illustrated in Figure 7.1 under all areas containing combustible materials.

Exception: See 7.3.3.

7.1.5 A construction employing individual barriers under components, groups of components or assemblies, as illustrated in Figure 7.1, is considered to comply with the requirement in 7.1.3.

7.2 Doors and covers

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

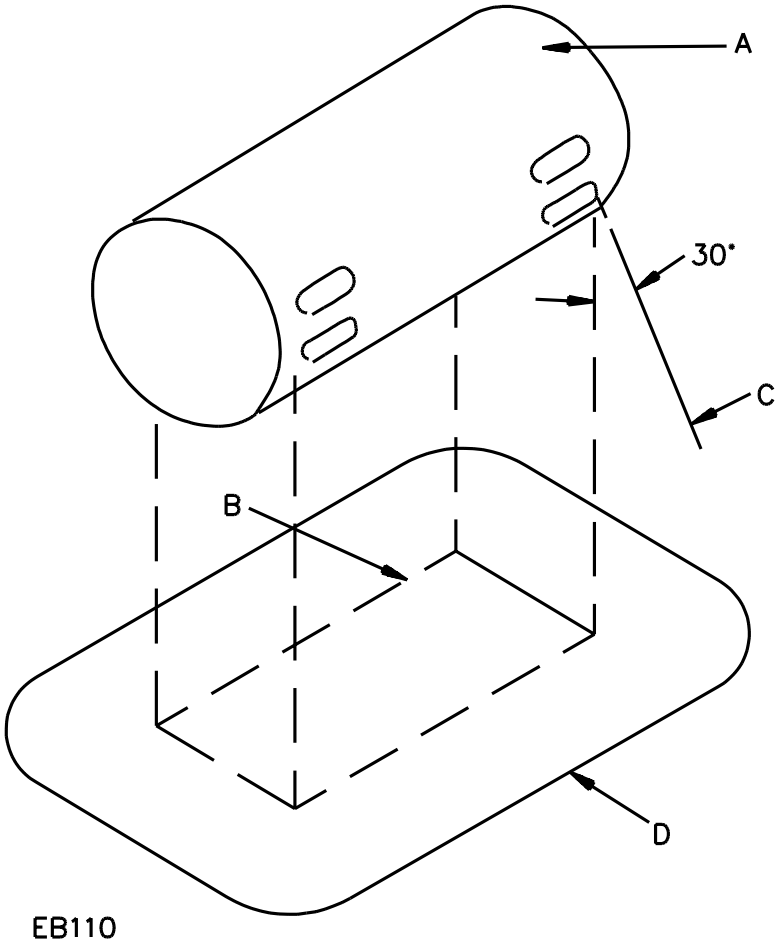
a) Gives access to fuses or any other overcurrent protective device, the intended functioning of which requires renewal; or

b) Is necessary to open the cover in connection with the intended operation of the unit.

Exception: If its position is supervised by a tamper contact that is connected in the closed protective circuit, an enclosure need not comply with the requirements of this paragraph. See also 30.5.

7.2.2 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.

Figure 7.1
Protective barrier



A – The entire component under which a barrier (flat or dished with or without a lip or other raised edge) of nonflammable material is to be provided. The sketch above is of a metal enclosed component with ventilating openings to show that the protective barrier is required only for those openings from which flaming parts might drop. If the component or assembly does not have its own nonflammable enclosure, the area to be protected would be the entire area occupied by the component or assembly.

B – Projection of the outline of the area of (A) which requires a bottom barrier vertically downward onto the horizontal plane of the lowest point on the outer edge (D) of the barrier.

C – Inclined line that traces out an area (D) on the horizontal plane of the barrier. Moving around the perimeter of the area (B) which requires a bottom barrier, this line projects at a 30-degree angle from the line extending vertically at every point around the perimeter of (A) and oriented to trace out the largest area, except that the angle may be less than 30-degrees if the barrier or portion of the bottom cover contacts a vertical barrier or side panel of nonflammable material, or if the horizontal extension of the barrier (B) to (D)) would exceed 6 inches (152 mm).

D – Minimum outline of the barrier, except that the extension B – D need not exceed 6 inches (152 mm) (flat or dished with or without lip or other raised edge). The bottom of the barrier may 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 barrier.

7.2.3 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. Requirements for complete electrical protection are covered in Subscriber's Control Units, Section 60.

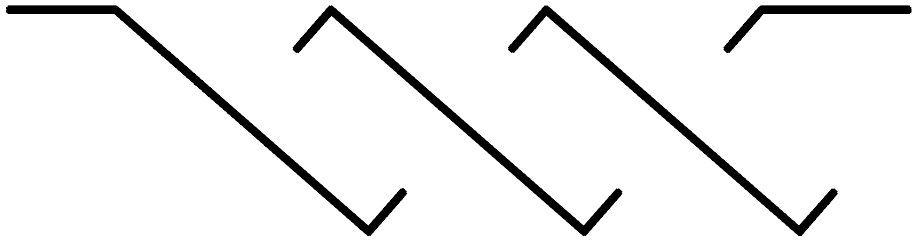
Exception: An enclosure located inside of a completely protected safe or vault does not require tamper protection.

7.3 Enclosure openings

7.3.1 Openings in the enclosure shall be constructed and of such size so that direct entry of foreign objects is prevented. See also 5.2.3. See Figure 7.2 for examples of acceptable top cover constructions that are deemed to prevent direct entry. See also Figure 7.3 for acceptable side opening constructions.

Figure 7.2
Cross sections of top cover designs

Figure 7.2 revised March 17, 1998



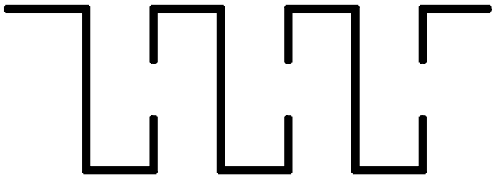
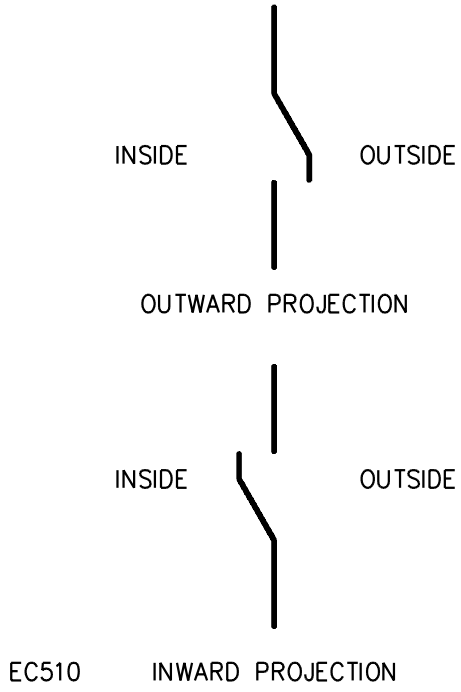


Figure 7.3
Louvers

Figure 7.3 revised March 17, 1998



7.3.2 Openings may be provided in the bottom panels or protective pans under areas containing materials not classified as 94V-1, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, if constructed in a manner that prevents materials from falling directly from the interior of the product onto the supporting surface or onto any other location under the product. Figure 7.4 illustrates a type of baffle that complies with this requirement. A second construction that complies with this requirement is a 0.040 inch (1.02 mm) sheet steel bottom panel in which round holes of 5/64 inch (2.0 mm) maximum diameter are spaced not closer together than 1/8 inch (3.2 mm) center-to-center. Constructions other than these two are acceptable if they comply with the Ignition Through Bottom-Panel Openings Tests, Section 49.

7.3.3 The bottom of the enclosure under areas containing only materials classified as 94V-1 or less flammable, may have openings not larger than 1/16 square inch (40.3 mm^2).

7.3.4 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.

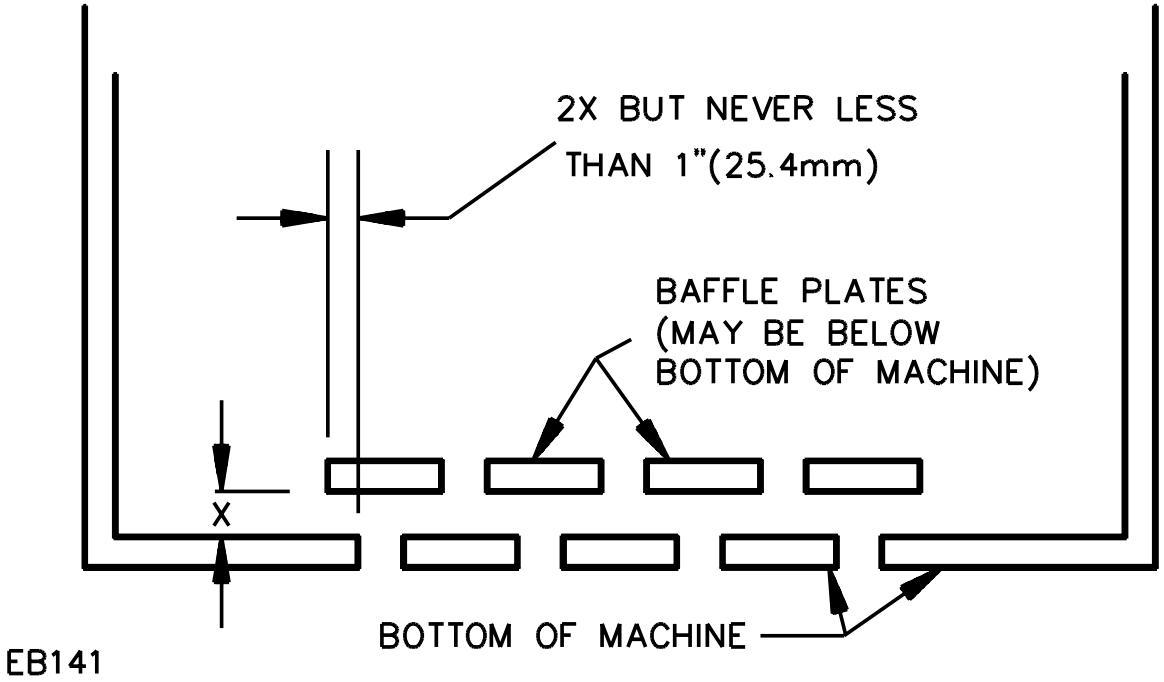
7.3.5 Openings in the enclosure shall not give access to relays, terminals, controls, or related components that might be subject to tampering by hand or with tools without causing an alarm or trouble signal.

7.4 Screens and expanded metal

7.4.1 Screens or expanded metal used as a guard, enclosure, or part of an enclosure, shall comply with the requirements in 7.4.3 and 7.5.1 and with the Mechanical Strength Tests for Enclosures, Section 50.

Figure 7.4
Bottom panel baffles

Figure 7.4 revised March 17, 1998



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7.4.2 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 square inch (323 mm^2) 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 23, and the Mechanical Strength Tests for Enclosures, Section 50), 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 square inches (464 cm^2) 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).

7.4.3 The wires of a screen shall be not less than No. 16 AWG (1.3 mm diameter) steel if the screen openings are 1/2 square inch (323 mm^2) or less in area, and shall be not less than No. 12 AWG (2.1 mm diameter) steel for larger screen openings.

7.5 Cast metal

7.5.1 The minimum thickness of cast metal for an enclosure shall be as indicated in Table 7.1.

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 47, and the Mechanical Strength Tests for Enclosures, Section 50.

Table 7.1
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) in thickness may be obtained by the provision of reinforcing ribs subdividing a larger area.

7.5.2 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.

7.5.3 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 which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

7.6 Sheet metal

7.6.1 The thickness of sheet metal for an enclosure shall not be less than that indicated in Table 7.2 or 7.3, 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 47, and the Mechanical Strength Tests for Enclosures, Section 50.

7.6.2 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.

7.6.3 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 7.1, 7.2, and 7.3.

7.6.4 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.

7.6.5 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.

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

7.6.7 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 23.

7.7 Product enclosure mounting

7.7.1 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.

Table 7.2
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			
								Uncoated,		Metal coated,	
Maximum width,[b] inches	(cm)	Maximum length,[c] inches	(cm)	Maximum width,[b] inches	(cm)	Maximum length, inches	(cm)	inches [MSG]	(mm)	inches [GSG]	(mm)
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020	(0.51)	0.023	(0.58)
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)	[24]		[24]	
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026	(0.66)	0.029	(0.74)
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)	[22]	[22]	[22]	
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)	0.034	(0.86)
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)	[20]		[20]	
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)	0.045	(1.14)
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)	[18]		[18]	
18.0	(45.7)	Not limited		27.0	(68.6)	Not limited		0.053	(1.35)	0.056	(1.42)
20.0	(50.8)	25.0	(63.5)	29.0	(73.7)	36.0	(91.4)	[16]		[16]	
22.0	(55.9)	Not limited		33.0	(83.8)	Not limited		0.060	(1.52)	0.063	(1.60)
25.0	(63.5)	31.0	(78.7)	35.0	(88.9)	43.0	(109.2)	[15]		[15]	
25.0	(63.5)	Not limited		39.0	(99.1)	Not limited		0.067	(1.70)	0.070	(1.78)
29.0	(73.7)	36.0	(91.4)	41.0	(104.1)	51.0	(129.5)	[14]		[14]	
33.0	(83.8)	Not limited		51.0	(129.5)	Not limited		0.080	(2.03)	0.084	(2.13)
38.0	(96.5)	47.0	(119.4)	54.0	(137.2)	66.0	(167.6)	[13]		[13]	
42.0	(106.7)	Not limited		64.0	(162.6)	Not limited		0.093	(2.36)	0.097	(2.46)
47.0	(119.4)	59.0	(149.9)	68.0	(172.7)	84.0	(213.4)	[12]		[12]	
52.0	(132.1)	Not limited		80.0	(203.2)	Not limited		0.108	(2.74)	0.111	(2.82)
60.0	(152.4)	74.0	(188.0)	84.0	(213.4)	103.0	(261.6)	[11]		[11]	
63.0	(160.0)	Not limited		97.0	(246.4)	Not limited		0.123	(3.12)	0.126	(3.20)
73.0	(185.4)	90.0	(228.6)	103.0	(261.6)	127.0	(322.6)	[10]		[10]	

Table 7.2 Continued on Next Page

Table 7.2 Continued

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)	Uncoated, inches (mm) [MSG]	Metal coated, inches (mm) [GSG]

[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 that 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.

7.8 Polymeric materials

7.8.1 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 45, and the Mechanical Strength Tests for Enclosures, Section 50.

8 Electric Shock

8.1 Any part that is exposed only during operator servicing shall not present the risk of electric shock. See the Electric Shock Current Test, Section 36.

Table 7.3
Minimum thickness of sheet metal for electrical enclosures – aluminum, copper, or brass

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]					
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,		Minimum thickness	
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inches	(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.

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

Exception: The conductive connection need not be provided if:

a) Such a connection is established in the event of electrical breakdown of the antenna isolating means,

b) The breakdown does not result in a risk of electric shock, and

c) In a construction employing an isolating power transformer, the resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 megohms.

8.3 The maximum value of 5.2 megohms mentioned in 8.2 is to include the maximum tolerance of the resistor value used; that is, a resistor rated 4.2 megohms with 20 percent tolerance or a resistor rated 4.7 megohms with a 10 percent tolerance is acceptable. A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements for antenna isolating capacitors may be rated a minimum of 1/4 watt.

8.4 The insertion in any socket of any vacuum tube or its glass or metal equivalent of like designation used in the product shall not result in a risk of electric shock.

9 Corrosion Protection

9.1 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.

9.2 The requirement of 9.1 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.

9.3 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.

9.4 Hinges and other attachments shall be resistant to corrosion.

FIELD WIRING CONNECTIONS

10 General

10.1 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.

11 Cord-Connected Products

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

Exception: 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.

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

11.3 A flexible cord shall be of Type SJ, SJT, or equivalent, having conductors not smaller than No. 18 AWG (0.82 mm^2). It shall be rated for use at the voltage and ampacity rating of the product.

11.4 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 48.

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

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

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

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.

12 Permanently-Connected Products

12.1 General

12.1.1 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.

12.1.2 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 12.1.

Table 12.1
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.

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

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

12.1.5 The product shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity not less than that required by the product. It is assumed that branch circuit conductors rated 60°C (140°F) will be used.

12.2 Field-wiring terminals

12.2.1 General

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

12.2.1.2 A field wiring terminal shall comply with:

a) 12.2.2.1 – 12.2.2.5;

b) The field wiring requirements in the Standard for Electrical Quick-Connect Terminals, UL 310;

c) The Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A;

d) The Standard for Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors, UL 486E; or

e) The field wiring requirements (Code 2) in the Standard for Terminal Blocks, UL 1059.

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 Terminal, 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.

12.2.1.3 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.

12.2.2 General application

12.2.2.1 Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for No. 8 AWG (8.4 mm^2) and larger wires. If the connectors or lugs are secured to a plate, the plate thickness shall not be less than 0.050 inch (1.3 mm). Securing screws may be plated steel.

12.2.2.2 A wire binding screw intended for connection to the power supply (line voltage) source shall not be smaller than No. 10 (4.8 mm diameter). The screw may be of plated steel.

Exception: A No. 8 (4.2 mm diameter) screw may be used for the connection of one No. 14 AWG (2.1 mm^2) or smaller conductor and a No. 6 (3.5 mm diameter) screw may be used for the connection of a No. 16 AWG (1.3 mm^2) or smaller conductor.

12.2.2.3 For connection of other than power supply (line voltage) circuits using No. 10 AWG (5.3 mm^2) and smaller wires, a wire binding screw shall not be smaller than No. 8 (4.2 mm diameter).

Exception: A No. 6 (3.5 mm diameter) screw may be employed for the connection of one No. 14 AWG (2.1 mm^2) or smaller conductor and a No. 4 (2.8 mm diameter) screw may be used for the connection of one No. 19 AWG (0.65 mm^2) or smaller conductor.

12.2.2.4 Terminal plates tapped for wire binding screws shall:

a) Have not less than two full threads in the metal (the terminal plate metal may be extruded to provide the two full threads) and shall have upturned lugs, clamps, or the equivalent, to hold the wires in position. Other constructions may be employed if they provide equivalent thread security of the wire binding screw. However, two full threads are not required if fewer threads will result in a secure connection in which the threads will not strip with tightening torque in accordance with the values indicated in the Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors, UL 486A.

b) Be of a nonferrous metal not less than 0.050 inch (1.3 mm) thick if used with a No. 8 (4.2 mm diameter) or larger screw, and not less than 0.030 inch (0.76 mm) thick if used with a No. 6 (3.5 mm diameter) or smaller screw.

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

12.2.3 Qualified application

12.2.3.1 Any of the following terminal configurations may be employed for connection of field wiring when they comply with all of the requirements in 12.2.3.2.

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

b) Solderless Wrapped Terminals – Solderless wrapped nonferrous terminals which require a special tool and terminal post design.

c) Quick-Connect Terminals – Nonferrous quick-connect (push type) terminals consisting of male posts permanently secured to the device and provided with compatible female connectors for connection to field wiring. Requires special tool for crimping of field wires. Mating terminals shall be shipped with the product with instructions for their installation.

d) Push-In Terminals – Nonferrous (screwless) push-in terminals of the type used on some switches and receptacles wherein solid conductors may be pushed into slots containing spring-type remaining contacts. The leads can be removed by means of a tool inserted to relieve the spring tension on the conductor. Push-in terminals are not acceptable for use with aluminum conductors. The marking adjacent to the terminal shall indicate that copper conductors only are to be used.

e) Solder Terminals – Conventional nonferrous solder terminals.

f) Other Terminals – Other terminal connections may be employed if found to be equivalent to (a) – (e) and limited to the same restrictions.

12.2.3.2 Any of the terminal configurations listed in 12.2.3.1 may be employed for connection of field wiring when there is compliance with all of the following:

a) If a special tool is required for connection, its use shall be indicated on the installation wiring diagram and the name of its manufacturer and its model number or equivalent shall also be indicated, along with information as to where the tool may be obtained.

b) The range of wire sizes shall be indicated on the installation wiring diagram. The minimum permissible wire size shall not be smaller than No. 22 AWG (0.32 mm^2).

c) The wire size to be employed shall have the current-carrying capacity for the circuit application.

d) The terminal configuration shall comply with the requirements in the Special Terminal Assemblies Tests, Section 51.

Exception: Terminals complying with the requirements in any of the standards specified in 12.2.1.2 (b) – (e) are not required to be subjected to the Special Terminal Assemblies Tests, Section 51.

12.3 Field wiring leads

12.3.1 If leads are provided in lieu of wiring terminals, they shall not be less than 6 inches (152 mm) long, and shall not be smaller than No. 22 AWG (0.32 mm^2).

Exception No. 1: A lead may be less than 6 inches long if it is evident that the use of a longer lead may result in damage to the lead insulation or product, or result in a risk of fire, electric shock, or injury to persons, or is not required for the intended operation of the product.

Exception No. 2: Solid copper leads as small as No. 26 AWG (0.13 mm^2) may be used if:

a) The current does not exceed 1 ampere for lengths up to 2 feet (61 cm) and the current does not exceed 0.4 ampere for lengths up to 10 feet (3.05 m),

b) There are two or more conductors and they are covered by a common jacket or the equivalent,

c) The assembled conductors comply with the requirement of 48.2.1 for strain relief, and

d) The installation instructions indicate that the lead shall not be spliced to a conductor larger than No. 18 AWG (0.82 mm^2).

12.3.2 Leads intended for connection of a line voltage source shall not be smaller than No. 18 AWG (0.82 mm^2).

12.3.3 Leads intended for connection to an external circuit shall comply with the strain relief test of 48.2.1.

12.4 Polarity identification

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

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

13 Grounding

13.1 A grounding means shall be provided for all equipment containing parts that require grounding, see Bonding for Grounding, Section 17.

13.2 The following are considered to constitute means for grounding:

a) In a product intended to be permanently connected by a metal enclosed wiring system, a knockout or equivalent opening in the metal enclosure of the product.

b) In a product intended to be permanently connected by a nonmetallic enclosed wiring system, such as nonmetallic-sheathed cable, an equipment grounding terminal or lead.

c) In a cord-connected product, an equipment grounding conductor in the cord.

13.3 On a permanently-connected product, a terminal intended solely for the connection of an equipment grounding conductor shall be capable of securing a conductor of the size rated for the application in accordance with the National Electrical Code, ANSI/NFPA 70.

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

13.5 On a permanently-connected product, a wire binding screw intended for the connection of an equipment grounding conductor shall have a green colored head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified by being marked ″G,″ ″GR,″ ″Ground,″ or ″Grounding,″ or the like, or by a marking on a wiring diagram provided on the product. See also 13.6. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the product and shall be located so that it is unlikely to be removed during service operations, such as replacing fuses, resetting manual-reset devices, or the like.

13.6 If a pressure wire connector intended for grounding is located where it could be mistaken for a neutral conductor of a grounded supply, it shall be identified by a marking ″EQUIPMENT GROUND″ or with a green color identification or both.

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

13.8 On a cord-connected product, the grounding conductor of the flexible cord shall be finished with a continuous green color or with a continuous green color with one or more yellow stripes, and no other conductor shall be so identified. The grounding conductor shall be secured to the frame or enclosure of the product by a positive means (see Bonding for Grounding, Section 17), that is not likely to be removed during any servicing operation not involving the power supply cord. The grounding conductor shall be connected to the grounding blade of the attachment plug.

INTERNAL WIRING

14 General

14.1 Internal wiring shall have thermoplastic or rubber insulation not less than 1/64 inch (0.4 mm) thick for 0 – 300 volt applications if power is less than 375 volt-amperes, current is less than 5 amperes, and the wiring is not subject to flexing or mechanical abuse. Otherwise, thermoplastic or rubber insulation not less than 1/32 inch (0.8 mm) thick and rated 600 volts shall be used. Other insulating material of lesser thickness may be used if it has equivalent insulating and mechanical properties.

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

14.3 Insulation, such as coated fabric and extruded tubing, shall not physically or electrically deteriorate as a result of exposure to the temperature or other environmental conditions to which it may be subjected in intended use.

14.4 Wireways shall be smooth and free from sharp edges, burrs, fins, moving parts, and the like, that may cause abrasion of the conductor insulation. Holes in sheet metal walls through which insulated wires pass shall be provided with a bushing if the wall is 0.042 inch (1.07 mm) or less in thickness. Holes in walls thicker than 0.042 inch shall have smooth, rounded edges.

15 Wiring Methods

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

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

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

15.4 A printed wiring board shall comply with the requirements in the Standard for Printed-Wiring Boards, UL 796.

15.5 A printed wiring assembly employing insulating coatings or encapsulation shall comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40, before and after being treated. If it is impractical to use untreated samples, finished samples shall comply with the requirements of the Dielectric Voltage-Withstand Test, after they are subjected to the Humidity Test, Section 34, the Temperature Test, Section 41, and other applicable tests in this standard.

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

15.7 If the cord hole is in phenolic composition or other nonconducting material, or in metal not less than 0.042 inch (1.07 mm) thick, a smooth, rounded surface is considered to be the equivalent of a bushing.

15.8 Ceramic materials and some molded compositions may be used for insulating bushings if they have been investigated and found acceptable for the purpose.

15.9 Fiber may be employed where it will not be subjected to temperatures higher than 90°C (194°F) under intended operating conditions if the bushing is not less than 3/64 inch (1.2 mm) thick and if it will not be exposed to moisture.

15.10 A soft rubber bushing may be employed in the frame of a motor if the bushing is not less than 3/64 inch (1.2 mm) thick and if the bushing is located so that it will not be exposed to oil, grease, oily vapor, or other substance which may have a deleterious effect on rubber. If a soft rubber bushing is employed in a hole in metal, the hole shall be free from sharp edges, burrs, projections, and the like, which would be likely to cut into the rubber.

15.11 An insulating-metal grommet is acceptable in lieu of an insulating bushing, when the insulating material used is not less than 1/32 inch (0.8 mm) thick and completely fills the space between the grommet and the metal in which it is mounted.

16 Separation of Circuits

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

16.2 A barrier used to provide separation between the wiring of different circuits shall be of metal or of insulating material. A barrier of insulating material shall not be less than 0.028 inch (0.71 mm) thick. Any clearance between the edge of a barrier and a compartment wall shall not be more than 1/16 inch (1.6 mm).

17 Bonding for Grounding

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

17.2 Uninsulated metal parts, such as cabinets, electrical enclosures, capacitors, and other electrical components, shall be bonded for grounding if they may be contacted by the operator or serviceperson, except as indicated in 17.3.

17.3 Metal parts described as follows need not be grounded:

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

b) Isolated metal parts, such as small assembly screws, that are physically separated from wiring and uninsulated live parts.

c) Cabinets, panels, and covers that do not enclose uninsulated live parts if wiring is physically separated from the cabinet, panel, or cover so that they are not likely to become energized.

d) Panels and covers that are insulated from electrical components and wiring by an insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar materials not less than 0.028 inch (0.71 mm) thick, and secured in place. If material having a lesser thickness is used, consideration is to be given to such factors as its electrical, mechanical, and flammability properties when compared with materials specified above.

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

17.5 Metal-to-metal hinge bearing members for a door or cover are considered to be a means for bonding a door or cover for grounding if:

a) A minimum of two pin-type hinges are employed, each with a minimum of three knuckles, or

b) The hinges are continuous (piano-type).

17.6 A separate component-bonding conductor shall be of copper, a copper alloy, or other material acceptable for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by metallic or nonmetallic coatings, such as enameling, galvanizing, or plating. A separate bonding conductor or strap shall:

a) Be protected from mechanical damage or be located within the confines of the outer enclosure or frame and

b) Not be secured by a removable fastener used for any purpose other than bonding for grounding unless the bonding conductor is unlikely to be omitted after removal and replacement of the fastener.

17.7 The bonding shall be by a positive means, such as by clamping or riveting, by bolted or screwed connections; or by welding, soldering, and brazing materials having a softening or melting point greater than 445°C (833°F). The bonding connection shall penetrate nonconductive coatings, such as paint or vitreous enamel. Bonding around a resilient mount shall not depend on the clamping action of rubber or other nonmetallic material.

Exception: See 17.10.

17.8 With reference to 17.7, a bolted or screwed connection that incorporates a star washer under the screwhead, or that incorporates a serrated screwhead, is acceptable for penetrating nonconductive coatings. If the bonding means depends upon screw threads, two or more screws or two full threads of a single screw shall engage the metal.

17.9 An internal connection for bonding internal parts to the enclosure for grounding, but not for a field installed grounding conductor or for the grounding wire in a supply cord, may employ a quick-connect terminal of the specified dimensions if the connector is not likely to be displaced and the component is limited to use on a circuit having a branch circuit protective device, rated as specified in Table 17.1.

Table 17.1
Internal terminal connections for bonding

Terminal dimensions, inches	Terminal dimensions, (mm)	Rating of protective device, amperes
0.020 by 0.187 by 0.250	0.51 by 4.75 by 6.4	20 or less
0.032 by 0.187 by 0.250	0.81 by 4.75 by 6.4	20 or less
0.032 by 0.205 by 0.250	0.81 by 5.2 by 6.4	20 or less
0.032 by 0.250 by 0.312	0.81 by 6.4 by 7.9	60 or less

17.10 A connection that depends upon the clamping action exerted by rubber or other nonmetallic material may be acceptable if it complies with 17.13 under any intended degree of compression resulting from the use of a variable clamping device and if the material's intended performance is not impaired after exposure to the effects of oil, grease, moisture, and thermal degradation which may occur in service. Also, the effect of assembling and disassembling such a clamping device for maintenance purposes is to be considered, with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

17.11 On a cord-connected product, a bonding conductor or strap shall have a cross-sectional area not less than that of the grounding conductor of the supply cord. See also 17.14 and 17.15.

17.12 On a permanently-connected product, the size of a conductor employed to bond an electrical enclosure shall be based on the rating of the branch circuit overcurrent device to which the equipment will be connected. The size of the conductor or strap shall be in accordance with Table 17.2. An equipment grounding conductor is not required to be larger than the circuit conductors supplying the equipment.

17.13 A conductor, such as a clamp or strap, used in place of a separate wire conductor as indicated in 17.12, is acceptable if the minimum cross-sectional conducting area is equivalent to the wire sizes specified in Table 17.2.

Table 17.2
Bonding wire conductor size

Rating of overcurrent device, amperes	Size of bonding conductor[a]			
	Copper wire,		Aluminum wire,	
	AWG	(mm^2)	AWG	(mm^2)
15	14	2.1	12	3.3
20	12	3.3	10	5.3
30	10	5.3	8	8.4
40	10	5.3	8	8.4
60	10	5.3	8	8.4
100	8	8.4	6	13.3
200	6	13.3	4	21.2

[a] Or equivalent cross-sectional area.

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

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

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

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

COMPONENTS, ELECTRICAL

18 General

18.1 Mounting of components

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

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

a) The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during intended operation of the switch,

b) The means for mounting the switch makes it unlikely that the operation of the switch will loosen it,

c) Spacings are not reduced below the minimum required values if the switch rotates, and

d) The operation of the switch is by mechanical means rather than by direct contact by persons.

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

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

18.1.5 The means for preventing turning shall not consist only of friction between surfaces.

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

18.1.7 A flush plate for outlet-box mounting shall be of 0.030 inch (0.76 mm) or thicker ferrous metal, of 0.040 inch (1.01 mm) or thicker nonferrous metal, or of 0.100 inch (2.54 mm) or thicker nonconductive material.

18.1.8 A yoke, strap, or the mounting ears of a part intended to be mounted on a standard outlet box or similar back box shall be of 0.040 inch (1.02 mm) or thicker steel. If a nonferrous metal is used, it shall be of thickness sufficient to provide mechanical strength and rigidity equivalent to that of 0.040 inch thick steel.

18.2 Insulating materials

18.2.1 Insulating materials used as a base for the support of live parts shall be of a flame-resistant, moisture-resistant insulating material, such as porcelain, phenolic or cold-molded composition, or the equivalent. (See the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.)

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

18.2.3 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not for the sole support of live parts where shrinkage, current leakage, or warping of the fiber may introduce a risk of fire or electric shock.

18.2.4 A countersunk sealed live part shall be covered with a waterproof insulating compound that will not melt at a temperature 15°C (27°F) higher than the maximum intended operating temperature of the assembly, and at not less than 65°C (149°F) in any case. The depth or thickness of sealing compound shall not be less than 1/8 inch (3.2 mm).

18.2.5 The thickness of a flat sheet of insulating material, such as phenolic composition or the equivalent, used for panel-mounting of parts shall not be less than that indicated in Table 18.1.

Table 18.1
Thickness of flat sheets of insulating material

Maximum dimensions				Minimum thickness,[a]	
Length or width,		Area,			
inch	(cm)	inch^2	(cm^2)	inch	(mm)
24	60.9	360	2322	3/8	9.5
48	122.0	1152	7432	1/2	12.7
48	122.0	1728	11148	5/8	15.9
Over 48	122.0	Over 1728	11148	3/4	19.1

[a] Material less than 3/8 inch (9.5 mm) but not less than 1/8 inch (3.2 mm) in thickness may be employed for a panel if the panel is supported or reinforced to provide rigidity not less than that of a 3/8 inch sheet. Material less than 1/8 inch may be employed for subassemblies, such as supports for terminals for internal wiring, resistors, and other components.

18.3 Fuseholders

18.3.1 A fuseholder shall be installed or protected so that adjacent uninsulated high-voltage live parts, other than the screw shell of a plug fuseholder, cartridge fuse clips, or wiring terminals to the fuseholder, will not be exposed to contact by persons removing or replacing fuses. A separation of less than 4 inches (102 mm) is considered to be adjacent.

18.4 Current-carrying parts

18.4.1 All current-carrying parts shall be of silver, copper, a copper alloy, or other material recognized as acceptable for use as an electrical conductor.

Exception: Multimetallic thermal elements and heater elements of a thermal protector need not comply with this requirement.

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

18.5 Power-on indicator

18.5.1 Loss of commercial power shall be indicated. See 87.2.

19 Overcurrent Protection

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

20 Semiconductors

20.1 Semiconductors shall be rated for the intended application under all environmental conditions to which they may be exposed in service. See Performance – All Units, Sections 25 – 51.

21 Switches

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

22 Transformers and Coils

22.1 A transformer shall be of the two-coil or insulated type.

Exception: An autotransformer may be employed, when the terminal or lead common to both input and output circuits is identified as being intended for connection to the grounded conductor, and the output circuits are located only within the enclosure containing the autotransformer. See 12.4.1.

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

22.3 Film-coated or equivalently coated wire is not required to be given additional treatment to reduce the risk of moisture absorption.

SPACINGS

23 General

23.1 Spacings between uninsulated live parts and between uninsulated live parts and dead metal parts shall not be less than those indicated in 23.2 – 23.5. See also 24.2.

23.2 The spacings between an uninsulated live part and:

a) A wall or cover of a metal enclosure,

b) A fitting for conduit or metal-clad cable, and

c) A metal piece attached to a metal enclosure,

where deformation of the enclosure is likely to reduce spacings, shall not be less than those specified in Table 23.1. See Figure 23.1.

Table 23.1
Minimum spacings

Point of application	Voltage range	Minimum spacings[a,b]			
		Through-air,		Over-surface,	
		inch	(mm)	inch	(mm)
To walls of enclosure:					
Cast metal enclosures	0 – 300	1/4	6.4	1/4	6.4
Sheet metal enclosures	0 – 300	1/2	12.7	1/2	12.7
Installation wiring terminals:					
With barriers	0 – 30	1/8	3.2	3/16	4.8
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Without barriers	0 – 30	3/16	4.8	3/16	4.8
	31 – 150	1/4	6.4	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Rigidly clamped assemblies[c]					
100 volt-amperes maximum[d]	0 – 30	1/32	0.8	1/32	0.8
Over 100 volt-amperes	0 – 30	3/64	1.2	3/64	1.2
	31 – 150	1/16	1.6	1/16	1.6
	151 – 300	3/32	2.4	3/32	2.4
Other parts	0 – 30	1/16	1.6	1/8	3.2
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5

[a] An insulating liner or barrier of vulcanized fiber, varnished cloth, mica, phenolic composition, or similar material employed where spacings would otherwise be insufficient, shall not be less than 0.028 inch (0.71 mm) in thickness; except that a liner or barrier not less than 0.013 inch (0.33 mm) in thickness may be used in conjunction with an air spacing of not less than one-half of the through air spacing required. The liner shall be located so that it will not be affected adversely by arcing. Insulating material having a thickness less than that specified may be used if it is acceptable for the particular application.

[b] Measurements are to be made with solid wire of acceptable ampacity for the applied load connected to each terminal. In no case is the wire to be smaller than No. 18 AWG (0.82 mm^2).

[c] Rigidly clamped assemblies include such parts as contact springs on relays or cam switches, printed wiring boards, and the like.

[d] Spacings less than those indicated, but not less than 1/64 inch (0.4 mm), are acceptable for the connection of integrated circuits and similar components where the spacing between adjacent connecting wires on the component is less than 1/32 inch (0.8 mm).

23.3 The spacings between an uninsulated live part and:

a) An uninsulated live part of opposite polarity,

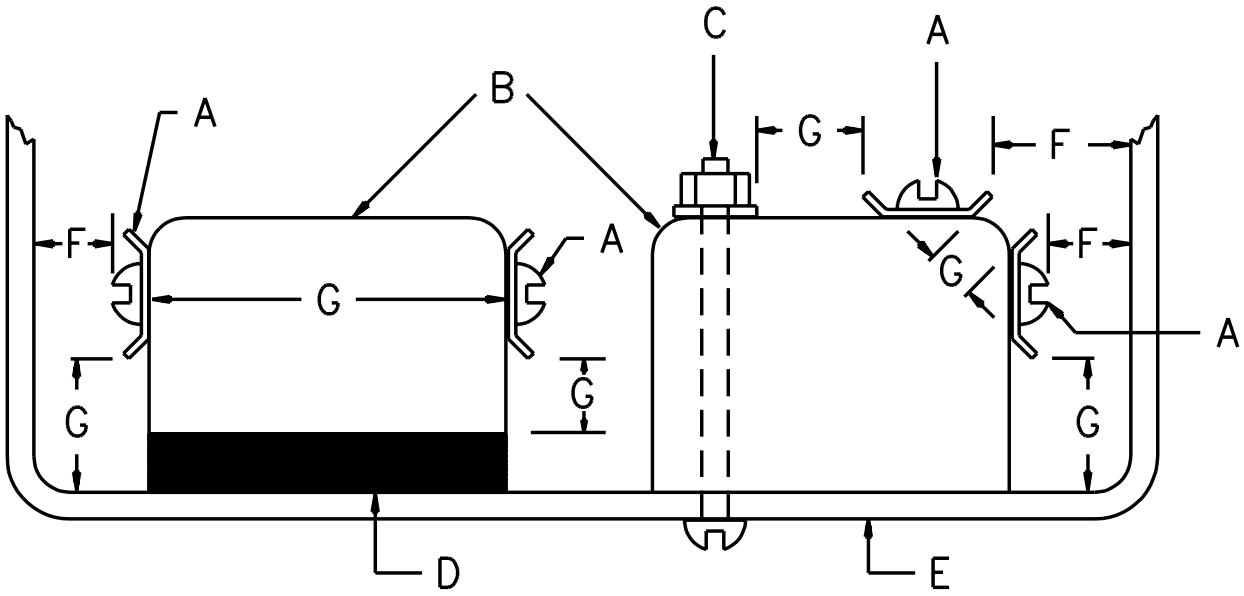
b) An uninsulated grounded dead metal part other than the enclosure, and

c) An exposed dead metal part that is isolated (insulated)

shall not be less than those indicated in Table 23.1. See also 24.1 and 24.2 and Figure 23.1.

Figure 23.1
Component spacings

Figure 23.1 revised March 17, 1998



SM100

A – Uninsulated live parts of a component.

B – Insulating material of a component.

C – Mounting screw of a component.

D – Dead metal part of a component.

E – Dead metal parts of the product.

F – Spacings to which the requirements of this standard apply unless specifically noted otherwise.

G – Spacings to which the requirements of this standard may not apply.

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23.4 If a short circuit between uninsulated live parts of the same polarity would prevent the intended operation of the product without simultaneously producing an alarm signal, the spacings between such parts shall not be less than those indicated for other parts in Table 23.1.

23.5 Film-coated wire is considered an uninsulated live part in determining compliance of a product with the spacing requirements, but film-coating is acceptable as turn-to-turn insulation in coils.

24 Components

24.1 A galvanometer-type relay in which the spacings do not comply with the requirements in 23.2 may be employed if, upon investigation, it is found to comply with the performance requirements of this standard.

24.2 Minimum values of spacings are not specified for vacuum tube sockets and similar related component parts, such as vacuum tubes, potentiometers, and the like, used in electronic circuits. However, if the spacings in such components do not comply with the requirements of 23.2 – 23.5, the spacings shall be such that the circuit complies with the Dielectric Voltage-Withstand Test, Section 40.

24.3 The spacings within snap switches, lampholders, and similar wiring devices supplied as part of a unit are judged on the basis of the requirements for such devices.

PERFORMANCE – ALL UNITS

25 General

25.1 Test units and data

25.1.1 Police station connected burglar-alarm system units that are fully representative of production units are to be used for each of the following tests unless otherwise specified.

25.1.2 The devices used for testing are to be those specified by the wiring diagram of the product, except that substitute devices may be used if they produce functions and load conditions equivalent to those obtained with the devices intended to be used with the product in service.

25.2 Test samples and miscellaneous data

25.2.1 The following samples are to be provided for testing:

a) Two or more complete police station connected burglar alarm system units.

Exception: A single sample may be provided if the size and complexity of the product w ould make it impracticable to provide more than one sample. The single sample shall be fully representative of the product.

b) One or more samples of each encapsulated or sealed assembly are to be provided in the unencapsulated or unsealed condition.

c) Installation and operating instructions (see 4.1 and 4.2).

25.3 Test voltages

25.3.1 Unless specifically noted otherwise, the test voltage for each test of a product shall be as specified in Table 25.1 and at the rated frequency.

Table 25.1
Voltages for tests

Voltage rating of product	Test potential, volts
110 – 120	120
220 – 240	240
Other	Marked rating

25.4 FCC requirements

25.4.1 A product radiating or utilizing radio frequency energy shall comply with the regulations of the Federal Communications Commission (FCC) before it is submitted for test. A letter of certification or the equivalent from the FCC is required as evidence of compliance.

26 Normal Operation Test

26.1 A unit shall perform its intended function when installed in accordance with 26.2.

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

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

26.4 Power-input supply terminals are to be connected to supply circuits of rated voltage and frequency. A product under test shall be in the circuit condition ready for intended signaling operation when it is connected to related products and circuits as specified in 26.2 and 26.3.

26.5 When installed as recommended by the manufacturer, a product shall not be subject to false operation and shall be positive in its operation.

27 Current Protection Test

27.1 There shall not be internal damage to circuitry if field wiring terminals are shorted together or are connected to power supply terminals. See 27.4.

27.2 A power source of rated voltage, see 25.3.1, shall be connected between the terminal under test and ground.

27.3 There shall not be internal damage to circuitry if all connections to power terminals, input and output lines, and central-station or police-station lines are reversed as pairs, reversed individually, or individually connected to any terminal adjacent to the one to which it is intended to be connected.

27.4 If damage can result from incorrect connections, markings shall be provided, clearly visible to the installer during installation, that warn of consequences of incorrect connection. If correct polarity is required, polarity markings shall appear immediately adjacent to wiring terminals.

28 Input Test

28.1 The input of a product shall not exceed the marked current, power, or volt-ampere rating by more than 10 percent when the product is operated under all conditions of use while connected to a source of supply in accordance with the requirements in 28.2.

28.2 The test voltage for this test is to be the maximum rated voltage for the product. For a product having a single voltage rating, such as 115 volts, maximum rated voltage is to be that single voltage. If the voltage is given in terms of a range of voltages, such as 110 – 120 volts, the maximum rated voltage is the highest value of the range.

29 Output Measurement Test

29.1 The measured output voltage of a police station connected burglar alarm system unit shall be within the limits specified in Table 29.1, while the unit is connected to a source of supply as specified in 25.3.1.

Exception: The limits of Table 29.1 need not apply if a product specified to be connected to an output voltage operates as intended at all voltage levels.

29.2 The measured voltages at the output circuits, with the minimum and maximum rated loads applied in turn, shall be compatible with the rating of the product intended to be connected to the circuit.

Table 29.1
Output voltage limits

No load			Full load		
85 percent rated input	**100 percent rated input**	**110 percent rated input**	**85 percent rated input**	**100 percent rated input**	**110 percent rated input**
85 to 110.5 percent of rated maximum	100 to 130 percent of rated maximum	100 to 143 percent of rated maximum	85 to 100 percent of rated maximum	100 to 110 percent of rated maximum	100 to 110 percent of rated maximum

29.3 The output circuits in a police station connected burglar alarm system unit shall be power limited. See 3.4.

Exception: This requirement does not apply to an output circuit using a connecting device or other method recognized for high-voltage wiring, such as a 125 volt, 15 ampere, parallel blade receptacle.

29.4 To determine if the output capacity of an inherently limited power source complies with the requirements in 29.3, a variable resistive load is to be connected to a circuit to simulate all loads that normally obtain their energy from that circuit. With the product connected to a rated source of supply (see 25.3.1), the load resistor is to be varied between open circuit and short circuit conditions in not less than 1-1/2 minutes nor more than 2-1/2 minutes. Voltage and current measurements are to be recorded for each value and the maximum volt-amperes calculated. If an overcurrent protective device is provided, it may be shunted out during the test, if necessary.

30 Electrical Supervision Test

30.1 Malfunctioning of an electronic component, such as opening or shorting of a capacitor, either shall not impair the intended operation or shall be indicated by a trouble or alarm signal, or the product shall be provided with a test feature as described in 30.3.

30.2 A malfunction of the power supply or loss of both primary power and standby battery capability shall result in an alarm or trouble signal.

30.3 A manual test method provided as a part of the operation of the system that effectively tests the capability of critical components or the battery will be accepted in lieu of electrical supervision.

30.4 With reference to the requirements in 30.3, a ″critical component″ is defined as a component whose malfunctioning will impair the operation of the product or will cause a risk of fire or electric shock.

30.5 Any cover, door, or access panel shall be electrically supervised if it gives access to any relays, terminals, controls, or related components that might be subject to tampering, so that opening or removal shall result in an alarm or trouble signal. The mounting of a product located outside the protected area shall be electrically supervised so that removal of the device shall result in an alarm or trouble signal.

Exception: This requirement does not apply to an enclosure that is under constant observation by police or central station personnel. See 7.2.3.

31 Undervoltage Operation Test

31.1 A police station connected burglar alarm unit shall operate for its intended signaling performance while energized at 85 percent of its rated voltage.

31.2 If a standby battery is employed, the reduced voltage value is to be computed on the basis of the rated nominal battery voltage.

31.3 A product that uses batteries for principal power shall be tested for operation at 60 percent of nominal battery voltage if supplied by primary batteries, or 85 percent of nominal battery voltage if supplied by secondary batteries.

31.4 A product that uses primary or secondary batteries for standby power shall be tested for operation at 85 percent of nominal battery voltage while operating from standby power.

31.5 If the maximum impedance of an initiating device circuit extended from a product is required to be less than 100 ohms in order to obtain intended operation, maximum impedance is to be connected to the circuit during this test. If no impedance limitation is indicated in the marking, an impedance of 100 ohms is to be employed in the initiating device circuit.

32 Overvoltage Operation Test

32.1 A police station connected burglar alarm unit shall withstand 110 percent of its rated supply voltage continuously without damage during the standby condition and shall operate for its intended signaling performance at the increased voltage.

32.2 The product is to be subjected to the increased voltage in the standby condition and then tested for its intended signaling performance. For this test, 0 ohms line impedance shall be employed in the initiating device circuit.

33 Variable Ambient Test

33.1 A police station connected burglar alarm unit intended for indoor use shall function as intended at the test voltage and at ambient temperatures of 0 and 49°C (32 and 120°F). The exposure to either of these temperatures shall be for a minimum of 4 hours.

34 Humidity Test

34.1 A police station connected burglar alarm system unit shall function as intended during and after exposure for 24 hours to air having a relative humidity of 85 ±5 percent and a temperature of 30 ±2°C (86 ±3°F).

34.2 Cord-connected products powered from a high-voltage source shall comply with the requirements of the Leakage Current Tests for Cord-Connected Products, Section 35, immediately following exposure to the environment specified in 34.1.

35 Leakage Current Tests for Cord-Connected Products

35.1 The leakage current of a cord-connected product intended to be located in an area accessible to contact by a person, or a cord-connected product that is interconnected to a product accessible to contact by a person, shall not exceed the values specified in Table 35.1 when tested in accordance with the requirements in 35.8 and 35.9 immediately after exposure to the Humidity Test, Section 34.

35.2 For this test, the product is to be de-energized, removed from the humidity environment, placed on a dry insulating surface, and immediately re-energized from a rated source of supply in accordance with 25.3.1. Leakage current measurements are to be made with the product in the standby and operating conditions.

Table 35.1
Maximum leakage current

Type of product[a]	Maximum leakage current (mA)
2-wire cord-connected product	0.50
3-wire (including grounding conductor) cord-connected, portable product	0.50
3-wire (including grounding conductor) cord-connected stationary or fixed product	0.75

[a] Products that incorporate a loss-of-ground detector that dependably opens the live conductors are exempted from the requirements of this table.

35.3 With reference to the requirements in 35.1, leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces and ground or other exposed conductive surfaces.

35.4 All exposed conductive surfaces are to be tested for leakage currents. Where these surfaces are simultaneously accessible, leakage currents from these surfaces are to be measured to the grounded supply conductor individually, as well as collectively, and from one surface to another. Parts are considered to be exposed surfaces unless enclosed in a manner that reduces the risk of electric shock. Surfaces are considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time.

35.5 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil with an area of 100 by 200 millimeters (3.9 by 7.8 inches) in contact with the surface. If the surface is less than 100 by 200 millimeters, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the product.

35.6 The measurement circuit for leakage current is to be as illustrated in Figure 35.1. The measurement instrument is described in (a) – (c). The meter used for a measurement need only indicate the same numerical value for a particular measurement as would the described instrument and need not have all of the attributes of the described instrument.

a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

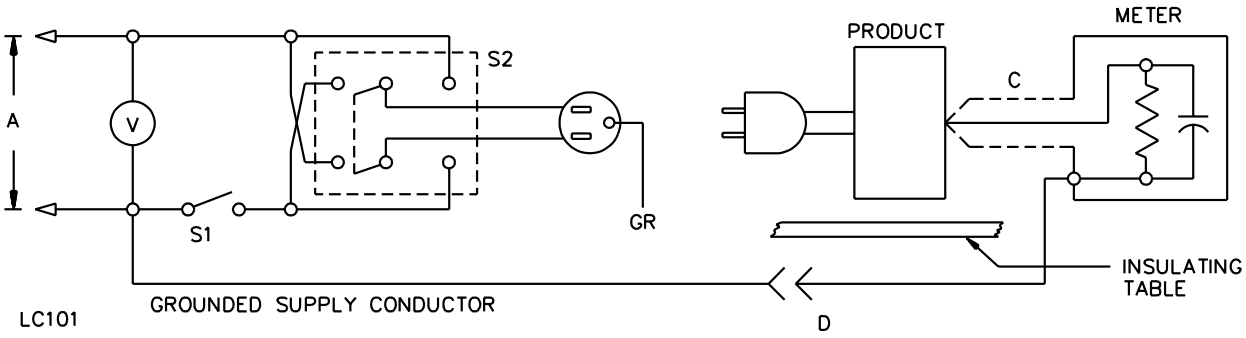
b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of the voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 kilohertz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 microfarad capacitor of 1500 ohms. At indications of 0.5 and 0.75 milliamperes, the measurement is to have an error of not more than 5 percent.

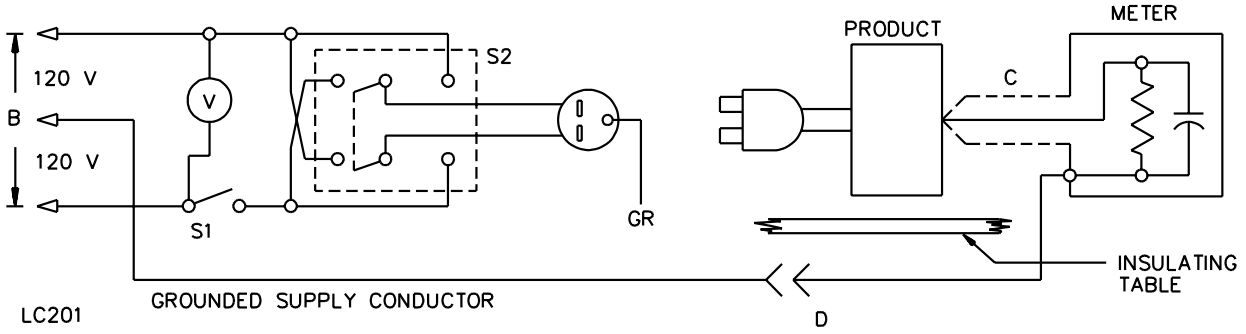
35.7 The test is to be conducted as soon as possible after completion of the Humidity Test, Section 34. The supply voltage is to be adjusted to the test voltage, in accordance with 25.3.1.

Figure 35.1
Leakage current measurement circuits

Figure 35.1 revised March 17, 1998



A – Product intended for connection to a 120- or 208-volt power supply.



B – 240- or 208-volt product intended for connection to a 3-wire, grounded, neutral power supply.

C – Probe with shielded lead. Under some circumstances where higher frequency components are present, shielding of measuring instrument and its leads may be necessary.

D – Separated and used as clip when measuring currents from one part of a product to another.

35.8 A sample of the product is to be prepared and conditioned for leakage current measurement as follows:

a) The sample is to be representative of the wiring methods, routing, components, component location and installation, and the like, of the product.

b) The grounding conductor is to be open at the attachment plug and the test product isolated from ground.

c) The sample is to be conditioned as described in 34.1.

35.9 The leakage current test sequence, with reference to the measuring circuit in Figure 35.1, is to be as follows:

a) With switch S1 open, the product is to be connected to the measurement circuit. Leakage current is to be measured using both positions of switch S2. All manual switching devices then are to be operated in their intended manner, and leakage currents measured in both positions of switch S2.

b) With the product switching devices in their intended operating positions, switch S1 then is to be closed, energizing the product, and within a period of 5 seconds, the leakage current is to be measured using both positions of switch S2. All manual switching devices then are to be operated in their intended manner, and leakage currents measured in both positions of switch S2.

c) The product switching devices then are to be returned to their intended operating positions and the product allowed to operate until thermal equilibrium is obtained. Leakage current is to be monitored continuously. For this test, thermal equilibrium is defined as that condition where leakage current is found to be constant or decreasing in value. Both positions of switch S2 are to be used in determining this measurement.

d) Immediately after the test, any single-pole switch on the product is to be opened, and the leakage current monitored until constant or decreasing values are recorded. Readings are to be taken in both positions of switch S2.

36 Electric Shock Current Test

36.1 If the open circuit potential between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part exceeds 42.4 volts peak, the part shall comply with the requirements of 36.2 – 36.4 as applicable.

36.2 The continuous current flow through a 500 ohm resistor shall not exceed the values specified in Table 36.1 when the resistor is connected between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part.

36.3 The duration of a transient current flowing through a 500 ohm resistor connected as described in 36.2 shall not exceed:

a) The value determined by the following equation:

$$T \leq \left(\frac{20\sqrt{2}}{I}\right)^{1.43}$$

in which:

T is the interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 milliamperes and the time that the current falls below 7.1 milliamperes for the last time; and

I is the peak current in milliamperes.

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b) 809 milliamperes, regardless of duration.

The interval between occurrences shall be equal to or greater than 60 seconds if the current is repetitive. Typical calculated values of maximum acceptable transient current duration are shown in Table 36.2.

Table 36.1
Maximum acceptable current during operator servicing

Frequency, hertz[a]	Maximum acceptable current through a 500-ohm resistor, milliamperes peak
0 – 100	7.1
500	9.4
1,000	11.0
2,000	14.1
3,000	17.3
4,000	19.6
5,000	22.0
6,000	25.1
7,000 or more	27.5

[a] Linear interpolation between adjacent values may be used to determine the maximum acceptable current corresponding to frequencies not shown. The table applies to repetitive nonsinusoidal or sinusoidal waveforms.

36.4 The maximum capacitance between the terminals of a capacitor that is acceptable during operator servicing shall comply with the following equations:

$$C = \frac{88{,}400}{E^{1.43}(\ln E - 1.26)} \quad \text{for} \quad 42.4 \le E \le 400$$

$$C = 35{,}288E^{-1.5364} \quad \text{for} \quad 400 \le E \le 1000$$

in which:

C is the maximum capacitance of the capacitor in microfarads and

E is the potential in volts across the capacitor prior to discharge.

E is to be measured 5 seconds after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like. Typical calculated values of maximum capacitance are shown in Table 36.3.

36.5 With reference to the requirements of 36.2 and 36.3, the current is to be measured while the resistor is connected between ground and:

a) Each accessible part individually and

b) All accessible parts collectively if the parts are simultaneously accessible.

The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, if the parts are simultaneously accessible.

Table 36.2
Maximum acceptable transient current duration

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum acceptable duration (T) of waveform containing excursions greater than 7.1 milliamperes peak
7.1	7.22 seconds
8.5	5.58
10.0	4.42
12.5	3.21
15.0	2.48
17.5	1.99
20.0	1.64
22.5	1.39
25.0	1.19
30.0	919 milliseconds
40.0	609
50.0	443
60.0	341
70.0	274
80.0	226
90.0	191
100.0	164
150.0	92
200.0	61
250.0	44
300.0	34
350.0	27
400.0	23
450.0	19
500.0	16
600.0	13
700.0	10
809.0	8.3

Table 36.3
Electric Shock – stored energy

Potential in volts, across capacitance prior to discharge	Maximum acceptable capacitance in microfarads
1000	0.868
900	1.02
800	1.22
700	1.50
600	1.90
500	2.52
400	3.55
380	3.86
360	4.22
340	4.64
320	5.13
300	5.71
280	6.40
260	7.24
240	8.27
220	9.56
200	11.2
180	13.4
160	16.3
140	20.5
120	26.6
100	36.5
90	43.8
80	53.8
70	68.0
60	89.4
50	124.00
45	150.00
42.4	169.00

36.6 With reference to the requirements of 36.5, parts are considered to be simultaneously accessible if they can be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is considered to be able to contact parts simultaneously if the parts are within a 4 by 8 inch (102 by 203 mm) rectangle, and two hands of a person are considered to be able to contact parts simultaneously if the parts are not more than 6 feet (1.8 m) apart.

36.7 Electric shock current refers to all currents, including capacitively coupled currents.

36.8 If the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3 wire, direct current supply circuit.

36.9 Current measurements are to be made:

a) With any operating control, or adjustable control that is subject to user operation, in all operating positions, and

b) Either with or without a vacuum tube, separable connector, or similar component in place.

These measurements are to be made with controls placed in the position that causes maximum current flow.

37 Overload Test

37.1 General

37.1.1 A police station connected burglar alarm unit other than that operating from a primary battery shall operate as intended after 50 cycles of operation at a rate of not more than 15 cycles per minute while connected to a source of supply adjusted to 115 percent of the rated test voltage. Each cycle is to begin with the product energized in the standby condition, followed by intended operation, and then restoration to standby condition.

37.1.2 Rated test loads are to be connected to the output circuits of the product. The test loads are to be remote indicators, relays, or the equivalent. If an equivalent load is employed to simulate an inductive component, a power factor of 60 percent is to be employed. The rated loads are to be established with the product initially connected to a source of supply in accordance with the requirements of 25.3.1 following which the voltage is to be increased to 115 percent of the initial value.

37.1.3 For DC circuits, an equivalent inductive test load is to have the required DC resistance for the test current and the inductance (calibrated) necessary to obtain a power factor of 60 percent when connected to a 60 hertz AC rms voltage equal to the rated DC test voltage. The resultant AC current is to be equal to 60 percent of the DC current when the load is connected first to an AC voltage and then to a DC voltage equal to the rms value of the AC source.

37.2 Separately energized circuits

37.2.1 Separately energized circuits that do not receive energy from the product, such as dry contacts, shall operate as intended after 50 cycles of signal operation at a rate of not more than 15 cycles per minute while connected to a voltage source in accordance with the requirements of 25.3.1 and with 150 percent rated current loads at 60 percent power factor applied to the output circuits.

37.2.2 The test loads shall be adjusted to draw 150 percent of their rated current while connected to a separate power source of supply in accordance with 25.3.1.

38 Endurance Test

38.1 General

38.1.1 A product intended to be operated one to five times a day shall operate at test voltage for 6000 cycles of intended operation.

38.1.2 A product intended to be operated six or more times a day shall operate at test voltage for 50,000 cycles of intended operation.

38.1.3 A product that operates only when it is required to perform its function shall operate at test voltage for 1000 cycles of intended operation.

38.1.4 The device may be cycled at any rate up to 15 cycles per minute.

38.2 Separately energized circuits

38.2.1 Separately energized circuits that do not receive energy from the product shall operate as intended following the applicable endurance test specified in 38.1.1 – 38.1.4 while connected to a source of supply in accordance with 25.3.1 and with rated load at 60 percent power factor applied to the output circuits.

39 Jarring Test

39.1 A police station connected burglar alarm unit shall withstand jarring resulting from impact and vibration anticipated in the intended application without causing operation of any part and without impairing its subsequent intended operation, as evidenced by compliance with the requirements of the Normal Operation Test, Section 26.

39.2 The product and associated equipment is to be mounted as intended to the center of a 6 by 4 foot (1.8 by 1.2 m), nominal 3/4 inch (19.1 mm) thick plywood board secured in place at four corners. An impact is to be applied to the center of the reverse side of this board by means of a 1.18 pound (0.54 kg), 2 inch (50.8 mm) diameter steel sphere either:

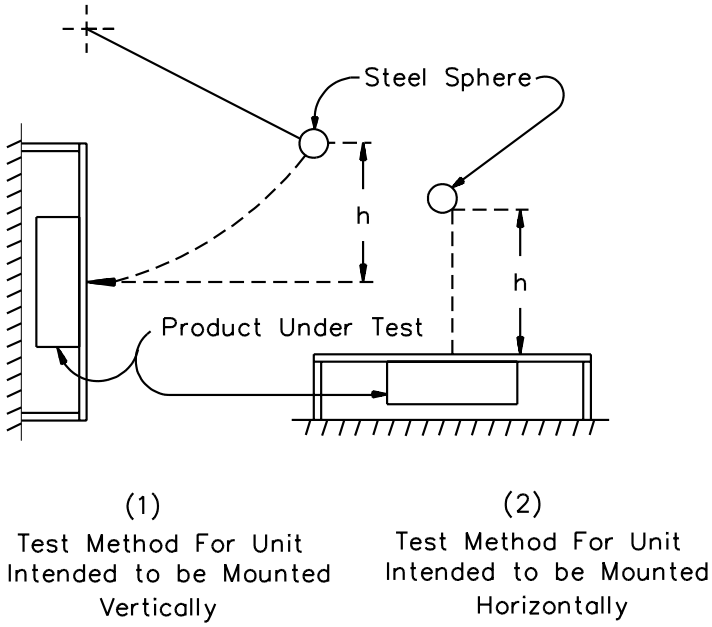
a) Swung through a pendulum arc from a height (h) of 30.5 inches (775 mm) or

b) Dropped from a height (h) of 30.5 inches, depending upon the mounting of the equipment. See Figure 39.1.

39.3 During this test, the unit is to be operated in the normal standby condition and connected to a rated source of supply in accordance with the requirements in 25.3.1.

Figure 39.1
Jarring test

Figure 39.1 revised March 17, 1998



40 Dielectric Voltage-Withstand Test

40.1 A unit shall withstand for 1 minute, without breakdown, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between live parts and the enclosure, live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be (also, see 40.2):

a) For a unit rated 30 volts AC rms (42.4 volts DC or AC peak) or less – 500 volts (707 volts, if a DC potential is used).

b) For a unit rated between 31 and 250 volts AC rms – 1000 volts (1414 volts, if a DC potential is used).

c) For a unit rated more than 250 volts AC rms – 1000 volts plus twice the rated voltage (1414 volts plus 2.828 times the rated AC rms voltage, if a DC potential is used).

40.2 For the application of a potential between live parts of circuits operating at different potentials or frequencies in accordance with 40.1, the voltage is to be the applicable value specified in 40.1 (a), (b), or (c), based on the highest voltage of the circuits under test instead of the rated voltage of the unit. Electrical connections between the circuits are to be disconnected before the test potential is applied.

40.3 Exposed dead metal parts referred to in 40.1 are noncurrent-carrying metal parts that are likely to become energized and are accessible from outside of the enclosure of a unit during intended operation with the door of the enclosure closed.

40.4 If an autotransformer is in the circuit, the primary of the transformer is to be disconnected and an AC test potential in accordance with 40.1(c) is to be applied directly to all wiring involving more than 250 volts.

40.5 If the charging current through a capacitor or capacitor type filter connected across the line, or from line to earth ground, is sufficient to prevent maintenance of the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 40.1.

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40.6 The test potential may be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. Starting at zero, the potential is to be increased at a rate of approximately 200 volts per minute until the required test value is reached and is to be held at that value for 1 minute.

40.7 A printed wiring assembly or other electronic circuit component that would be damaged by the application of, or would short-circuit, the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. A representative subassembly may be tested instead of an entire unit. Rectifier diodes in the power supply may be individually shunted before the test to avoid destroying them in the case of a malfunction elsewhere in the secondary circuits.

41 Temperature Test

41.1 The materials employed in the construction of a police station connected burglar alarm unit shall not attain temperature rises greater than those indicated in Table 41.1.

41.2 The values for temperature rise in Table 41.1 are based on an assumed ambient temperature of 25 ±15°C (77 ±27°F) and tests are to be conducted at an ambient temperature within that range. A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but at not less than 5 minute intervals, indicate no change.

41.3 Temperatures are to be measured by thermocouples consisting of wires not larger than No. 24 AWG (0.21 mm^2) or by the change-in-resistance method, except that the thermocouple method is not to be employed for a temperature measurement at any point where supplementary thermal insulation is employed.

41.4 Thermocouples consisting of No. 30 AWG (0.06 mm^2) iron and constantan wires and a potentiometer-type indicating instrument shall be used whenever referee temperature measurements by thermocouples are necessary.

41.5 The temperature of a coil winding may be determined by the change-in-resistance method, wherein the resistance of the winding at the temperature to be determined is compared with the resistance at a known temperature by means of the formula:

$$\Delta t = \frac{R}{r}(k + t_1) - (k + t_2)$$

in which:

Δt is the temperature rise in degrees C,

R is the resistance in ohms at the end of test,

r is the resistance in ohms at the start of test,

k is 234.5 for copper or 225.0 for electrical conductor grade aluminum.

t_1 is the room temperature at start of test, in degrees C, and

t_2 is the room temperature at end of test, in degrees C.

Table 41.1
Maximum temperature rises

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm conditions, °C	(Signaling) alarm conditions, (°F)
A. Components				
1. Capacitors:[a,b]				
a. Electrolytic types	25	45	40	72
b. Other types	25	45	65	117
2. Rectifiers – At any point				
a. Germanium	25	45	50	90
b. Selenium	25	45	50	90
c. Silicon				
(1) Maximum 60 percent of rated volts	50	90	75	135
(2) 61 percent or more of rated volts	25	45	75	135
3. Relay, solenoid, transformer, and other coils with:				
a. Class 105 insulation system:				
Thermocouple method	25	45	65	117
Resistance method	35	63	75	135
b. Class 103 insulation system:				
Thermocouple method	45	81	85	153
Resistance method	55	99	95	171
c. Class 155 insulation system:				
(1) Class 2 transformers				
Thermocouple method	95	171	95	171
Resistance method	115	207	115	207
(2) Power transformers				
Thermocouple method	110	198	110	198
Resistance method	115	207	115	207
d. Class 180 insulation system:				
(1) Class 2 transformers				
Thermocouple method	115	207	115	207
Resistance method	135	243	135	243
(2) Power transformers				
Thermocouple method	125	225	125	225
Resistance method	135	243	135	243

Table 41.1 Continued on Next Page

Table 41.1 Continued

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm conditions, °C	(Signaling) alarm conditions, (°F)
4. Resistors: [c]				
a. Carbon	25	45	50	90
b. Wire wound	50	90	125	225
c. Other	25	45	50	90
5. Solid state devices	See Note[d]			
6. Other components and materials:				
a. Fiber used as electrical insulation or cord bushings	25	45	65	117
b. Varnished cloth insulation	25	45	60	108
c. Thermoplastic materials	Rise based on temperature limits of the material			
d. Phenolic composition used as electrical insulation or as parts whose malfunction or deterioration will result in a risk of electric shock, explosion, fire, or personal injury[e]	25	45	125	225
e. Wood or other combustibles	25	45	65	117
f. Sealing compound	15°C (27°F) less than the melting point			
g. Fuses	25	45	65	117
B. CONDUCTORS				
1. Appliance wiring material[f]	25°C (45°F) less than the temperature limit of the wire			
2. Flexible cord (for example, SJO, SJT)	35	63	35	63
3. Conductors of field-wired circuits to be permanently connected to the product	35	63	35	63
C. GENERAL				
1. All surfaces of the product and surfaces adjacent to or upon which the product may be mounted	65	117	65	117
2. Surfaces normally contacted by the user in operating the unit (control knobs, push buttons, levers, and the like):				
a. Metal	35	63	35	63
b. Nonmetallic	60	108	60	108
3. Surfaces subjected to casual contact by the user (enclosure, grille, and the like):				
a. Metal	45	81	45	81
b. Nonmetallic	65	117	65	117

Table 41.1 Continued on Next Page

Table 41.1 Continued

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm conditions, °C	(Signaling) alarm conditions, (°F)
[a]For an electrolytic capacitor that is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be not more than 65°C (117°F).				
[b]A capacitor that operates at a temperature higher than a 65°C (117°F) rise may be judged on the basis of its marked temperature rating.				
[c]The temperature rise of a resistor may exceed the values shown if the power dissipation is 50 percent or less of the manufacturer's rating.				
[d]The temperature of a solid-state device (for example, transistor, SCR, integrated circuit) shall not exceed 50 percent of its rating during the normal standby condition. The temperature of a solid-state device shall not exceed 75 percent of its rated temperature under the alarm condition or any other condition of operation which produces the maximum temperature dissipation of its components. For reference purposes 0°C (32°F) shall be considered as 0 percent. For integrated circuits the loading factor shall not exceed 50 percent of its rating under the normal standby condition and 75 percent under any other condition of operation. Both solid-state devices and integrated circuits may be operated up to the maximum ratings under any one of the following conditions: 1. The component complies with the requirements of MIL-STD.883E. 2. A quality-control program is established by the manufacturer consisting of an inspection stress test followed by operation of 100 percent of all components, either on an individual basis, as part of a subassembly, or equivalent. 3. Each assembled production unit is subjected to a burn-in test, under the condition which results in the maximum temperatures, for 24 hours while connected to a source of rated voltage and frequency in an ambient of at least 49°C (120°F) followed by Operational Tests.				
[e]The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and determined to have special heat-resistant properties.				
[f]For standard insulated conductors other than those mentioned, reference should be made to the National Electrical Code, the maximum allowable temperature rise in any case is 25°C (45°F) less than the temperature limit of the wire in question.				

41.6 To determine compliance with these requirements, the product is to be connected to a supply circuit of rated voltage and frequency in accordance with 25.3.1 and operated continuously under representative service conditions that are likely to produce the highest temperature.

41.7 If a current-regulating resistor or reactor is provided as a part of a unit, it is to be adjusted for the maximum resistance or reactance at intended current.

41.8 The test is to be continued until:

a) Constant temperatures are attained during the normal supervisory condition and

b) One hour has elapsed during the normal alarm signaling condition of a unit intended to produce a continuous signal until it is restored to normal.

41.9 If a control unit has provision for multiple zones, 10 percent of the total number of zones, but in no case less than three zones, shall be energized during the alarm or other intended operating condition.

42 Abnormal Operation Test

42.1 A police station connected burglar alarm unit operating in any condition of intended operation shall not increase the risk of fire or electric shock when abnormal fault conditions are introduced.

42.2 To determine compliance with the requirement of 42.1, the product is to be connected to a source of supply in accordance with 25.3.1 and operated under the most severe circuit fault conditions likely to be encountered in service. There shall not be emission of flame or molten metal, or any other manifestation of fire, see 42.4. The product shall also comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40.

42.3 The fault condition is to be maintained continuously until constant temperatures are attained or until burnout occurs, if the fault does not result in the operation of an overload protective device. Shorting of the secondary of the power supply transformer and shorting of an electrolytic capacitor represent typical fault conditions.

42.4 The product shall be wrapped in a single layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 m^2/kg) and a count of 32 by 28, and then energized. There shall not be molten metal or flame emitted from the unit as a result of this test as evidenced by ignition or charring of the cheesecloth. The dielectric voltage-withstand test shall be conducted immediately at the conclusion of the test.

43 Electrical Transient Tests

43.1 General

43.1.1 A police station connected burglar alarm unit, other than that operating from a primary battery, shall operate for its intended signaling performance after being subjected to 500 supply line transients, 500 internally induced transients, and 60 input/output circuit transients while energized from a source of supply in accordance with 25.3.1.

43.2 Supply line transients

43.2.1 A high-voltage AC-operated unit shall:

a) Not false alarm,

b) Operate as intended, and

c) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit

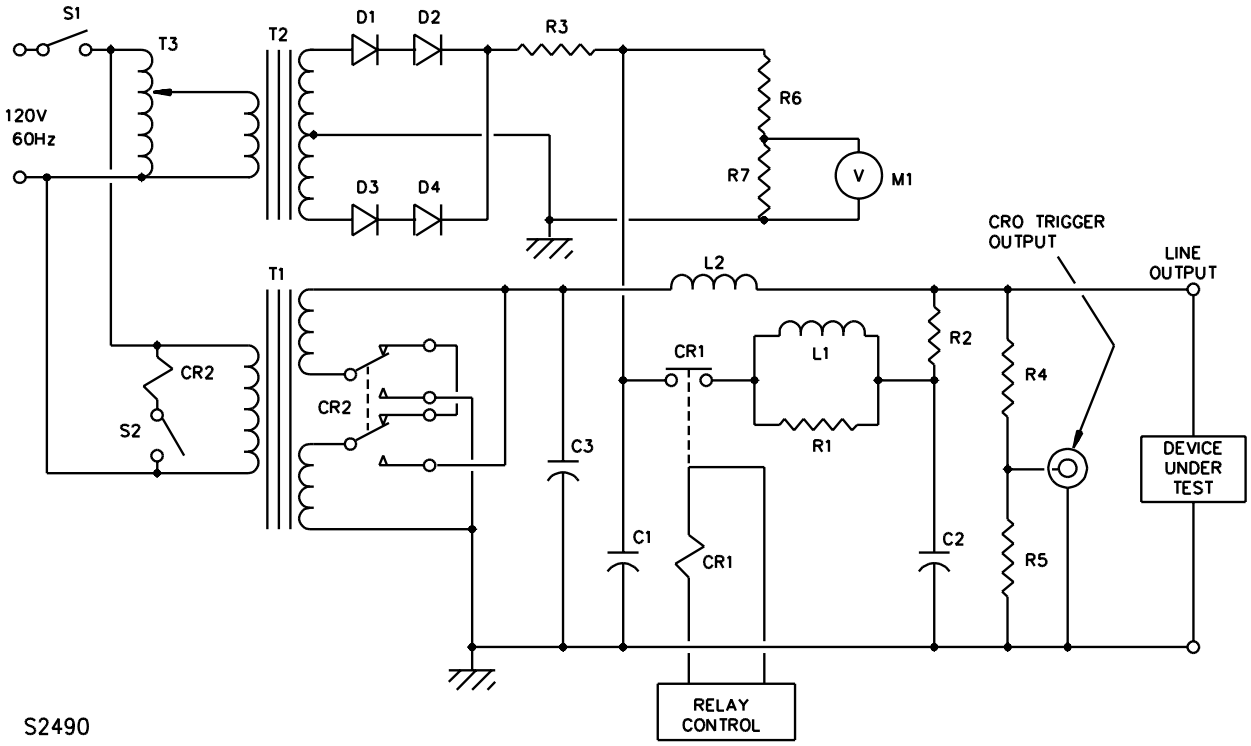
when subjected to supply line transients induced directly between the power supply circuit conductors of the equipment under test and ground. Supplemental information stored within the unit need not be retained.

43.2.2 For this test, the unit is to be connected to a transient generator, consisting of a 2 kilovolt-ampere isolating power transformer and control equipment that produces the transients described in 43.2.3. See Figure 43.1. The output impedance of the transient generator is to be 50 ohms.

43.2.3 The transients produced are to be oscillatory and are to have an initial peak voltage of 6000 volts. The rise time is to be less than 1/2 microsecond. Successive peaks of the transient are to decay to a value of not more than 60 percent of the value of the preceding peak.

43.2.4 The unit is to be subjected to 500 oscillatory transient pulses induced at a rate of 6 transients per minute. Each transient pulse is to be induced 90 degrees into the positive half of the 60 hertz cycle. A total of 250 pulses are to be applied so that the polarity of the transients is positive with reference to earth ground, and the remaining 250 pulses are to be negative with respect to earth ground.

Figure 43.1
Transient generator circuit



C1	– Capacitor, 0.025 µF, 10 kV	R1	– Resistor, 22 Ohms, 1 W, composition
C2	– Capacitor, 0.006 µF, 10 kV	R2	– Resistor, 12 Ohms, 1 W, composition
C3	– Capacitor, 10 µF, 400 V	R3	– Resistor, 1.3 Megohms (12 in series, 110K Ohms each, 1/2 W)
CR1	– Relay, coil 24V, DC. Contacts, 3-pole, single throw, each contact rated 25 A, 600 V, AC maximum: All three poles wired in series	R4	– Resistor, 47 K Ohms (10 in series, 4.7 K Ohms each, 1/2 W)
		R5	– Resistor, 470 Ohms, 1/2 W
CR2	– Relay, coil 120 V, AC. Contacts DPDT. Provides either 120 V or 240 V test circuit.	R6	– Resistor, 200 Megohms, 2 W, 10 kV
		R7	– Resistor, 0.2 Megohms (2 in series, 100 K Ohms each, 2 W, carbon)
D1 – D4	– Diodes, 25 kV PIV each	S1	– Switch, SPST
L1	– Inductor 15 µH [33 turns, No. 22 AWG wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]	S2	– Switch, SPST, key-operated, 120 V, AC, 1 A
		T1	– Transformer, 2 kVA, 120 V primary, 1:1 (120 V or 240 V output)
L2	– Inductor, 70 µH [45 turns, No. 14 AWG wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]	T2	– Transformer, 90 VA, 120/15,000 V
M1	– Meter, 0 – 20 V, DC	T3	– Meter, 0 – 20 V, DC

43.3 Internally induced transients

43.3.1 The product is to be energized in the standby condition while connected to a source of supply in accordance with 25.3.1. The supply source is to be interrupted a total of 500 times. Each interruption is to be for approximately 1 second at a rate of not more than 6 interruptions per minute. At the conclusion of the test, the product shall operate for its intended signaling performance. Standby power shall be connected during this test.

43.4 Input/output circuit transients

43.4.1 The unit is to be energized in the normal standby condition while connected to a source of supply in accordance with 25.3.1. All input/output circuits are to be tested as specified in 43.4.2.

Exception: A circuit or cable that interconnects equipment located within the same room need not be subjected to this test.

43.4.2 Input/output circuits are to be tested as specified in 43.4.3 – 43.4.5. The signaling equipment connected to these circuits shall:

a) Not false alarm,

b) Operate as intended, and

c) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit

when subjected to transient voltage pulses as described in 43.4.3. Supplemental information stored within the unit need not be retained.

Exception: Transients applied to the modem or interface module of packet switched data network systems shall not affect the operation of the system except for the modem or interface module circuit. Failure of the packet switched data network signaling circuit is acceptable if the loss of communication is annunciated at the receiving station.

Revised 43.4.2 effective March 8, 2007

43.4.3 For this test, each input/output circuit is to be subjected to five different transient waveforms having peak voltage levels in the range of 100 to 2400 volts, as delivered into a 200 ohm load. A transient waveform at 2400 volts shall have a pulse rise time of 100 volts per microsecond, a pulse duration of approximately 80 microseconds, and an energy level of approximately 1.2 joules. Other applied transients shall have peak voltages representative of the entire range of 100 to 2400 volts, with pulse durations from 80 to 110 microseconds, and energy levels not less than 0.3 joule or greater than 1.2 joules. The transient pulses are to be coupled directly onto the input/output circuit conductors of the equipment under test.

43.4.4 The equipment is to be subjected to 60 transient pulses induced at a maximum rate of six pulses per minute as follows:

a) Twenty pulses (two at each transient voltage level specified in 43.4.3) between each input/output circuit lead or terminal and earth ground, consisting of ten pulses of one polarity, and ten of the opposite polarity (total of 40 pulses), and

b) Twenty pulses (two at each transient voltage level specified in 43.4.3) between any two input/output circuit leads or terminals consisting of ten pulses of one polarity and ten pulses of the opposite polarity.

43.4.5 At the conclusion of the test, the equipment shall comply with the requirements of the Normal Operation Test, Section 26.

44 AC Induction Test

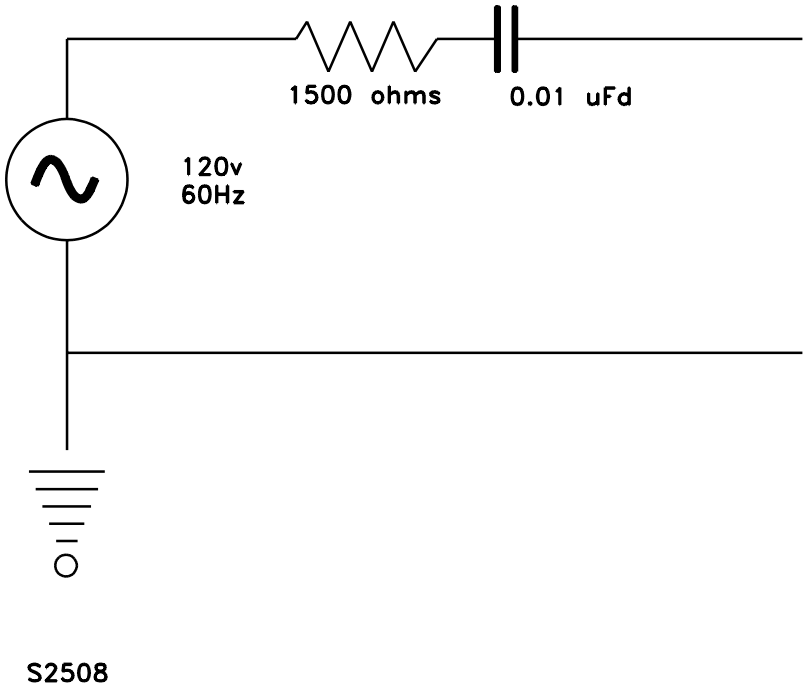
44.1 Police station connected burglar alarm units shall not false alarm and shall operate as intended when subjected to an alternating current induced in any signal leads, initiating device leads, loops, DC power leads, or in any other leads which extend throughout the premises wiring.

Exception: AC power leads and any leads consisting of conductors insulated from and surrounded by a shielding conductive surface grounded at one or more ends are exempted from this test.

44.2 To determine compliance with the requirements in 44.1, the product is to be energized from a source of rated voltage and frequency in accordance with 25.3.1, and an AC (60 hertz) current is to be injected into each circuit extending from the product. The AC signal current shall be induced as illustrated in Figure 44.1 to simulate induction from AC power sources.

Figure 44.1
AC induction test circuit

Figure 44.1 revised March 17, 1998



45 Polymeric Materials Test

45.1 Polymeric materials used as an enclosure or for the support of current-carrying parts shall comply with the applicable portion of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

46 Battery Replacement Test

46.1 The battery connections of a police station connected burglar alarm unit shall withstand removal and replacement from the battery terminals without any reduction in contact integrity. Batteries used for principal power shall be subjected to 50 cycles and standby batteries to 10 cycles of removal and replacement.

46.2 For this test, a product is to be installed as intended in service and the battery connections removed and replaced as recommended by the manufacturer. The product then shall comply with the requirements of the Normal Operation Test, Section 26.

No Text on This Page

47 Drop Test

47.1 As a result of being dropped onto a hardwood floor, as described in 47.2, the electrical spacings within a portable cord-connected high-voltage product shall not have been reduced below the limits specified in Spacings, General, Section 23, and Components, Section 24. No high-voltage live parts shall be exposed. See 5.2.4 and 5.2.5.

47.2 A sample of a portable cord-connected high-voltage product is to be dropped four times from a height of 3 feet (0.9 m) onto a hardwood floor. If it has corners, it is to be dropped on a different corner each time, selecting the corners that appear to be most susceptible to damage. If the product has no corners, it is to be dropped on the four portions that appear to be most susceptible to damage. If the product is intended to use internally mounted batteries, the batteries shall be in place for this test.

47.3 Following the test described in 47.2, the product then is to be wrapped in bleached cheesecloth having an area 14 – 15 square yards to the pound (26 – 28 m^2/kg) and having a count of 32 by 28, and energized 3 hours at rated voltage in accordance with 25.3.1. There shall not be molten metal or flame emitted from the unit, as evidenced by ignition or charring of the cheesecloth. The product shall also comply with the requirements of the Dielectric Voltage-Withstand Test, Section 40.

48 Strain Relief Test

48.1 Supply cord

48.1.1 When tested as described in 48.1.2, the strain relief means provided on the flexible cord shall withstand for 1 minute without displacement, a pull of 35 pounds-force (156 N) applied to the cord. During this test the connections within the product are to be disconnected.

48.1.2 A 35 pound (15.8 kg) weight is to be secured to the cord and supported by the product so that the strain relief means will be stressed from any angle that the construction of the product permits. There shall not be movement of the cord sufficient to indicate that stress would have been transmitted to the internal connections.

48.2 Field-wiring leads

48.2.1 Each lead employed for field connections shall withstand a pull of 10 pounds-force (44.5 N) for 1 minute without evidence of damage or of transmittal of stress to the internal connections.

49 Ignition Through Bottom-Panel Openings Test

49.1 General

49.1.1 Both of the bottom-panel constructions described in 7.1.4 are acceptable without test. Other constructions are acceptable if they comply with the requirements specified in 49.2.1 – 49.3.3.

49.1.2 These tests do not apply to low-voltage power limited products or to products in which an internal fault does not produce flame, molten metal, flaming or glowing particles, or flaming drops. See the Abnormal Operation Test, Section 42.

49.2 Hot, flaming oil

49.2.1 Openings in a bottom panel shall be so arranged and sufficiently small in size and few in number that hot, flaming No. 2 furnace oil poured three times onto the openings from a position above the panel is extinguished as it passes through the openings.

49.2.2 A sample of the complete, finished bottom panel is to be securely supported in a horizontal position several inches above a horizontal surface under a hood or other area that is well ventilated but free from drafts. One layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 m^2/kg) and a count of 32 by 28 is to be draped over a shallow, flat-bottomed pan that is of sufficient size and shape to completely cover the pattern of openings in the panel but is not to be large enough to catch any of the oil that runs over the edge of the panel or otherwise does not pass through the openings. The pan is to be centered under the pattern of openings in the panel. The center of the cheesecloth is to be 2 inches (50.8 mm) below the openings. Use of a metal screen or wired-glass enclosure surrounding the test area is recommended to reduce the risk of injury to persons and damage due to splattering of the oil.

49.2.3 A small metal ladle [preferably not more than 2-1/2 inches (63.5 mm) in diameter] with a pouring lip and a long handle whose longitudinal axis is to remain horizontal during pouring is to be partially filled with 10 milliliters of No. 2 furnace oil, which is a medium-volatile distillate having an API gravity of 32 – 36 degrees, a flash point of 110 – 190°F (43 – 88°C), and an average calorific value of 136,900 Btu per gallon (39.7 MJ/L) (see Specification for Fuel Oil, ASTM D396-92). The ladle containing the oil is to be heated and the oil ignited. After burning for 1 minute, all of the hot, flaming oil is to be poured from a position 4 inches (102 mm) above the openings and at a rate of approximately, but not less than, 1 milliliter per second in a steady stream onto the center of the pattern of openings.

49.2.4 Five minutes after completion of the pouring of the oil, the cheesecloth is to be replaced with a clean piece and a second 10 milliliters of hot, flaming oil is to be poured from the ladle onto the openings. Five minutes later, the cheesecloth is to be replaced again and a third identical pouring is to be made. The openings are not acceptable if the cheesecloth is ignited as a result of any of the three pourings.

49.3 Molten PVC and copper

49.3.1 Openings in a bottom panel shall be arranged and sufficiently small in size and few in number so that molten polyvinyl chloride and copper dripping onto the openings from above the panel do not pass through the openings in sufficient quantity to ignite cheesecloth below the openings.

49.3.2 A sample of the complete, finished bottom panel is to be securely supported in a horizontal position 2-1/2 inches (63.5 mm) above a horizontal firebrick or other nonflammable surface located under a hood or in a well ventilated area. Two layers of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 m^2/kg) and having a count of 32 by 28 is to be placed on the nonflammable surface. The cheesecloth is to cover somewhat more area than that immediately under the pattern of openings in the panel. Use of a metal screen or wired glass enclosure surrounding the test area is recommended to reduce the risk of injury to persons and other damage due to splattering of the molten materials.

49.3.3 A bare 12 inch (305 mm) length of No. 12 AWG (3.3 mm^2) solid copper wire and a 12 inch length of No. 12 AWG stranded copper wire insulated with 1/32 inch (0.8 mm) of PVC are to be melted simultaneously at an even rate by means of an oxy-acetylene torch and allowed to drop from a point 6 inches (152 mm) above the pattern of openings in the panel. The panel openings are not acceptable if the cheesecloth is ignited.

50 Mechanical Strength Tests for Enclosures

50.1 The external enclosure of a product containing high-voltage circuits or other than power limited circuits shall withstand a force of 25 pounds (111 N) for 1 minute without permanent distortion to the extent that spacings are reduced below the values specified in 23.2 – 23.5, without transient

distortion that results in the enclosure contacting live parts, and without causing openings that expose uninsulated high- or low-voltage live parts. The force is to be applied by the curved side of a 1/2 inch (12.7 mm) diameter steel hemisphere. Any openings that occur during application of the force are to be evaluated according to the requirements specified in 5.2.4 and 5.2.5.

50.2 The external enclosure of a product containing only low-voltage power-limited circuits shall be subjected to the test of 54.1, except that the applied force shall be 10 pounds (44 N).

50.3 The external enclosure of a product containing high-voltage circuits or other than power-limited circuits shall withstand an impact of 5 foot-pounds (6.78 J) without permanent distortion to the extent that spacings are reduced below the values specified in 23.2 – 23.5, without transient distortion that results in the enclosure contacting live parts, and without causing openings that expose uninsulated high- or low-voltage live parts. The impact is to be applied by means of a solid, smooth, steel sphere 2 inches (50.8 mm) in diameter and weighing approximately 1.18 pounds (0.54 kg) falling freely from rest through a vertical distance of 51 inches (1.31 m). Any openings resulting from the impact are to be evaluated according to the requirements specified in 5.2.4 and 5.2.5.

50.4 The external enclosure of a product containing only low-voltage power-limited circuits is to be subjected to the test described in 50.3, except that the impact is to be 2 foot-pounds (2.7 J), and the sphere is to fall freely from rest through a vertical distance of 20-13/32 inches (0.52 m).

51 Special Terminal Assemblies Tests

51.1 General

51.1.1 To determine compliance with the requirements in 12.2.3.1 and 12.2.3.2, representative samples of the terminal assembly shall comply with the requirements in 51.2.1 – 51.5.2.

Exception: Terminals complying with the requirements in any of the standards specified in 12.2.1.2 are not required to be subjected to these tests.

51.2 Disconnection and reconnection

51.2.1 If a wire is to be disconnected for testing or routine servicing and then reconnected, each terminal to be subjected to 20 alternate disconnections and reconnections prior to the tests described in 51.2.2 – 51.5.2.

51.2.2 A terminal connection shall withstand, without separating from the wire, the application of a straight pull of 5 pounds-force (22.2 N), applied for 1 minute to the wire in the direction that would most likely result in pullout.

51.2.3 Six terminal assemblies using the maximum wire size and six using the minimum wire size are to be subjected to this test. If a special tool is required to assemble the connection it is to be used, in accordance with the manufacturer's instructions. Each sample is to be subjected to a gradually increasing pull on the wire until the test pull of 5 pounds-force (22.2 N) is attained.

51.3 Flexing test

51.3.1 The wire attached to a terminal shall withstand five right angle bends without breaking.

51.3.2 Six terminal assemblies employing the maximum wire size and six with the minimum wire size are to be subjected to this test. The terminal is to be rigidly secured to prevent any movement. With each wire in 3 pounds-force (13.3 N) tension and held at a point 3 inches (76.2 mm) from the terminal-to-wire junction, each wire is to be bent at a right angle from its nominal position. The wires are to be assembled to the terminals using any special tool required, according to the manufacturer's instructions.

51.4 Millivolt drop test

51.4.1 The millivolt drop across a terminal connection using the maximum and minimum wire sizes intended to be employed, and with the terminals connected in series, shall not be greater than 300 millivolts with the maximum current specified by the manufacturer flowing through the terminal connections and the circuit connected to rated voltage.

51.4.2 Six terminal assemblies employing the maximum wire sizes and six assemblies employing the minimum sizes are to be subjected to this test. The wires are to be assembled to the terminals, using any special tool, if required, according to the manufacturer's instructions. The millivolt drop then is to be measured by using a high impedance millivoltmeter.

51.5 Temperature test

51.5.1 The maximum temperature rise on a terminal junction using the maximum and minimum wire sizes with which the terminal is intended to be employed shall not be greater than 30°C (54°F) based on an ambient temperature of 25°C (77°F).

51.5.2 Six terminal assemblies employing the maximum wire size and six employing the minimum size are to be subjected to this test. The wire is to be assembled to the terminals using any special tools, if required, according to the manufacturer's instructions. The maximum current to which the wire will be subjected in service is then to be passed through the series connection of the terminals. The maximum temperature rise then is to be measured by the thermocouple method after temperatures have stabilized.

POLICE STATION RECEIVING AND TRANSMITTING UNITS

52 General

52.1 The requirements in Sections 53 – 59 cover police station alarm receiving and transmitting units for the connection of an alarm system to a police department:

a) Directly;

b) Through a central station complying with the Standard for Central-Station Burglar-Alarm Systems, UL 611, or the Standard for Central-Station Alarm Services, UL 827; or

c) Through a residential monitoring station complying with UL 611, UL 827, or both.

52.1 revised March 17, 1998

52.2 Police station alarm receiving and transmitting units shall comply with the construction and performance requirements specified in Sections 4 – 51 and 53 – 59.

53 Common Requirements

53.1 The connection between the protected premises and the police station is usually predicated on the use of transmission wires or cables leased from the local telephone or telegraph company.

53.2 The receiving equipment and the subscriber's equipment shall include operating instructions in a form that will be convenient for reference. See Marking, General, Section 108.

53.3 The protected premises alarm controls shall be such that the act of opening and closing the protected premises in the prescribed manner does not transmit an alarm.

53.4 Signals shall be indicated both audibly and visually at the receiving equipment.

53.5 To permit normal opening and closing, the transmitted signal may be delayed up to 45 seconds after the alarm has been initiated.

54 Direct-Connected Units

54.1 The requirements in 54.2 – 54.4 apply if each alarm system is connected directly to an individual receiving unit in the police station or central station.

54.2 The alarm transmission circuit lines outside the protected premises shall be arranged to actuate an alarm or trouble signal at the police station or central station to which they are connected if these lines are opened or shorted.

54.3 Switches shall be provided for silencing the audible alarm, but the visual signal shall be retained until the circuit is restored. Restoration of the alarm circuit to normal operation shall be clearly indicated. The silencing of the audible signal for a single protected premises on the system shall not disable the audible signal for an alarm from any other protected premises on the same system.

54.4 The audible signal at the police station or central station may be common to as many as 100 separate protected premises, but the visual signal shall be individual to each premises and shall be clearly marked.

55 Transmitter-Connected Units

55.1 If alarm systems are connected by coded transmitters on a common alarm transmission circuit to a recording unit in the police station or central station, the requirements in 55.2 – 55.13 shall apply.

55.2 Each subscriber's premises shall have at least one code transmitter. Not more than 25 code transmitters may be connected in any one station circuit, and each transmitter shall give an individual distinct signal readily distinguishable as coming from that circuit rather than from any other such circuit in the police station or central station.

55.3 The transmitting mechanism shall be enclosed in a protected cabinet and shall have sufficient mechanical strength to prevent the defeat of the mechanism, using ordinary tools, before three rounds have been transmitted. See the Mercantile Premises Alarm Systems, Attack Tests, Section 66, and 68.1.

55.4 The transmitter shall operate so that in the event of disturbance of the subscriber's protective circuit, the code signal transmitted shall be repeated not less than three times.

55.5 Electrically operated transmitters shall be provided with supervision over both their source of energy and their propelling mechanism.

55.6 Spring-wound or mechanically operated transmitters shall be provided with supervision over the wound condition of the mechanism.

55.7 Winding keys projecting outside of the case shall be constructed so that it is not possible to apply reverse rotary pressure sufficient to stop the mechanism before one complete round of the code signal is sent in.

55.8 Actuation of the transmitters shall open and close a circuit to related receiving equipment.

55.9 The circuit shall be arranged so that a single ground or single break in the circuit will:

a) Not prevent the reception of alarm signals from any transmitter on that circuit and

b) Indicate such condition or conditions by a distinctive trouble signal at the receiving equipment.

55.10 Code transmitters shall be capable of actuating printing registers or other recording instruments.

55.11 An audible supervisory signal shall be provided to sound during the time a code signal is being received. This signal may be common to not more than 25 police station or central station line circuits.

55.12 A police station or central station line unit shall be provided with a visual supervisory signal which shall be actuated during the time a signal is being received form any equipment on its circuit. The arrangement shall be such that the circuit from which the signal is being transmitted may be identified promptly.

55.13 A visual supervisory signal shall also indicate whenever the circuit is being operated with a break, ground, or other temporary fault.

56 Other Methods of Alarm Transmission

56.1 A method of transmitting alarm signals to remote locations other than that specified in Direct-Connected Units, Section 54, or Transmitter-Connected Units, Section 55, may be used when the method complies with the applicable requirements in the Standard for Central-Station Burglar-Alarm Units, UL 1610, or the Standard for Digital Alarm Communicator System Units, UL 1635.

Exception: If the transmission is directly to the police department, the equipment is only required to transmit alarm signals (and the 24 hour supervisory signal if the equipment complies with UL 1635). If the transmission is to a central station or to a residential monitoring station (see 1.8 and 52.1), opening and closing signals are optional but all other signals will be required.

56.1 revised March 17, 1998

57 Basic Line Security

57 deleted effective March 8, 2007

57.1 Deleted effective March 8, 2007

58 Intermediate Line Security

58 deleted effective March 8, 2007

58.1 Deleted effective March 8, 2007

58.2 Deleted effective March 8, 2007

58.3 Deleted effective March 8, 2007

59 Standard Line Security Equipment

59.1 The connecting line between the police station or central station and the protected premises shall be supervised so as to detect automatically, and within 6 minutes, a compromise attempt by any of the methods described in 59.3.

Exception: During the disarmed period, the time to detect a compromise may be longer than 6 minutes, but shall not be longer than 60 minutes, if (a) – (e) are met.

a) The method used to detect and report a compromise attempt shall be applied at a statistically random rate. The minimum time of a random check for a compromise attempt shall be 5 minutes or less.

b) The system shall check for substitution of premises equipment when it is armed. If substitution has occurred the system shall provide an alarm signal to the police station or central station. The check shall be made by some automatic means, such as an identifying code built into read only memory, rather than relying on some action or acknowledgment by the user that an acknowledgment signal has been received from the police station or central station, indicating that the police station or central station has received a normal closing signal.

c) A protection system that uses this method of checking for a compromise attempt shall use two methods of signal transmission to the police station or central station. Loss of the second method of signal transmission shall be annunciated at the central station receiver within 200 seconds.

d) An alarm signal shall be sent to the police station or central station over both methods of signal transmission. Only one of the transmission methods need comply with the line security requirements. The other shall comply with the requirements of one of the methods of signal transmission of this standard.

e) The following faults on the antenna circuit on an RF system that prevents communication to the central station shall be annunciated as a problem condition at the central station receiver within 200 seconds. A fault is defined as:

1) A single open, or

2) A single earthground, or

3) A wire-to-wire short.

Revised 59.1 effective March 8, 2007, except revised item b to the Exception effective March 8, 2005

59.2 With reference to the requirements in 59.1, a compromise is the disconnection of the protected premises from the connecting line or communication channel in a manner that:

a) Does not cause a signal at the police station or central station and

b) Allows entry into the protected premises without causing a signal at the police station or central station.

59.3 A compromise attempt by any one of the following methods shall be detected:

a) The substitution of resistance;

b) The substitution of an electrical potential;

c) The substitution of randomly-selected equipment of the same design and manufacture as the equipment installed on the protected premises. If there is a 95 percent probability of detection, the equipment is considered in compliance with this method;

d) Reintroduction of information recorded by a portable tape recorder from the connecting line or communication channel between the police station or central station and the protected premises; or

e) Introduction of a synthesized signal, produced by a portable variable frequency (20 – 20,000 hertz) signal generator capable of producing sinusoidal, square, and sawtooth wave forms, onto the connecting line or communication channel between the police station or central station and the protected premises.

59.4 The compromise attempts described in 59.3 are to be conducted at the protected premises at the end of the connecting line or communication channel, and at terminals located outside of the protected premises.

59.5 The compromise equipment used is to be introduced by a quick-action multiple-pole switch so that the transfer is accomplished in 5 milliseconds, or less.

59.6 Voltmeters, ammeters, ohmmeters, and frequency meters with 5 percent or greater accuracy are to be used to determine the adjustment of the compromise equipment used in 59.3 (a), (b), (d), and (e).

59.7 The amplitude of the compromise signal introduced in 59.3 (d) and (e) is to be within ±10 percent of the normal signal.

59.8 The frequency of the compromise signal introduced in 59.3(e) is to be within ±10 percent of the normal signal.

59.9 A compromise attempt by any one of the methods in 59.3 shall cause a locked-in alarm signal requiring attention by police station or central station personnel.

59.10 It is not required that an alarm signal caused by a compromise attempt be distinguishable from a normal alarm signal.

59.11 If a number of systems depend on one signaling line or communication channel, the system against which a compromise attempt is made in accordance with 59.3 shall be identified and the attempt shall not cause confusing signals from any of the other systems on that line or channel.

59A Encrypted Line Security Equipment

Added 59A effective March 8, 2007

59A.1 In addition to the requirements of 59.1, encrypted line security equipment shall use equipment encryption algorithms of a minimum of 128 bits to provide protection against a compromise attempt.

59A.2 For products incorporating encrypted line security, evidence of a certificate of compliance for the validation of encryption algorithms [for example, Federal Information Processing Standards (FIPS) 197 or 46–3] or validation of security requirements for cryptographic modules (for example, FIPS 140–2) with the National Institute of Standards and Technology (NIST) shall be provided.

59A.3 A compromise attempt against a system provided with encrypted line security equipment shall cause an audible and visual signal within 6 minutes that will require attention by central station personnel. The signal shall be stored after it is acknowledged. Equipment complying with the requirements in this Section shall be classified as encrypted line security equipment.

PROTECTED PREMISES EQUIPMENT

60 Subscriber's Control Units

60.1 The subscriber's control unit shall provide for the connection of protective wiring, conductors, and attachments, and shall provide for the transmission of an alarm signal to a police department. See Sections 53 – 59.

60.2 Control units and terminal panels intended to be located outside of a complete vault, a complete safe, or an extent number 1 stockroom shall be electrically protected so that no opening can be created of sufficient size to permit defeat of the system without signaling an alarm condition.

60.3 Control units mounted inside the protected area shall have the cover electrically supervised through the protective wiring circuit to protect against unauthorized opening. See 7.2.3 and 68.3.

61 Outside Alarm Devices

61.1 Outside sounding devices shall be of the enclosed type and shall comply with the Standard for Audible Signal Appliances, UL 464, for outdoor use and with audibility requirements given in 64.5 – 64.9 and 74.10 – 74.14. Also see Outdoor Use Equipment, Sections 110 – 122.

61.2 The construction of the outside alarm housing shall be such that it will shed water when mounted as intended. Sufficient drain openings shall be provided in the lowest part of the housing to prevent accumulation of water. See the Rain Test, Section 115.

61.3 Protective linings employed in housings shall be sealed in a moisture-tight envelope unless of rust resisting material or treated to resist corrosion. If air is depended upon for insulation, ″live″ linings shall be spaced not less than 1/4 inch (6.4 mm) nor more than 1 inch (25.4 mm) from the housing or other parts that would result in an alarm if they contact the protective lining.

61.4 Instruments and connecting wire shall be located at a sufficient height above the bottom of the housing to avoid saturation with water, snow, and the like.

61.5 Ringing mechanisms and other apparatus in housings subject to vibration shall be mounted with lock washers or the equivalent to prevent loosening.

62 Intrusion Detection

62.1 Intrusion detection portions of a police station connected burglar alarm unit, such as a motion detector, proximity detector, sound detector, vibration detector, or the like, shall comply with the appropriate performance requirements of the Standard for Intrusion-Detection Units, UL 639.

MERCANTILE PREMISES ALARM SYSTEMS

GENERAL

63 Construction

63.1 Alarm units shall comply with the applicable requirements for construction and performance in this Standard and shall, in addition, comply with the requirements in Circuit and Operation, Section 64, and Maintenance, Section 65.

Revised 63.1 effective March 8, 2007

64 Circuit and Operation

64.1 The protective circuits shall be of the electrically-supervised type, arranged to produce an alarm if the protective circuit is opened, if circuits of opposite polarity are crossed, or if an initiating device in the circuit transfers to the alarm condition.

64.2 A time delay of up to 1 second to prevent accidental alarms resulting from momentary breaks, crosses, leakage to ground, or the like, is acceptable in circuits where quick reaction to such alarm conditions is not required.

64.3 The circuit shall be constructed so that once an alarm is initiated from protective circuits it cannot be stopped by removing the cause thereof.

64.4 Provision shall be made for the user to conveniently test the operability of the protection circuit each time it is placed on duty for the closed period.

64.5 The alarm sounding device, mounted within its intended housing and in its intended mounted position, shall provide a sound output equivalent to that of an omnidirectional source with an A-weighted sound pressure level of at least 85 decibels at 10 feet (3.05 m) while connected to a source of rated voltage. See 25.3.1.

64.6 The sound power output of the alarm sounding device shall be measured in a reverberant room qualified for pure tones under Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms, ANSI S12.31-1990, or Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms, ANSI S12.32-1990. The sound power in each 1/3 octave band shall be determined using the comparison method. The A-weighting factor shall be added to each 1/3 octave band. The total power shall then be determined on the basis of actual power. The total power shall then be converted to an equivalent sound pressure level for a radius of 10 feet (3.05 m) using the following formula:

$$L_p = L_w - 20\text{Log}_{10}R - 0.6$$

in which:

L_p is the converted sound pressure level,

L_w is the sound power level measured in the reverberation room, and

R is the radius for the converted sound pressure level (10 feet).

64.7 The output specified in 64.5 shall not be less than 82 decibels when the voltage is reduced to the minimum value specified in the Undervoltage Operation Test, Section 31.

64.8 The alarm sounding device, with its power supply, shall produce sound at the level specified in 64.5 for not less than 15 minutes.

64.9 An alarm cutoff feature shall not operate in less than 15 minutes.

64.10 The sounding of the protected premises audible alarm may be delayed by not more than 5 minutes, but the transmission of an alarm to the police station or central station shall be delayed not more than 45 seconds after the alarm has been initiated. See 53.5.

64.11 There shall be an indication, at the time of setting the system, that all protection up to the egress door is set for duty.

64.12 The system shall be such that the setting of closed-circuit wiring, detection devices, or alarm sounding device circuits is not dependent upon the operation of an egress-door-actuated switch or transfer mechanism on the door unless failure of these switches to operate as intended at closing time gives position indication to the user.

64.13 Key-operated controls located outside of the protected area shall employ high-security locking cylinders complying with the Standard for Key Locks, UL 437.

64.13 revised March 17, 1998

64.14 Switches other than the entrance door shunt, that permit convenient shunting of portions of the protection by the user, shall not be used unless audible or visual indicators, or both, are provided to remind the user to remove the shunt.

64.15 The length of the time delay intended to prevent an alarm during ingress, shall not exceed the time established in 68.2 and shall not, in any case, exceed 60 seconds.

64.16 There shall be constant indication to the user, of the condition of the protection circuit power supply.

64.17 Either a graduated milliammeter in the protection circuit or an underload device adjusted to operate a trouble signal when the current in the protection circuit drops to a certain value are acceptable methods of supervising the condition of the protection-circuit power supply.

64.18 The system shall be arranged to provide at least one daily automatic test of the sounding device and its source of energy.

65 Maintenance

65.1 Installations shall be maintained by the alarm service company under provisions of a service contract or agreement. They shall be inspected at intervals that will maintain the system in its intended operating condition. The interval between regular maintenance inspections shall not exceed 1 year. The regular maintenance inspection may be done in parts throughout the year.

65.2 In the case where the alarm receiving equipment is the responsibility of a company other than the operating company, that second company shall be a qualified alarm installer and there shall be an agreement between the two companies that will provide the same maintenance and service as though one company is responsible for all of the equipment.

65.3 The alarm service company shall maintain a means of receiving requests for service at all times and shall keep a permanent record of the time and date that:

a) A request for service is received,

b) Service begins, and

c) The repairs are completed.

Requests for service shall be received by alarm service company personnel. Or, a method shall be devised that will result in the beginning of service within the time interval indicated in 65.5.

Revised 65.3 effective January 1, 1998

65.4 The alarm service company shall provide the alarm service subscriber with written instructions on how to contact the company for service. The method of communication shall allow the subscriber to promptly report trouble conditions.

Revised 65.4 effective January 1, 1998

65.5 Repairs to a mercantile alarm system shall begin within 18 hours after the receipt of a request for service. The maximum range of travel (driving time) from the company's main business location or service center to an alarm system installation shall not exceed 3 hours in a land-based vehicle.

Exception: The beginning of repair service may be extended to the time that the protected property is next open for business when the subscriber to the alarm service provides written or oral authorization. Authorization shall be given to alarm service company personnel when the subscriber makes the decision to delay service. When authorization is given, the alarm service company shall make a record of the:

a) Time and date of the authorization,

b) Name and identification code of the person giving the authorization, and

c) Name and address of the company receiving alarm service.

Revised 65.5 effective January 1, 1998

65.6 The operating company shall maintain authorized service stations in sufficient number and distributed throughout the territory served as necessary to provide compliance with the requirement in 65.5. Service stations shall employ at least one expert repairman and shall maintain on hand a stock of such parts and materials as required to fully maintain all equipment in its territory.

66 Attack Tests

66.1 General

66.1.1 These tests are to be conducted as required to verify compliance with the requirements for Tamper Protection, Section 68.

Revised 66.1.1 effective March 8, 2007

66.2 Test method

66.2.1 The tools used in the attack tests against control units, power-supply enclosures, alarm housings, or the like, are to include the type of tool intended for use with the fasteners used to assemble the product (excluding a key or lock pick), a blade type screwdriver not more than 8 inches (203 mm) in length from the blade tip to the handle and not more than 1/4 inch (6.4 mm) square or 9/32 inch (7.1 mm) diameter, and a wire cutter. The use of a wire cutter is to be restricted to the cutting of conductors inside the enclosure under attack.

66.2.2 The product under test is to be securely mounted in its intended position on a 3/4 inch (19.1 mm) thick plywood board that extends not less than 12 inches (305 mm) beyond each edge of the product and then to a substantial rack.

66.2.3 A single operator is to subject the product to:

a) A disassembly attack using the tool intended for the fasteners used to assemble the product,

b) A forcing attack using the blade type screwdriver, and

c) A combination of disassembly and forcing attacks.

66.2.4 The forcing attack is to be directed against the enclosure cover, against any slot at least 1/8 inch (3.2 mm) wide, and against any other unobstructed opening having a dimension of 1/8 inch or more.

66.2.5 If the number of knockouts in an enclosure exceeds the number required for the connection of conduit in an installation, all knockouts are to be subjected to a forcing attack using the screwdriver described in 66.2.1.

66.2.6 Knockouts in the mounting surface of an enclosure are not to be subjected to attack. See 5.2.6.

66.2.7 The diameter of an opening provided in the control unit for conductors other than the alarm sounding-device power conductors, shall not exceed 3/8 inch (9.5 mm) and the opening shall not be subjected to attack if only one is provided. If more than one such opening is provided, each shall be subjected to attack using the screwdriver described in 66.2.1.

67 Attack Resistance Time

67.1 A product complying with the requirements of Tamper Protection, Section 68, shall resist the attack specified in the Attack Tests, Section 66, for the length of time required to transmit the off premises signal to the alarm receiving location specified in 1.8.

Revised 67.1 effective March 8, 2007

67.2 If an attack against the control unit in an attempt to silence the local alarm sounding device will not prevent the complete transmission of a signal to the off premises receiving location, the control unit is not required to offer an attack resistance. This requirement applies to a transmission system that either immediately transmits a signal or results in an indication at the receiving location that the control at the protected premises is no longer functioning.

67.3 If an attack against a control unit to silence the local alarm sounding device can prevent the complete transmission of a signal to the off premises receiving location, the attack resistance time shall be as follows:

a) For a transmitter system, the complete transmission of at least three complete code rounds. If the number of pulses in each round affects the length of time required to transmit the round, an average length of transmission shall be used to determine the attack time. A unit that can be set for 111 – 999 shall use the code 555 or 456.

b) For a digital alarm communicator transmitter complying with the requirements for the Standard for Digital Alarm Communicator Units and Systems, UL 1635, sufficient time to allow the transmitter to contact its digital alarm communicator receiver, transmit an acceptable signal, and receive a shut down signal, assuming that contact is made with the receiver on the first attempt. The slowest transmission time is to be used. A seven digit number is to be used assuming that the receiver is in the same area code. The transmission shall be over a local public telephone system. Ten transmissions shall be made and the average time to complete the transmission shall be the required attack resistance time.

Exception: The manufacturer may specify the slowest transmission format suitable for use in an alarm system installed in accordance with the requirements of the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681.

c) For a one-way radio system, sufficient time to allow the radio to make contact with its receiver and deliver a complete alarm signal.

d) *Deleted*

Exception: Deleted

Revised 67.3 effective March 8, 2005, except deleted item d effective March 8, 2007

67.4 If turning an alarm system off will prevent the transmission of a complete alarm to the off premises receiving location, the switch used to turn the alarm systems off shall:

a) Be key operated or

b) Require the input of a code having at least 1000 possible codes.

Exception: This is not required for a transmission system that either immediately transmits a signal or results in an indication at the receiving location that the control at the protected premises is no longer functioning.

68 Tamper Protection

68.1 The alarm sounding-device power supply, control switches, and circuits that can be cut or short-circuited to silence the alarm sounding-device shall be located in enclosures that are:

a) At least equal in strength to 0.053 inch (1.35 mm) minimum sheet steel and

b) Provided with door or cover securing devices, and otherwise constructed to resist attempts to silence the alarm by the attack methods described in the Mercantile Premises Alarm Systems, Attack Tests, Section 66, for the period of time specified in Attack Resistance Time, Section 67.

68.2 Each attack is to be continued beyond the test period specified in Attack Resistance Time, Section 67, for an additional 60 seconds, or until the alarm has been silenced, and the additional time recorded. The minimum additional time recorded shall establish the maximum time delay described in 64.15.

68.3 The door or cover of the control unit and sounding-device power supply enclosure, or enclosures, shall be arranged so that:

a) The door or cover must be closed and secured before the user can set the system for duty and

b) An alarm is initiated if the door or cover is opened while the system is set for duty.

68.4 The construction of an outside alarm housing (see 3.3) shall be at least equivalent in strength to a 0.067 inch (1.70 mm) sheet steel outer housing and an electrical inner lining of 0.053 inch (1.35 mm) sheet steel, covering all sides except the back. An attempt to remove the alarm housing from its mounting surface or an attempt to disassemble it shall result in an alarm signal when the alarm system is set for duty. At least one-half of the outer-cover-securing devices shall be supervised so as to result in an alarm signal if any are removed while the alarm system is set for duty. If the alarm housing is intended for use out-of-doors, it shall comply with Sections 110 – 112.

68.5 The outer and inner housings shall be connected in the closed protection circuit or fully insulated electric linings shall be used so that an alarm will result if the housing is penetrated by drills, pry bars, or similar tools.

68.6 Connection of linings, housings, and housing contacts shall be supervised by the closed protection circuit that enters and leaves at different points. If the housing is intended to be grounded, it shall be connected to the correct circuit with respect to single-circuit protection wiring.

68.7 The alarm housing shall resist, for 120 seconds, attempts to silence the alarm by the attack methods described in the Mercantile Premises Alarm Systems, Attack Tests, Section 66. The alarm is to be silent when the attack is started and the attack shall initiate the alarm.

68.8 An inside alarm sounding device shall be arranged so that opening the outer door or cover of the housing shall result in an alarm signal when the alarm system is set for duty.

Revised 68.8 effective March 8, 2007

68.9 Deleted effective March 8, 2007

68.10 The alarm housings described in 68.4 shall be provided with an opening or knockout for the connection of conduit or electrical metallic tubing in the mounting surface of the housing that is to be used for the conductors used to supply power to the alarm sounding device. The opening or knockout in the housing described in 68.4 shall only be accessible when the cover of the inner housing or lining is removed.

Exception: Such an opening is not required if the power supply for the alarm sounding device is located within the alarm housing.

Revised 68.10 effective March 8, 2007

68.11 An inside audible alarm sounding device shall provide for the connection of conduit or electrical metallic tubing or shall provide for mounting to an electrical back box that will provide for such connection.

Revised 68.11 effective March 8, 2007

68A Alarm Sounding Devices

Added 68A effective March 8, 2007

68A.1 In a mercantile burglar alarm system, a mercantile alarm sounding device located within a building but outside the protected area, is acceptable, provided it is rated for outside service and alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

68A.2 In a mercantile burglar alarm system, an alarm sounding device located within the area of greatest protection, or outside the area of greatest protection but within an area protected by an alarm system and that shares a common control unit with the system installed in the area of greatest protection, is acceptable provided it is rated for inside service and alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

68A.3 An inside sounding device shall be mounted at least 10 feet (3.05 m) above the floor or at the surface of the ceiling. When there is fixed construction within the area that could provide access for an intruder, the alarm sounding device shall also be mounted at least 4 feet (1.2 m), as measured horizontally, away from the edges of the fixed construction or at least 10 feet (3.05 m) above it so as to minimize access by an intruder.

LINE SECURITY

69 General

69.1 Standard line security systems shall comply with requirements in Sections 63 – 68A and Standard Line Security Equipment, Section 59.

Revised 69.1 effective March 8, 2007

69.2 Encrypted line security systems shall comply with requirements in Standard Line Security Equipment, Section 59, and Encrypted Line Security Equipment, Section 59A.

Added 69.2 effective March 8, 2007

MERCANTILE SAFE AND VAULT ALARM SYSTEMS

DETAILS

70 General

70.1 Systems for mercantile safes or vaults and standard line security equipment shall comply with the requirements for police station connected burglar alarms for mercantile premises, or shall provide equivalent protection, and shall comply with the requirements in Circuit and Operation, Section 71. See also 60.2. In addition, standard line security equipment shall comply with the requirements in Standard Line Security Equipment, Section 59.

Revised 70.1 effective March 8, 2007

70.2 Encrypted line security systems shall comply with requirements in Standard Line Security Equipment, Section 59, and Encrypted Line Security Equipment, Section 59A.

Added 70.2 effective March 8, 2007

71 Circuit and Operation

71.1 The leads providing operating power to the alarm sounding device shall be electrically and mechanically protected as required in the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681, or the circuit shall be constructed so that the system is not defeated by cutting or short-circuiting connections between the control unit and the alarm housing.

71.1 revised March 17, 1998

71.2 If the system makes provision for connection of vault or safe wiring to the same circuit and to the same alarm housing used with premises wiring on the surrounding premises, tampering with the premises wiring shall not defeat the safe or vault wiring.

GRADE AA REQUIREMENTS – DELETED

72 General

72.1 Deleted effective March 8, 2007

BANK SAFE AND VAULT ALARM SYSTEMS

POLICE STATION CONNECTED BANK SAFE AND VAULT BURGLAR ALARM UNITS

73 General

73.1 Police station connected bank safe and vault burglar alarm units shall comply with the requirements specified in Mercantile Safe and Vault Alarm Systems, General, Section 70, and Circuit and Operation, Section 71, and with the requirements in Bank Safe and Vault Alarm Systems, Circuit and Operation, Section 74, and Maintenance, Section 75.

Revised 73.1 effective March 8, 2007

74 Circuit and Operation

74.1 All systems shall employ a closed-circuit cable for connecting the safe or vault to the alarm housing so that an alarm is produced if the cable is severed or disconnected.

74.2 When the system is placed on duty, a timer in the system shall prevent the turning OFF, prior to a time set by the user, of the door protection and of other circuits that are inoperative during the open period. The timer shall be capable of covering a closed period of at least 96 hours (4 days).

74.3 The door protection and other circuits that are inoperative during the open period shall be arranged so that they are placed on duty manually at the time of closing or automatically by the timer within 30 minutes after closing of the door and setting of the system for the closed period.

74.4 The requirements of 74.2 and 74.3 may be provided by a 7 day (1 week) timer that will automatically place the protection on duty not later than 10 p.m. and remove it not sooner than 6 a.m. the next business day. These times may be revised if they conflict with normal business hours of the protected vault or safe. The timer shall automatically maintain the protection on duty on Sundays and holidays. An electrically protected key or combination control shall be provided for the user to change the ON and OFF times and to adjust the holiday carry-over as required.

74.5 An audible or prominent visual signal (or absence thereof) shall indicate automatically to the user if winding of any time-control mechanism is neglected.

74.6 The main protective circuits, linings, and attachments on the safe or vault, control units, and alarm housing shall be of the normally closed circuit fully supervised type.

74.7 Auxiliary protection circuits used to supplement or reinforce the main protective devices on these units may be of the nonsupervised type.

74.8 Systems employing sound-, vibration-, or proximity-detector systems shall include provision for testing the operation of detectors and all associated relays and circuits without sounding the alarm. See Intrusion Detection, Section 62.

74.9 Provision shall be made for a separate test of detectors in each safe or vault connected to a single control unit.

74.10 The alarm sounding device mounting within its intended housing and in its intended mounting position, shall provide a sound output equivalent to that of an omnidirectional source with an A-weighted sound pressure level of at least 87 decibels at 10 feet (3.05 m) while connected to a source of rated voltage. See 25.3.1.

74.11 The sound power output of the alarm sounding device shall be measured in a reverberant room qualified for pure tones under Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms, ANSI S12.31-1990, or Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms, ANSI S12.32-1990. The sound power in each 1/3 octave band shall be

determined using the comparison method. The A-weighting factor shall be added to each 1/3 octave band. The total power shall then be determined on the basis of actual power. The total power shall then be converted to an equivalent sound pressure level for a radius of 10 feet (3.05 m) using the following formula:

$$L_p = L_w - 20\text{Log}_{10}R - 0.6$$

in which:

L_p is the converted sound pressure level,

L_w is the sound power level measured in the reverberation room, and

R is the radius for the converted sound pressure level (10 feet).

74.12 The output specified in 74.10 shall not be less than 84 decibels when the voltage is reduced to the minimum value specified in the Undervoltage Operation Test, Section 31.

74.13 The alarm sounding device, with its power supply, shall be capable of sounding at the level specified in 74.10 for:

a) Not less than 15 minutes nor more than 30 minutes if the alarm condition has not cleared or

b) Not less than 5 minutes if an automatic feature is provided to silence the alarm and reset the system if the alarm system has cleared.

74.14 A mechanical ringer shall give an indication automatically to the user when only 5 minutes operating power remains in the sounding device.

74.15 The sounding of the local alarm may be delayed by not more than 5 minutes, but the transmission of an alarm to the police station or central station shall be delayed not more than 45 seconds after the alarm has been initiated. See 53.5.

74.16 If the system design provides for two electrically powered alarm sounding devices, and one is to be mounted inside and one outside the building, the inside alarm shall have resistance to tampering and an audibility equal to that specified for a single outside alarm.

75 Maintenance

75.1 Repairs to a bank alarm system shall begin within 24 hours after the receipt of a service request. In cases where access to the protected property is controlled by a time lock not scheduled for release within 24 hours of the service request, service shall begin when the time lock releases. The maximum range of travel (driving time) from the company's main business location or service center to an alarm system installation shall not exceed 6 hours in a land-based service vehicle.

Exception: The beginning of repair service may be extended to the time that the protected property is next open for business if the subscriber to the alarm service provides written or oral authorization. Authorization shall be given to alarm service company personnel when the subscriber makes the decision to delay service. If authorization is given, the alarm service company shall make a record of the:

a) Time and date of the authorization,

b) Name and identification code of the person giving the authorization, and

c) The name and address of the company receiving alarm service.

Revised 75.1 effective January 1, 1998

75.2 Batteries shall be replaced or renewed by the operating company. However, in an emergency, the user may replace batteries, when battery cells are shipped from the factory, connected and sealed in containers as a complete unit, and when installation of the batteries does not require electrical skill.

75.3 The alarm service company shall maintain a means of receiving requests for service at all times and shall keep a permanent record of the time and date that:

a) A request for service is received,

b) Service begins, and

c) The repairs are completed.

Requests for service shall be received by alarm service company personnel, or a method shall be devised that results in the beginning of service within the time interval indicated in 75.1.

Added 75.3 effective January 1, 1998

75.4 The alarm service company shall provide the alarm service subscriber with written instructions on how to contact the company for service. The method of communication illustrated shall allow the subscriber to promptly report trouble conditions.

Added 75.4 effective January 1, 1998

75.5 Installations shall be maintained by the alarm service company under a service contract or agreement. They shall be inspected at intervals that will maintain the system in its intended operating condition. The interval between regular maintenance inspections shall not exceed 1 year. The regular maintenance inspection may be done in parts throughout the year.

76 Attack Test

76.1 The tools used in the attack tests of 78.1 and 81.1 are to include hammers, chisels, adjustable wrenches, pry bars, punches, and screwdrivers. The hammers are not to exceed 3 pounds-mass (1.36 kg) in head weight, and no tool is to exceed 18 inches (45.7 mm) in length.

76.2 The tools used in the attack tests of 78.2 are to include those described in 76.1 and in addition, are to include drills, fish wires, firearms, hooks, and lines.

76.3 Drill bits are not to exceed 1/4 inch (6.4 mm) in diameter, are to be high-speed bits, and are to be used in a 1/4 inch capacity electric drill rated not greater than 2000 revolutions per minute.

76.4 The firearm used shall be a 38 special revolver with an 8-1/4 inch (210 mm) barrel, and shall be used to fire a 158 grain (10.2 g) lead 38 special bullet from a distance of 12 – 15 feet (3.7 – 4.6 m).

76.5 The measuring instruments and tools used in the attack test described in 78.3 shall include not more than four multimeters, jumper wires with clips or needle point probes, wire cutters, wire strippers, needle point pliers, and knives.

Revised 76.5 effective March 8, 2007

76.6 Multimeters shall be capable of measuring volts, amperes, and resistance, and on the voltage ranges shall have an input impedance of 10,000 ohms/volts or higher.

76.7 The product under test is to be securely mounted in its intended position on a 3/4 inch (19.1 mm) thick plywood board that extends not less than 12 inches (305 mm) beyond each edge of the product and then to a substantial rack. The attack shall be carried out by a single operator.

ALARM SYSTEMS FOR BANK SAFES AND VAULTS

77 General

77.1 Alarm systems for bank safes and vaults shall comply with the requirements specified in Sections 73 – 76, and the requirements in Tamper Protection, Section 78; Alarm Sounding Devices, Section 78A; and Circuit and Operation, Section 79.

Revised 77.1 effective March 8, 2007

78 Tamper Protection

78.1 The alarm housing shall be at least equal in mechanical strength and electrical protection to a 0.123 inch (3.12 mm) sheet steel enclosure with an electrically connected lining completely covering the interior of the housing. The housing shall resist for a period of 5 minutes all attempts to silence the alarm by use of the tools specified in 76.1. See Sections 110 – 122.

78.2 In addition to the requirements of 76.1, mechanical safeguards shall be placed around the ringing mechanism, sources of energy, and the like, to withstand for 15 minutes any attempt to defeat the alarm mechanism, by use of the tools specified in 76.1 and 76.2, before it has had an opportunity to initiate an alarm.

78.3 The cable connecting the safe or vault with the alarm housing shall employ balanced electrical circuits arranged to resist an attack on the cable by an expert having detailed knowledge of the circuit employed and equipped with the measuring instruments and tools specified in 76.5.

78.4 The provision for turning off the alarm from the control unit shall be guarded by a key lock or combination, except in systems where this control is inoperative during the closed periods.

78A Alarm Sounding Devices

Added 78A effective March 8, 2007

78A.1 In a bank burglar alarm system, a bank alarm sounding device and housing that is located anywhere within a building is acceptable provided that alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

79 Circuit and Operation

79.1 There shall be provision for testing of automatic meter supervision over all sources of electrical energy. If testing is used it is to be made under load with the sounding device operating.

79.2 Switches provided on the control unit by use of which the user can turn off portions of the protection or turn off the alarm, shall give an audible or prominent visual indication to the user as long as the switches remain in the inoperative position.

GRADE B REQUIREMENTS – DELETED

80 General

80.1 Deleted effective March 8, 2007

81 Tamper Protection

81.1 Deleted effective March 8, 2007

81.2 Deleted effective March 8, 2007

82 Circuit and Operation

82.1 Deleted effective March 8, 2007

82.2 Deleted effective March 8, 2007

LINE SECURITY EQUIPMENT

83 General

83.1 Standard line security systems shall comply with the requirements in Sections 73 – 79 and Standard Line Security Equipment, Section 59.

Revised 83.1 effective March 8, 2007

83.1.1 Encrypted line security systems shall comply with requirements in Section 73 – 79, Standard Line Security equipment, Section 59, and Encrypted Line Security Equipment, Section 59A.

Added 83.1.1 effective March 8, 2007

83.2 Deleted effective March 8, 2007

POWER SUPPLIES

DETAILS

84 General

84.1 Systems shall not depend solely on commercial power if failure thereof will cause a public alarm or render the system inoperative.

84.2 The following are acceptable sources of electrical power for police station connected burglar alarm units:

a) Rechargeable (secondary) batteries on full float or trickle charge,

b) A power supply with battery standby, and

c) Nonrechargeable (primary) batteries.

84.3 A battery provided with the product, other than a primary battery having an open circuit potential of 42.4 volts or less, shall:

a) Be protected by a fuse or circuit breaker rated at not less than 130 nor more than 200 percent of the maximum operating load on the battery or

b) Comply with low-voltage (power limited) requirements as defined by 3.4 (b) and (c).

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84.4 Batteries provided with a product and intended to be located out-of-doors shall be of such a type, or installed or protected so, that they will continue to operate the system after they have been in service for 1 year and after they have been subjected to the Outdoor Use Equipment, Variable Ambient Test, Section 117. See 84.5.

84.5 Provision shall be made for heating battery compartments if batteries are intended for installation out-of-doors in localities where local weather bureau or other authentic records indicate that temperatures of minus 22°C (minus 8°F) or lower will be encountered.

Exception No. 1: This requirement does not apply to batteries of a type that operate as intended in the environment described without requiring external heating.

Exception No. 2: This requirement does not apply to batteries that operate as intended when subjected to the low-temperature conditions of the Outdoor Use Equipment, Variable Ambient Test, Section 117.

84.6 If the product is equipped with terminals for the connection of standby power, the terminals shall be marked with, or reference, a drawing that shows the power ratings, including voltage, current, and capacity of batteries in ampere-hours, and the number and type of batteries to be used. See 108.1(d)(2).

RECHARGEABLE (SECONDARY) BATTERIES

85 General

85.1 A rechargeable battery shall have sealed cells with spray-trap vents and shall be floated or trickle charged. See Sections 110 – 122.

85.2 Batteries shall be located and mounted so that terminals of adjacent cells will be prevented from coming in contact with each other or with metal parts of the battery enclosure as a result of shifting of the batteries. The mounting arrangement shall permit ready access to the cells, if such access is required to check the specific gravity of the electrolyte.

85.3 A conditioning charge shall be limited so that, at the maximum obtainable rate of charge, the battery gases will not affect any part of the control unit.

85.4 The interior of metal cabinets used to enclose vented rechargeable batteries shall be painted with two coats of acid-resistant and alkali-resistant compound, or shall be protected by baked enamel.

85.5 Cabinets used to enclose liquid electrolyte batteries shall be constructed so that the condition of the elements may be observed without disturbing the cells.

85.6 If the battery is contained in a compartment in the same cabinet that houses instruments, the cells shall be located below the instrument compartment, or otherwise arranged to reduce the risk of damage to the instruments as a result of leakage or fumes from the battery.

85.7 The police-station connected burglar alarm unit manufacturer shall:

a) Provide all specifications, information, and calculations necessary to determine that the battery is used within its specifications; and

b) Confirm that the charging method used complies with the battery manufacturer's specifications and continues to provide a charging current under all conditions of intended use.

The conditions of intended use shall be construed as including over- and undervoltage conditions as described under the Undervoltage Operation Test, Section 31, and the Overvoltage Operation Test, Section 32, in all combination with the temperature variations described under the Performance – All Units, Variable Ambient Test, Section 33, or the Outdoor Use Equipment, Variable Ambient Test, Section 117.

85.8 All conditions of battery discharge shall comply with the battery manufacturer's specifications, with regard to rate of discharge and with automatic voltage cutoff, if required to prevent polarity reversal or damage.

85.9 If two or more cells are used in series or parallel, the conditions of use shall provide for equalization of cells, in compliance with the battery manufacturer's specifications.

85.10 The conditions of storage shall comply with the battery manufacturer's specifications with regard to position, temperature, and state-of-charge.

85.11 If the battery is of a type that will lose capacity as a result of long periods of inactivity, provision shall be made for cycling of the battery to prevent the condition or for a method of detecting the existence of a capacity loss.

85.12 A warning of precautions necessary to prevent premature battery failure, if any precautions are necessary, shall be contained in the installation instructions and shall include position of mounting, temperature limits, state-of-charge, and period of inactivity if the battery is of a type that may lose capacity due to these conditions. Markings on the product adjacent to the battery shall indicate either battery type and estimated life or a method of testing battery condition.

NONCHARGEABLE (PRIMARY) BATTERIES

86 General

86.1 Compartments for nonrechargeable cells shall be constructed to prevent adjacent cell terminals from contacting each other or the metal enclosure.

86.2 No. 6 size, 1-1/2 volt nonrechargeable cells may be expected to perform and require replacement at the intervals shown in Table 86.1 when used indoors on police station connected burglar alarms, depending on whether the ″ignition type″ (high-amperage) or ″protective alarm type″ (low-amperage) cells are used.

Table 86.1
Dry cell replacement period

Drain in milliamperes	Final working voltage	Replacement period	
		Ignition cell	Protective alarm cell
2	1.0	12 months	24 months
3	1.0	10 months	22 months
5	1.0	7 months	14 months
6	1.0	6 months	12 months
10	1.0	4 months	6 months

86.3 Table 86.1 applies to systems wherein the load may not be applied 24 hours each day. If the battery is operated continuously, a shorter replacement period is to be anticipated.

86.4 The replacement period shall be shortened if batteries are located in outside housings at temperatures of 52°C (126°F) or higher. In northern climates, provision shall be made for heating cells located out-of-doors where temperatures below minus 22°C (minus 8°F) are anticipated. See 86.5.

Exception: A shortened replacement period, or heating, or both, is not required if the type of battery used performs as intended under the temperature conditions of the Outdoor Use Equipment, Variable Ambient Test, Section 117.

86.5 Nonrechargeable batteries shall be replaced when the short-circuit amperage is less than 10 amperes or when the cell voltage is less than 1 volt while connected to a load of 1 ohm per cell. Nonrechargeable batteries shall be replaced at least annually, or every 2 years if of the protective-cell type, regardless of their condition.

86.6 A unit-type nonrechargeable battery shall be replaced when its voltage is less than two-thirds nominal voltage while connected to a load of 1 ampere.

PERFORMANCE

87 Power Failure Test

87.1 A police-station connected burglar alarm unit operated from commercial power shall be provided with standby power sufficient to operate the product for the period specified in 87.5 in the event of loss of the primary source of power.

87.2 Loss of commercial power shall be indicated. See 18.5.1.

87.3 With standby power connected, neither loss nor restoration of a line voltage source shall cause an alarm signal.

87.4 To determine compliance with the requirement in 87.3, the control unit is to be energized in the intended supervisory condition and the supply circuit is to be interrupted for 1 minute and then restored for 1 minute for a total of 10 cycles of supply circuit interruption.

87.5 Compliance with the requirement in 87.1 necessitates the automatic provision of a standby power supply in the event of commercial power loss so that the product will be maintained in the intended condition for the following periods of time:

a) Bank Vault Alarms – 72 hours,

b) Mercantile Alarms – 4 hours,

c) Police-Station or Central-Station Receiving Unit, Mercantile Systems – 4 hours,

d) Police-Station or Central-Station Receiving Unit, Bank Systems – 8 hours.

87.6 Ultimate loss of battery power for the protection circuit shall result in an alarm or trouble signal.

87.7 If the power supply is intended to provide a continuous output for the protection circuit and an intermittent output for an alarm sounding device, it shall comply with the requirements of 85.7 while under constant load conditions, but may provide power from the battery while under intermittent load conditions.

87.8 Under standby conditions, the continuous output shall not deplete the battery to a level where it cannot provide the intermittent load for the required period. This may be done by removing the constant load after the required standby time has been exceeded and before the battery capacity has fallen below that required for the intermittent load. See 64.8 and 74.13.

87.9 Following an extended power failure and restoration of power, rechargeable batteries shall recharge sufficiently within 24 hours to provide the required power for 4 hours of standby operation, within 48 hours for 8 hours of standby operation, and within 72 hours to provide 72 hours of standby operation.

87.10 Compliance with the requirement of 87.9 is to be determined by:

a) Fully charging the standby battery by operating the product from commercial power for not less than 7 days (168 hours); then

b) Operating the product on the standby battery for an extended power failure (see 87.11); then

c) Reconnecting the product to commercial power for the time period required in 87.9; and then

d) Operating the product on the standby batteries for the period of time required by 87.5.

87.11 With reference to the requirements of 87.9, an extended power failure is defined as follows:

a) Bank Vault Alarms – 72 hours,

b) Mercantile Alarms – 24 hours,

c) Police-Station or Central-Station Receiving Unit – 24 hours.

87.12 If standby power is provided from nonrechargeable batteries, provision shall be made to test the condition of the batteries. See 64.16 – 64.18, 79.1, 79.2, 84.1, and 88.3.

88 Power Supply Located at Police Station

88.1 Cabinets enclosing the power supply shall be protected against tampering. If these cabinets are not constantly visible to the police attendant, the cabinets doors shall be secured either by a key lock or by a tamper contact. If the conditions described in 7.2.3 apply, the tamper contact is required.

88.2 The power supply shall have constant meter supervision, or the equivalent, to indicate its condition.

88.3 The power supply of a multizone system shall operate the unit with 10 percent of the zones (minimum of two zones) in the alarm condition and the audible signal reset. While in this condition, the unit shall annunciate alarms from an additional 10 percent of the zones (minimum of two zones).

88.4 To determine the standby capacity, 10 percent of the zones (minimum of two zones) are to be placed in alarm with the audible signal reset. The remaining zones are to be in normal supervisory condition. The unit shall receive an alarm from any one of the systems in the supervisory condition at the end of the required standby time period.

88.5 In determining the power and standby capacities, it is to be assumed that a zone that has been alarmed and silenced increases the power supply load.

SHORT RANGE RADIO FREQUENCY (RF) DEVICES

89 General

89.1 These requirements cover the operation of control units and systems that utilize initiating, annunciating, and remote control devices that provide signaling by means of low power radio frequency (RF) in accordance with the Code of Federal Regulations, (CFR) 47, Part 15. Such control units and systems shall comply with Sections 1 – 88 of this standard except that in the event of conflict, the requirements of this section shall apply.

89.2 These requirements are applicable to a system configuration consisting of multiple transmitters and a single receiver with the transmitters operating on a random basis, and with modifications, to a system employing such configurations as multiple receivers or a two-way interrogate response system.

89.3 Initiating circuit transmitters that are powered by a nonrechargeable (primary) battery shall serve only one device and shall be individually identified at the receiver/control unit.

Exception: More than one device may be served by one transmitter if:

a) The transmitter and the devices are located in the same room and

b) The devices all service the same function such as:

1) Door contacts,

2) Window contacts,

3) Motion detectors, or

4) Glass break detectors.

89.4 A repeater is a transceiver (transmitter/receiver) that is used to receive transmissions from transmitters and relay the signals to the receiver/control unit. A repeater shall comply with all of the requirements that apply to a transmitter.

89.5 A transmitter that is powered from a nonrechargeable (primary) battery, may shut down for a maximum of 3 minutes after a transmission sequence in order to conserve its battery if it is used with a motion detector, a public door, or other application where it would be frequently triggered during the disarmed period of the alarm system. After the shutdown, the transmitter shall initiate a transmission sequence the next time the device that it is connected to is operated.

90 Time to Report Alarm

90.1 The transmitter/receiver combination shall be arranged so that the occurrence of an alarm or emergency condition at any transmitter will be immediately communicated to the receiver/control unit and processed as required. Under unusual or abnormal operating conditions (such as clash or interference), this signal may be delayed for a period not exceeding 90 seconds.

90.2 A signal from an RF initiating device shall latch at the receiver/control unit until manually reset and shall identify the particular RF initiating device in alarm.

Exception: Check-in signals required by Inoperative Transmitter Reporting, Section 91, are not required to latch and identify.

90.3 To provide higher priority to alarm and emergency signals than to other signals, such signals shall be either continuous or periodically repeated at intervals not exceeding 60 seconds until the initiating device is returned to its normal condition. If the signal is continuous, the transmitter shall be limited to a maximum 15 percent duty cycle measured over a 1-minute interval.

91 Inoperative Transmitter Reporting

91.1 A receiver/control unit shall report and identify an inoperative transmitter in the system within 4 hours after the transmitter becomes inoperative. The report indication shall include an audible trouble signal.

91.2 The normal periodic transmission from a wireless initiating device shall, by transmitting at a reduced power level of at least 3 decibels or by other means, provide additional assurance of successful alarm transmission capability.

91.3 The requirements of 91.2 are met through compliance with Clash, Section 98, the Error (Falsing) Rate, Section 100, the Throughput Rate, Section 101, and the Transmitter Accelerated Aging Test, Section 103.

92 Battery Status Indication

92.1 A transmitter shall supervise the capacity of the battery. The battery shall be monitored while loaded by transmission of the transmitter, or a load equivalent to the load imposed by transmission.

92.2 A trouble status signal shall be transmitted to the receiver before the battery capacity of the transmitter has depleted to a level insufficient to power the unit for at least 7 days. The trouble signal shall be retransmitted at intervals not exceeding 4 hours until the battery is replaced or is depleted.

92.3 The battery (of the transmitter) shall be capable of operating the transmitter, including the initiating device (if powered by the same battery), for not less than 1 year of normal signaling service before the battery depletion threshold specified in 92.2 is reached.

92.4 Annunciation of low battery trouble at the receiver/control unit shall be distinctly different from alarm, supervisory, tamper, and initiating device trouble signals. It shall consist of an audible and visual signal which shall identify the affected transmitter.

92.5 The battery trouble status signal may be transmitted at the normal supervisory status report time of the transmitter. The audible annunciation of a battery trouble signal at the receiver/control unit may be delayed for a maximum period of 4 hours.

92.6 The audible signal of the receiver may be silenceable if provided with an automatic feature to reinstate the signal at intervals not exceeding 4 hours.

92.7 The trouble status signal shall persist at the receiver/control unit until the depleted battery has been replaced.

92.8 Any mode of failure of a nonrechargeable (primary) battery in an initiating device transmitter shall not affect any other initiating device transmitter.

93 Tamper Protection

93.1 Removal of a transmitter from its installed location or the removal of a cover exposing its battery shall cause immediate transmission of a signal to the receiver/control unit that will, in turn, result in an audible and visual trouble signal individually identifying the affected device when the system is in the disarmed condition. When the system is in the armed conditions, an alarm shall also be initiated. The audible signal of the receiver may be silenceable if provided with an automatic feature to reinstate the signal at intervals not exceeding 4 hours.

94 Protection From Interference

94.1 Reception of any unwanted (interfering) transmission by a repeater, or by the receiver/control unit for a continuous period of 20 seconds or more, that would inhibit any status change signaling within the system, shall result in an audible and visual trouble signal indication at the receiver/control unit when the system is in the disarmed condition. This indication shall identify the specific trouble condition (interfering signal) as well as each device affected (repeater or receiver/control unit, or both). When the system is in the armed condition, an alarm shall also be indicated.

95 Reference Level Determination

95.1 General

95.1.1 A transmitter/receiver combination shall operate for its intended signaling performance when tested in a configuration at minimum signal strength, measured at the receiver, as specified in the manufacturer's installation instructions.

95.1.2 The reference level test is not intended to determine the actual service communication range of a transmitter/receiver combination. Rather, this data is utilized as a reference level for the testing specified in Sections 96 – 103. The range determined during the ideal conditions of this test is not to be considered representative of the actual range within a building structure, which will probably be significantly less.

95.2 Method 1

95.2.1 The tests are to be conducted in an open, flat area characteristic of cleared, level terrain. Such test sites are to be:

a) Void of buildings, electrical lines, fences, trees, or the like;

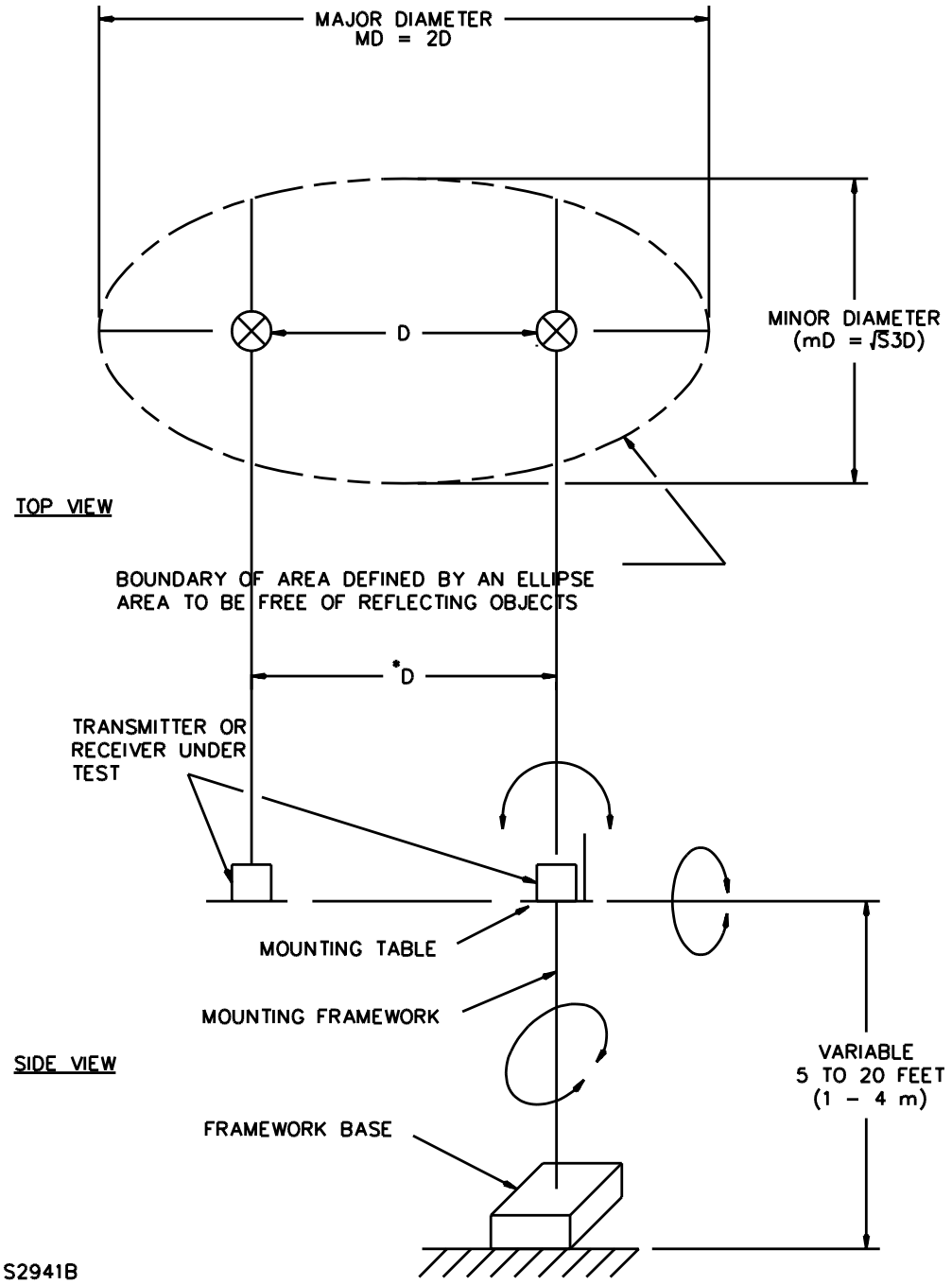
b) Free from underground cables, pipes, lines, or the like, except as required to supply and operate the equipment under test; and

c) Free of snow and water accumulations.

The ambient radio noise level and other undesired signals are to be sufficiently low (see Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electric Equipment in the Range of 10 kHz to 1 GHz, IEEE C63.4-1992) so as not to interfere with the measurements. Any large reflecting object, such as a metal fence or the like, is to be sufficiently far from the test site so as not to influence the test results. See Figure 95.1. In lieu of (b) a ground plane may be used. The ground plane is to cover the area required to be free of reflecting objects shown in Figure 95.1, or more. The ground plane is to be constructed of wire mesh with 1/4 to 1/2 inch (6.4 to 12.7 mm) openings or the equivalent.

95.2.1 revised March 17, 1998

Figure 95.1
Test site and equipment arrangement



D – For Method 1, manufacturer's maximum specified range, not less than 10 feet (3.05 m). Test site to comply with 95.2.1 within area defined by boundary in top view. If Method 2 is used, D = 3 m (9.84 feet).

NOTE – Signal strength is measured at receiver.

95.2.2 The equipment under test is to be positioned as intended in use on a wooden or other nonconducting table and framework that will permit the transmitter and receiver to be relatively oriented for worst-case communication. The mounting of the table on the framework is to be arranged so that the table surface can be adjusted to elevations of 5, 10, and 20 feet (5, 3, and 6 m). The number of elevations and relative positions may be reduced if the manufacturer's installation instructions provide specific limitations relating to orientation, as well as a method of testing as specified in 95.2.3.

95.2.3 Worst-case communication is that relative orientation between transmitter and receiver that results in the minimum field strength specified by the manufacturer, measured at the receiver by the appropriate installation aids and test equipment designated for that purpose.

95.2.4 The equipment and procedures specified in the installation instructions are to be used to establish test installation of the RF system.

95.2.5 A sample transmitter with fresh batteries and a sample receiver are to be placed on similar tables, as specified in 95.2.2, resulting in a separation at the maximum range specified for the transmitter/receiver combination.

95.2.6 A transmitter is to be remotely activated by a nonconductive mechanism that will not increase the effective radiating or receiving size of the antenna.

95.2.7 The transmitter or receiver is to be rotated through a 90-degree angle in each of the three orthogonal axes with either the transmitter or receiver fixed in position, and the level of the received signal is to be observed for worst-case communication. The test is to be conducted at the 5-, 10-, and 20-foot (-1.5-, 3-, and 6-m) elevations or as otherwise specified in 95.2.2.

95.2.8 The test is to be repeated with batteries depleted to the trouble level as specified in 92.1 – 92.4. For the purpose of this requirement, a depleted battery is defined as a battery that is at the level (terminal voltage under load) that results in a trouble signal as required in 92.1 – 92.4. For test purposes, a depleted battery may be replaced by a circuit arrangement that does not affect the RF characteristic (±6 decibels as measured at the receiver), but does simulate the characteristics of a depleted battery as specified in 92.2.

95.3 Method 2

95.3.1 This test may be alternately conducted in a 3-m (9.84-feet) site as described in:

a) Recommended Limits and Methods of Measurement of Radio Interference Characteristics of Sound and Television Broadcast Receivers and Associated Equipment, IEC Standard Publication CISPR 13:1990 or

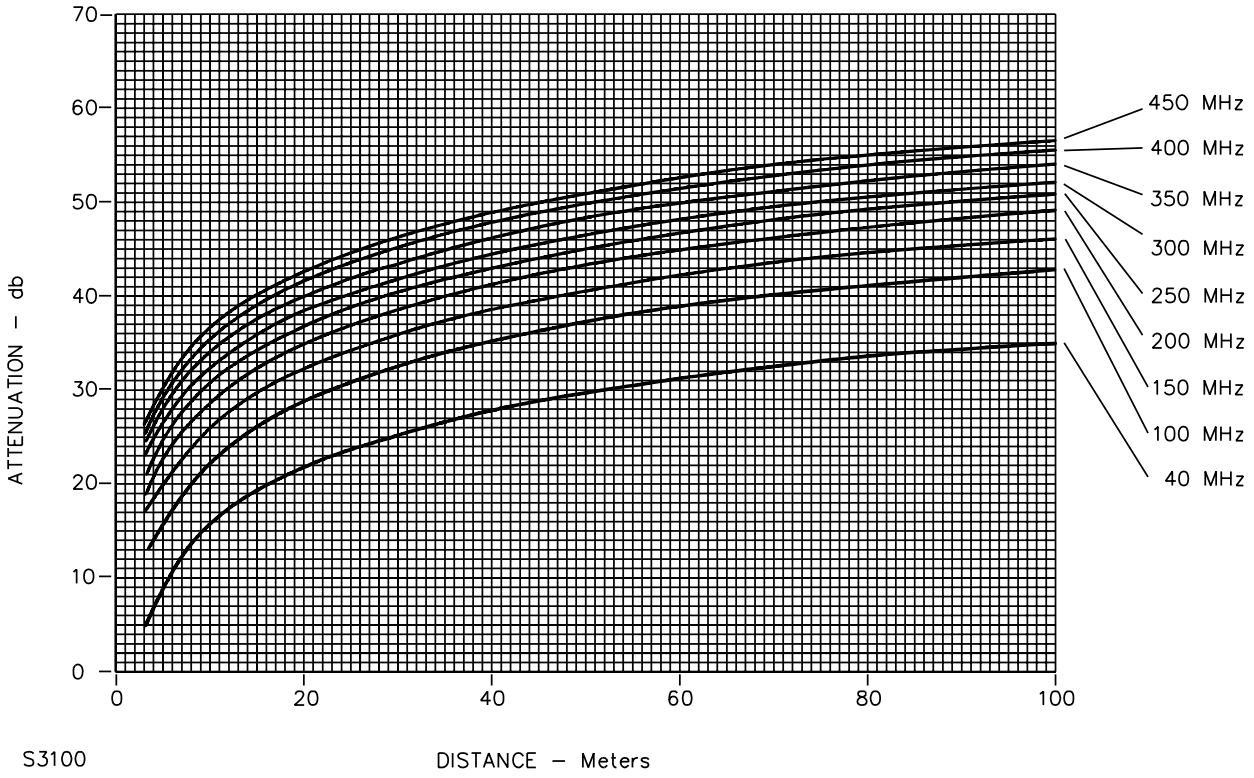
b) Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz, IEEE C63.4-1992.

If Method 2 is used, the test methodology described in 95.1.2 – 95.2.8 is to be followed except that the attenuation factors for receiver/transmitter specified in Figure 95.2 are to be utilized as scaling factors.

95.3.1 revised March 17, 1998

95.3.2 Details in applying Method 2 are specified in 95.3.3 – 95.3.5.

Figure 95.2
Signal attenuation curves



95.3.3 Attenuation is to be determined from the equation:

$$A = 20 \log_{10} D + 20 \log_{10} F_m - 36.6$$

in which:

A is the attenuation in decibels,

D is the manufacturer's specified range,

F_m is the operating frequency in megahertz, and

36.6 is the derived numerical value assuming that ground reflection is 4.7 dB average.

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95.3.4 The attenuation factor for a reference signal at 3 m (9.84 feet) is to be determined from the equation:

$$A_C = A_D - A_{3M}$$

in which:

A_C is the attenuation factor,

A_D is the attenuation at manufacturer's specified range, and

A_{3M} is the attenuation at 3-meter distance.

Table 95.1 specifies the attenuation factors, A_D, for absolute attenuation at the manufacturer's specified range and the attenuation relative to the 3-meter test distance, A_C.

95.3.5 Figure 95.2 depicts attenuation curves for signals at 40, 100, 150, 200, 250, 300, 350, 400, and 450 megahertz. The attenuation adheres to a slope of 20 decibels per decade at a given frequency.

95.3.6 The reference level is the measured signal level at 3 meters minus A_C.

Table 95.1
Signal attenuation values

Distance, meters	A_D Frequency									A_C
	40 MHz	100 MHz	150 MHz	200 MHz	250 MHz	300 MHz	350 MHz	400 MHz	450 MHz	
3	4.98	12.94	16.46	18.96	20.90	22.48	23.82	24.98	26.01	–
10	15.44	23.04	26.92	29.42	31.35	32.94	34.28	35.44	36.46	10.46
15	18.96	26.94	30.44	32.94	34.88	36.46	37.80	38.96	36.99	13.98
20	21.46	29.42	32.94	35.44	37.37	48.96	40.30	41.46	42.48	16.48
25	23.40	31.35	34.88	37.37	39.31	40.90	42.24	43.40	44.42	18.42
30	24.98	32.94	36.46	38.96	40.90	42.48	43.82	44.98	46.01	20.00
35	26.32	34.28	37.80	40.30	42.24	43.82	45.16	46.32	47.35	21.34
40	27.48	35.44	38.96	41.46	43.40	44.98	46.32	47.48	48.50	22.50
45	28.50	36.46	39.97	42.48	44.42	46.01	47.35	48.50	49.53	23.52
50	29.42	37.38	40.90	43.40	45.34	46.92	48.26	49.42	50.44	24.44
55	30.25	38.20	41.73	44.22	46.17	47.75	49.09	50.24	51.27	25.27
60	31.00	38.96	42.48	44.99	46.92	48.50	49.84	51.00	52.03	26.02
65	31.70	39.66	43.18	45.68	47.62	49.20	50.54	51.70	52.72	26.72
70	32.34	40.30	43.82	46.32	48.26	49.84	51.18	52.34	53.37	27.36
75	32.94	40.90	44.42	46.92	48.86	50.44	51.78	52.94	53.96	27.96
80	33.50	41.46	44.98	47.48	49.42	50.00	52.34	53.50	54.53	28.52
85	34.03	41.99	45.51	48.00	48.95	51.53	52.87	54.03	55.05	29.05
90	34.53	42.48	46.01	48.50	50.44	52.03	53.36	54.53	55.54	29.54
95	35.00	42.95	46.48	48.97	50.91	52.50	53.84	55.00	56.02	30.01
100	35.44	43.40	46.92	49.42	51.36	52.94	54.28	55.44	56.46	30.46

96 Interference Immunity

96.1 A receiver/transmitter combination at maximum range shall operate for its intended signaling performance in both a ″Radio Quiet″ and a ″Radio Noisy″ environment. See 96.2 and 96.3. Also see Error (Falsing) Rate, Section 100, and Throughput Rate, Section 101.

96.2 For the purpose of this requirement, a ″Radio Quiet″ environment is one in which the interference signal magnitude level is at least 20 decibels peak below the desired signal as determined by 95.2.2 within the frequency band of the signal, as measured at the receiver.

96.3 For the purpose of this requirement, a ″Radio Noisy″ environment is one in which the interference signal level is 10 – 20 decibels peak below the desired signal as determined by 95.2.2, as measured at the receiver. This condition is intended to test the receiver's ability to discriminate the desired signal from background noise under worst-case conditions.

96.4 A Radio Noisy environment is to be created by each of the sources specified in (a), (b), and (c), connected to modulate the amplitude of an RF oscillator at 100 percent. The signal strength is to be measured at the receiver with a spectrum analyzer or other acceptable instrument to determine that the signal intensity is within the parameters defined for a Noisy environment. The interference is to emanate from a tuned 1/2 wave dipole antenna, capable of 360 degrees rotation in order to vary the polarization.

a) A white noise generator[a] modulating an RF signal generator[b] in which the frequency is varied ±5 percent about the signaling frequency.

b) Variable frequency audio oscillator[c] varied between 20 hertz to 40 kilohertz, modulating an RF signal generator in which the frequency is varied ±5 percent about the:

1) Carrier frequency,

2) Image frequency, if applicable, and

3) Intermediate frequency (IF), if applicable.

c) A square wave generator[d] varied between 20 hertz to 40 kilohertz, modulating an RF signal generator in which the frequency is varied ±5 percent about the:

1) Carrier frequency,

2) Image frequency, if applicable, and

3) Intermediate frequency (IF), if applicable.

[a] General Radio, Model 1382, rated 20 – 50 kilohertz or the equivalent.

[b] Hewlett Packard, Model 8640B, with frequency doubler option or the equivalent.

[c] Hewlett Packard, Model 654A, signal generator modulating the RF signal generator (or the equivalent) or may utilize the variable audio oscillator option.

[d] Square wave generator to modulate the RF signaling generator. The output impedance of the square wave generator is to match the input impedance of the RF signal generator.

96.5 Each of the interference signals specified in 96.4 shall not cause false alarming; however, they may cause a jamming or a loss of transmitter indication. Operation of the receiver/transmitter combination shall comply with the requirements for the Error (Falsing) Rate, Section 100, and Throughput Rate, Section 101.

97 Frequency Selectivity

97.1 If a product utilizes multiple frequencies, a receiver shall not respond to any signal:

a) Having a signal strength equivalent to the most powerful system transmitter located at a distance of 32.8 feet (10 m) from the receiver and

b) Having a frequency shifted more than two working channel widths of the system, as measured between the manufacturer's rated upper and lower frequency limits of the receiver/transmitter combination.

For example, if the communication channel is 5 megahertz wide, the receiver shall ignore any signal with a similar band width, even one with identical coding, if the center frequency is shifted by more than 10 megahertz.

97.2 A receiver is to be connected to a source of rated supply and is to be positioned for intended use in a ″Radio Quiet″ environment.

97.3 A sample transmitter that is adjusted for receiver-acceptable information is to be tuned to a center frequency that is shifted from the receiver's tuned center frequency by twice the band width of the transmitter/receiver combination. The transmitter then is to be repeatedly activated as specified in 97.1, and the receiver shall not provide an output to any signal transmitted.

97.4 This test is to be conducted for frequencies above and below the receiver frequency, including at least ten additional frequencies randomly selected about the center frequency (0.5 MHz – 1.024 GHz) and outside the frequency as specified in 97.1.

97.5 The test is to be monitored by a spectrum analyzer or other acceptable instrument to verify transmitter output.

97.6 For test purposes, if the operating frequency or signal level, or the like, of a transmitter cannot be varied, the transmitter may be partially replaced by an RF signal generator or the entire transmitter assembly may be replaced by a combination of a programmable processor and an RF signal generator. The processor is to produce the base band signal which modulates the RF signal generator output, when similar signal levels are generated at the receiver.

98 Clash

98.1 The clash rate relative to normal status transmissions for each specific signal shall not exceed:

a) 0.0001, for fire signals.

b) 0.0002, for medical or panic signals.

c) 0.0005, for security signals.

d) 0.005, for other signals, not including the check-in signals required to comply with Inoperative Transmitter Reporting, Section 91.

98.2 For the purpose of these requirements, clash is a loss of alarm signal information at the receiver for a period greater than 90 seconds as a result of two or more transmitters being concurrently activated when only one is in an alarm mode so that their transmitted signals interfere with each other.

98.3 The calculated clash rate for any given system is a derivative of the:

a) Maximum number of transmitters (transmitters for neighboring systems are not to be considered),

b) Duration of individual transmission,

c) Transmission rate,

d) Coding scheme,

e) Error (falsing) rate, and

f) Prioritization.

When determining this rate for each type of signal noted in 98.1 (a) – (d), each specified factor is to be considered in the evaluation. The manufacturer shall provide a derivation of the rate. This derivation shall provide an explicit definition of the requirements for clash and shall describe all the assumptions and equations used in the derivation of the clash rate.

98.4 If an alarm signal and another signal, alarm or otherwise, are transmitted at precisely the same time, the signal received at the receiver shall:

a) Be correct for one of the two, or both, or

b) Not be accepted by the receiver as a correct signal.

99 Clash Error

99.1 A receiver shall demonstrate a zero clash error rate while subjected to the test conditions described in 99.3 – 99.5.

99.2 For the purpose of these requirements, clash error is defined as the misinterpretation by the receiver of two simultaneous or overlapping valid transmitter signals that result in the receiver locking-in and annunciating a third (false) signal.

99.3 The receiver is to be mounted in a position of intended use and energized from a source of rated supply. Two transmitters, energized from a rated source of supply or from a DC power supply in place in their nonrechargeable (primary) batteries, are to be placed in close proximity to the receiver and orientated such that the manufacturer's specified signal strength is present at the receiver. The address of each transmitter is to be set such that the logical ″or″ of the two addresses is a valid address recognized by the receiver.

99.4 One transmitter is then to be conditioned for continuous alarm transmission. The other transmitter is to be conditioned to transmit an alarm signal once every 2 seconds for a total of 100,000 transmissions.

99.5 The test described in 99.3 and 99.4 shall be repeated while one transmitter is conditioned for continuous alarm transmission and the other transmitter is conditioned to transmit a normal supervisory status signal once every 2 seconds for a total of 100,000 transmissions.

100 Error (Falsing) Rate

100.1 The transmitter/receiver shall comply with the following:

a) The communication between each transmitter and receiver shall involve a unique message for each signal status.

b) The communication message shall include information uniquely identifying each transmitter.

c) The communication message components that identify the individual transmitter shall permit at least 256 unique combinations. For larger systems, the number of combinations shall be increased so that the number of combinations available to the system is numerically equivalent

to eight times the maximum number of transmitters that may be used within the system. For example, if 50 transmitters are used, the system's capability shall provide at least 400 unique combinations.

100.2 When tested as described in 100.4 the transmitter/receiver shall comply with the specifications in Table 100.1.

Table 100.1
Error (falsing) rate test

Number of incorrect elements per message	Messages completed	Maximum number of incorrect messages accepted as valid
1	100,000	1
	1,000,000	2
2	100,000	0
	1,000,000	1
3	100,000	0
	1,000,000	0

100.3 For the purpose of these requirements, the error (falsing) rate is a measure of the ability of a receiver to discriminate between correct and incorrect transmission so that false or erroneous signals are not accepted by the receiver as valid status indications from the various transmitters in the system.

100.4 As a measure of compliance with 100.1, the error (falsing) rate of the receiver is to be determined by utilizing the test procedure described for reference level determination, see 95.1.2 – 95.2.8 except for the following:

a) Batteries depleted to the trouble signal level are to be installed in the transmitter. See 95.2.8 for depleted battery simulation.

b) The transmitter is to be physically oriented for ″worst-case″ signaling as determined during reference level determination. See 95.2.7.

c) A counter is to be connected to the transmitter to record the number of transmissions. The arrangement is not to interfere with the transmitter output.

d) The transmitter is to be conditioned for continuous transmissions:

1) 1,000,000 messages with one element incorrect, then

2) 1,000,000 messages with two elements incorrect, and finally

3) 1,000,000 messages with three elements incorrect.

See 97.6 for alternate transmitter configurations.

e) A counter is to be connected to the receiver that will record the number of incorrect messages accepted as valid messages by the receiver.

f) The test is to be continued until at least 1,000,000 messages are completed for each of the three conditions of incorrect transmission, except that if zero incorrect messages are accepted as valid after the first 100,000 messages, the test at that number of incorrect elements per message and any higher number of incorrect elements per message need not be conducted.

100.5 The test is to be conducted in both a ″Radio Quiet″ and ″Radio Noisy″ environment as described in Interference Immunity, Section 96.

101 Throughput Rate

101.1 The transmitter/receiver combination shall be structured so that alarm or emergency signals take precedence over all other signals. The prioritization may be achieved by extending the duration of the signal, repeating the alarm or emergency signal, or any other means that can be demonstrated to be equivalent. If multiple services are utilized on the same system, the priority levels of signals shall be:

a) Fire alarm,

b) Medical or panic alarm,

c) Security alarm,

d) Trouble and supervisory signals,

e) Other.

101.2 For the purpose of these requirements, the throughput rate is a measure of the ability of a receiver to accurately interpret and execute upon receipt of a correct signal in order to achieve a high degree of assurance that alarm or emergency signals are not lost.

101.3 The throughput rate of the receiver is to be determined by utilizing the test procedure described for the error (falsing) rate, 100.4 and 100.5, except that only correct signals of each type are to be transmitted. The test results shall comply with Table 101.1. The test may be conducted for 100,000 cycles rather than 1,000,000 if the test results comply with the 100,000 signals completed row in Table 101.1.

Table 101.1
Throughput rate test

Type of signal	Signals completed	Maximum number of missed signals in test conditions	
		Radio quiet	Radio noisy[a]
Fire	100,000[b]	4	24
	1,000,000	50	250
Medical or Panic	100,000[b]	9	48
	1,000,000	100	500
Security	100,000[b]	19	197
	1,000,000	200	1000
Other	100,000[b]	38	195
	1,000,000	400	2000

[a] See 101.4.
[b] See 101.3.

101.4 If the test results in the ″Radio Noisy″ environment comply with those corresponding missed signal specifications for the ″Radio Quiet″ environment in Table 101.1, the latter tests are waived and the unit is considered to comply with the requirements specified for ″Radio Quiet.″

102 Transmitter Stability Test

102.1 The intended performance of a transmitter shall not be degraded nor shall the output signal frequency vary beyond the rated receiver input frequency while the transmitter and receiver (and repeater if used) are exposed and tested under the following environmental conditions:

a) 0°C (32°F) for 3 hours.

b) 49°C (120°F) for 3 hours.

c) 85 ±5 percent relative humidity at 30 ±2°C (86 ±3.6°F) for 24 hours.

103 Transmitter Accelerated Aging Test

103.1 A transmitter shall operate for its intended signaling performance as specified in 102.1 after the conditioning described in 103.2.

103.2 The transmitter is to be exposed for 30 days to an ambient temperature of 70°C (158°F), followed by a stabilization period of 24 hours in an ambient temperature of 23°C (73.4°F). During the test, the unit is to be powered from either a separate power supply adjusted to the rated nominal battery voltage, or the battery if it is capable of maintaining nominal voltage for the test duration.

104 Installation Instructions and User Manual

104.1 The installation instructions and user manual shall include at least the following:

a) Specific and detailed installation limitations for RF equipment, such as building construction, possible effect of metallic bodies that may not be visible, specification of procedures, installation aids, and test equipment (by manufacturer and model number or the equivalent) needed to install the system as intended, and specific receiver-to-transmitter orientations;

b) The maximum separation (range) of the equipment, including indication that the manufacturer's specified range is for comparative purposes only and may be significantly reduced when the equipment is installed in a typical installation;

c) Instructions to test the system for operation upon completion of installation; and

d) Instructions to replace transmitter batteries yearly.

MANUFACTURING AND PRODUCTION LINE TESTS FOR HIGH-VOLTAGE PRODUCTS

105 General

105.1 The manufacturer shall provide the necessary production control, inspection and tests. The program shall include at least the tests in the Production Line Dielectric Voltage-Withstand Test, Section 106, and the Production Line Grounding Continuity Test, Section 107. A record shall be maintained of accepted police station connected burglar alarm units and their unit serial numbers or equivalent.

106 Production Line Dielectric Voltage-Withstand Test

106.1 Each unit rated at more than 30 volts AC rms (42.4 volts DC or AC peak) shall withstand, without breakdown, as a routine production-line test, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between high-voltage live parts and the enclosure, high-voltage live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be:

a) For a unit rated at 250 volts AC rms or less – either 1000 volts (1414 volts, if a DC potential is used) applied for 60 seconds or 1200 volts (1697 volts, if a DC potential is used) applied for 1 second.

b) For a unit rated at more than 250 volts – either 1000 volts plus twice the rated AC rms voltage (1414 volts plus 2.828 times the rated AC rms voltage, if a DC potential is used) applied for 60 seconds or 120 volts plus 2.4 times the rated voltage (1697 volts plus 3.394 times the rated AC rms voltage, if a DC potential is used) applied for 1 second.

106.2 If a product employs both high-voltage and low-voltage circuits, the test is to be conducted with the low-voltage circuit connected to the cabinet, chassis, or other dead metal part so that the potential applied between the high-voltage live parts and dead metal parts will simultaneously be applied between high-voltage live parts and low-voltage circuits.

106.3 A printed wiring assembly or other electronic circuit component that would be damaged by the application of, or would short-circuit, the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. A representative subassembly may be tested instead of an entire unit. Rectifier diodes in the power supply may be individually shunted before the test to avoid destroying them in the case of a malfunction elsewhere in the secondary circuits.

106.4 If the charging current through a capacitor or capacitor type filter connected across the line, or from line to earth ground, is sufficient to prevent maintenance of the specified AC test potential, the unit is to be tested using a DC test potential in accordance with 106.1.

106.5 A 500 volt-ampere or larger transformer, the output voltage of which can be varied, is to be used to determine compliance with 106.1. The requirement of a 500 volt-ampere or larger transformer can be waived if the high potential testing equipment used is such that it maintains the specified voltage at the unit during the test.

106.6 The test equipment is to include a visible indication of the application of the test potential and an audible or visible indication, or both, of breakdown. In the event of breakdown, manual reset of an external switch is required, or an automatic reject of the unit under test is to result. Other arrangements may be accepted if found to achieve the results contemplated.

107 Production Line Grounding Continuity Test

107.1 The manufacturer shall test each high-voltage product having a power supply cord to verify electrical continuity between the device and the grounding blade of the attachment plug. See Bonding for Grounding, Section 17.

107.2 This test is also required for permanently-connected units, or sections, or both, and for accessories of such units that derive high-voltage power by means of cord and plug connection.

107.3 An indicating device such as an ohmmeter, low-voltage battery- and buzzer-combination, or the like, may be employed in establishing compliance with these requirements.

107.4 If the initial investigation of the product determines that internal parts referred to in 17.1 are bonded to the frame and enclosure of the unit, a test that verifies the electrical continuity between the grounding blade of the supply and the frame or enclosure of the product is sufficient for establishing compliance with the requirement in 107.1.

MARKING

108 General

108.1 Except where otherwise indicated, a police station connected burglar alarm unit shall be plainly and permanently marked where it will be readily visible after installation, with the following information:

a) Manufacturer's or private labeler's name or identifying symbol.

b) Date of manufacture by day, week, month, or quarter and year, which may be abbreviated or in an established or otherwise acceptable code.

c) Model number or equivalent.

d) Electrical ratings:

1) AC Powered Units – Rated voltage; amperes, watts, or volt-amperes; and frequency.

2) Battery Powered Units – Rated voltage, and type and number of batteries to be used.

e) Mounting position if a product is intended to be mounted in a specific position.

f) Rating of fuse in each fuseholder which is required to comply with the requirements of this standard; located in close proximity to the fuseholder.

g) Reference to an installation wiring diagram, if one is not attached to the product, by drawing number and issue date. See 4.1 and 4.2.

h) For a primary or secondary battery, the recommended battery maintenance and replacement instructions, as well as any specific test instructions to determine its capacity. See 85.12.

i) For an end-of-line device, the name or trademark of the manufacturer and model number. This marking may be on a tag secured to the device.

j) For accessories other than the end-of-line devices, with the name or trademark of the manufacturer, model number, and electrical rating in volts, amperes or watts or volt-amperes, and frequency if separately powered.

k) For cord and plug-in transformer-connected products, the following or equivalent wording: ″Do Not Connect To A Receptacle Controlled By A Switch.″

l) For a combination product, identification with respect to its function.

m) Identification and function of lights, switches, meters, and the like, to be located adjacent to the component.

n) Information necessary for the operation of any manually operated part or the performance of a required test by the operator.

Exception No. 1: The marking in (d), (e), and (k), may be on a separate installation diagram, if so referenced on the product.

Exception No. 2: Markings covered in (b), (c), (d), (e), (g), and (k) may be marked on the inside of the unit if the marking is visible when the product is opened for servicing.

108.2 A marking to identify the application and signaling function of the product (local mercantile burglar alarm, mercantile safe and vault burglar alarm, bank safe and vault burglar alarm, standard line security, encrypted line security, or dual signal line transmission) shall be visible after installation. The marking may be located on the inside of the unit if the unit is opened when serviced.

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108.3 Wiring and mounting instructions shall be provided with each product. The instructions may be attached to the product or may be separate from the product if they are referenced in the marking attached to the product.

108.4 An installation wiring diagram shall be attached to the product or referenced in the product marking, and shall indicate the devices and circuits acceptable for connection, in the field, to the control unit.

108.5 A product intended for permanent connection to a wiring system other than a metal-enclosed system shall be marked to indicate the system(s) to which it is intended to be connected. The marking shall be located so that it will be visible when power connections are being made to the product.

108.6 If a manufacturer produces police station connected burglar alarm units at more than one factory, each unit shall have a distinctive marking to identify it as the product of a particular factory.

108.7 All markings shall be permanent. Markings affixed to a product shall be sufficiently durable to resist the deleterious effects of handling, cleaning agents, and the like, anticipated in the intended use. See the Marking Permanency Tests, Section 109.

108.8 If a warning notice is marked on a product, the letter height shall not be less than 7/64 inch (2.8 mm) for a single word, such as ″DANGER,″ ″WARNING,″ or ″CAUTION,″ and not less than 3/32 inch (2.4 mm) for the remainder of the notice.

108.9 If the design of a product is such that replacing lamps or fuses or resetting circuit breakers exposes persons to the risk of unintentional contact with enclosed high-voltage live parts, the product shall be marked to indicate that such servicing is to be performed only while the equipment is electrically disconnected from the branch-circuit supply. The marking shall be adjacent to every door or cover that requires opening for such servicing.

108.10 There shall be legible and durable marking for each fuse required to comply with the requirements in this standard indicating the ampere rating (and voltage rating if more than 125 volts) of the fuse to be used for replacement. The marking is to be located so that it is obvious to which fuse or fuseholder the marking applies. In addition, the following prominent marking shall be provided (a single marking is acceptable for a group of fuses) where it will be clearly visible to persons replacing fuses: ″WARNING – For Continued Protection Against the Risk of Fire, Replace Only With Same Type and Rating of Fuse.″

108.11 If a separate grounding conductor is necessary as part of the installation wiring for a product, a marking shall be included on the product to indicate this fact, and shall refer to the installation instructions unless complete instructions are attached to the appropriate product.

108.12 If the wires in a terminal box or compartment of a product intended for power-supply connections may attain a temperature higher than 60°C during the Temperature Test, Section 41, the unit shall be marked ″For supply connections, use wires rated for at least ____°C,″ or with an equivalent statement at or near the point at which the supply connections are to be made. The temperature to be used in this marking shall be as indicated in Table 108.1. The marking shall be located so that it will be readily visible during and after installation of the product.

Table 108.1
Temperature for marking

Temperature attained in terminal box or compartment, °C	(°F)	Temperature in marking, °C
61 – 75	142 – 167	75
76 – 90	168 – 194	90

108.13 Additional marking requirements are specified in 13.5.

109 Marking Permanency Tests

109.1 A marking plate secured by cement or adhesive shall comply with the applicable portions of the Standard for Marking and Labeling Systems, UL 969.

OUTDOOR USE EQUIPMENT

ASSEMBLY

110 General

110.1 A product or section of a product intended for installation where it will be exposed to the effects of weather shall comply with the requirements of the preceding sections of this standard and shall, in addition, comply with the following requirements.

111 Construction

111.1 General

111.1.1 An enclosure exposed to weather shall be constructed to prevent the wetting of live parts as indicated in 111.1.2 and 111.1.3.

111.1.2 To determine compliance with 111.1.1, a complete assembly, with supply conduit connections but without pipe thread compounds, is to be subjected to the Rain Test, Section 115.

111.1.3 Enclosures for electrical components shall have provision for drainage if knockouts or unthreaded openings in the enclosure are employed.

111.1.4 Cabinets and enclosures shall have a thickness of not less than 0.032 inch (0.81 mm) if uncoated sheet steel, not less than 0.034 inch (0.86 mm) if zinc coated sheet steel, and not less than 0.045 inch (1.14 mm) if copper, brass, or aluminum, except as stated in 111.1.5. See 7.6.3.

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111.1.5 Enclosures thinner than indicated in 111.1.4 and that comply with Table 7.2 or 7.3, whichever applies, are acceptable if they are protected by an outer cabinet. Sheet steel cabinets and enclosures employing panels consisting of more than one sheet of lesser thickness than specified in 111.1.4 may be used if the construction is found to be equivalent in all respects, including mechanical strength and corrosion resistance, to a single sheet of steel of the thicknesses stated in 111.1.4.

111.2 Corrosion protection

111.2.1 Sheet steel cabinets and electrical enclosures exposed to the effects of weather shall be protected against corrosion as specified in 111.2.2 and as determined by the applicable Corrosion Tests, Section 119.

111.2.2 Outer cabinets that protect wiring or enclosed current-carrying parts; and inside enclosures that protect current-carrying parts shall be protected in accordance with:

a) 111.2.4 if they are not less than 0.053 inch (1.35 mm) in thickness or

b) 111.2.5 if of lesser thickness.

Outer cabinets that are the sole enclosure of current-carrying parts shall be protected in accordance with 111.2.5. See also 111.2.6. (Minimum metal thicknesses are specified in Table 7.2.)

111.2.3 The requirements in 111.2.1, 111.2.2, 111.2.4, 111.2.5, and 111.2.6 are not applicable to a metal part, such as a decorative grille, which is not required for compliance with the requirements in this standard.

111.2.4 If referenced by 111.2.2, one of the following coatings shall be used:

a) Hot-dipped, mill-galvanized sheet steel conforming with the coating Designation G60 or A60 in Table I of ASTM Designation A525-91b, but not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM Designation. The weight of zinc coating may be determined by any method; however, in case of question the weight of coating shall be established in accordance with the Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles, A90-81(1991). An A60 (alloyed) coating shall also comply with the requirements in 111.2.7.

b) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.01041 mm) on each surface with a minimum thickness of 0.00034 inch (0.00864 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 118. An annealed coating shall also comply with the requirements in 111.2.7.

c) A coating providing protection equivalent to a G60 hot-dipped, mill-galvanized coating. See 111.2.7.

111.2.5 If referenced by 111.2.2, one of the following coatings shall be used:

a) Hot-dipped, mill-galvanized sheet steel conforming with the coating Designation G90 in Table I of Specifications for Sheet Steel, Zinc-Coated (Galvanized) by Hot-Dip Process, General Requirements, ASTM A525-91b, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM Designation. The weight of zinc coating may be determined by any method; however, in case of question the weight of coating shall be established in accordance with the Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles, ASTM A90-81(1991).

b) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.01549 mm) on each surface with a minimum thickness of 0.00054 inch (0.01372 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 118. An annealed coating shall also comply with the requirements in 111.2.7.

c) A cadmium coating not less than 0.001 inch (0.0254 mm) thick on both surfaces. The thickness of coating shall be established in accordance with the Metallic Coating Thickness Test, Section 118.

111.2.6 With reference to 111.2.4 and 111.2.5, other finishes, including paints, special metallic finishes, and combinations of the two may be accepted when comparative tests with galvanized-sheet steel (without annealing, wiping or other surface treatment) complying with the requirements of 111.2.4(a) or 111.2.5(a), as applicable, indicate that they provide equivalent protection. Among the factors to be taken into consideration when judging the suitability of such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide (CO_2-SO_2) air mixtures, moist hydrogen sulphide (H_2S) air mixtures, and ultraviolet light and water. The applicable corrosion exposure tests specified in the Corrosion Tests, Section 119, and the Ultraviolet Light and Water Exposure Test, Section 120, are to be used.

111.2.7 A hot-dipped, mill-galvanized A60 (alloyed) coating or an annealed zinc coating on metal that is bent or similarly formed after annealing and that is not otherwise required to be painted, shall be painted in the bent or formed area if the bending or forming process damages the zinc coating, except that such areas on the inside surface of a cabinet or enclosure into which water does not enter during the Rain Test, Section 115, need not be painted.

111.2.8 If flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification, the zinc coating is considered to be damaged. Sheared or cut edges and punched holes are not considered to be formed, but extruded and rolled edges and holes shall comply with the requirements in 111.2.7.

111.2.9 Nonferrous cabinets and enclosures may be employed without special corrosion protection. The thickness of the material is to be judged on the basis of its strength and rigidity.

111.2.10 Nonmetallic cabinets and enclosures shall comply with the requirements of the Mechanical Strength Tests for Enclosures, Section 50, after being subjected to the Ultraviolet Light and Water Exposure Test, Section 120.

111.2.11 If gaskets are required to seal electrical enclosures against the entrance of rain and condensate, they shall be held in place by mechanical fasteners or adhesives, except as indicated in 111.2.12, and shall comply with the performance requirements of the Accelerated Aging Tests for Gaskets, Sealing Compounds, and Adhesives, Section 121. Gaskets shall be neoprene, rubber, or thermoplastic. Other materials may be used if they have equivalent properties.

111.2.12 If a gasket is prevented from displacement either by its location, placement, or by other components in the enclosure when the cover is removed, and if the gasket is re-engaged in the intended manner when the cover is replaced, the gasket is not required to be held by mechanical fasteners or adhesives.

112 Field-Wiring Connections

112.1 Openings provided for high-voltage field-wiring connections shall be acceptable for connection of conduit and shall not be less than 7/8 inch (22.2 mm) in diameter. The openings shall be threaded unless they are located below the lowest uninsulated live part within the enclosure, or their location prevents drainage into the enclosure along the outside surface of a field-supplied wireway. Threaded holes for conduit shall be provided with a conduit end stop unless the thread is tapered.

113 Internal Wiring

113.1 The internal wiring shall be constructed and assembled so as to reduce the risk of electric shock as a result of exposure to weather.

113.2 For the wiring between electrical component enclosures, Type RW wire or appliance wiring material of the type indicated in Group A of Table 113.1, and having moisture resistant properties equivalent to Type RW wire is considered acceptable when enclosed in rigid or flexible-steel conduit, electrical or metallic tubing, or moisture-resistant nonmetallic sheathed cable. Wiring materials of the type indicated in Group A of Table 113.1, installed in either rigid conduit or electrical metallic tubing with raintight fittings, or in liquid-tight flexible metal conduit with suitable fittings, are acceptable. The use of cords or appliance wiring material as described in Group B of Table 113.1, is also acceptable. Bushings, where used, are to be nonabsorptive.

113.3 The entrance of a wiring assembly into an electrical enclosure (such as conduit connections) shall be constructed to exclude water. See 111.1.2.

113.4 Wires not acceptable for use in wet locations and cords shall be routed and supported so that they will not be immersed in water.

Table 113.1
Typical wiring materials

Group	Type of wire, cord, or cable	Wire size		Insulation thickness	
		No. AWG	mm^2	inch	mm
A	AC, ACL, ACT, RF-2, FF-2, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, RUH, RUW, T, THW, XHHW, MTW, THW-MTW, THWN, PF, PGF, PFF, PGFF, TW, or thermoplastic appliance wiring material, with insulation thicknesses shown at the right corresponding to wire sizes indicated	10 and smaller	5.3	2/64	0.8
		8	8.4	3/64	1.2
		6	13.3	4/64	1.6
		4	21.2	4/64	1.6
		3	26.7	4/64	1.6
		2	33.6	4/64	1.6
		1	42.4	5/64	2.0
		1/0	54.0	5/64	2.0
		2/0	67.0	5/64	2.0
		3/0	85.0	5/64	2.0
		4/0	107.2	5/64	2.0
B	SO, ST, SPT-3, SJO, SJT, or appliance wiring material[a] having thermoplastic or neoprene insulation, with insulation thicknesses shown at the right corresponding to the wire sizes indicated	18	0.82	4/64	1.6
		16	1.3	4/64	1.6
		14	2.1	5/64	2.0
		12	3.3	5/64	2.0
		10	5.3	5/64	2.0
		8	8.4	6/64	2.4
		6	13.3	8/64	3.2
		4	21.2	9/64	3.6
		2	33.6	10/64	4.0

[a] Appliance wiring material acceptable for refrigeration use.

114 Components, Electrical Insulating Material

114.1 Nonabsorptive electrical insulation shall be used in the construction of electrical components. Untreated fiber is an example of a material that shall not be used. Vulcanized fiber on electrical components is acceptable if components are not wetted as a result of the Rain Test, Section 115.

PERFORMANCE

115 Rain Test

115.1 The section of the product exposed to weather shall withstand a rain exposure for 1 hour, and shall comply with the requirements in 115.8 at the conclusion of the test.

115.2 Electrical components are to be energized during this test, and the product is to be tested under the conditions most likely to cause the entrance of water into or onto electrical components. It may be necessary to operate the product under various modes of operation or to de-energize the product if more water entry could result. In any case, each exposure is to be for 1 hour and if more than one exposure is required, the product is to be prepared for test as indicated in 115.4 before repeating the test.

115.3 Field-wiring connections are to be made in accordance with the wiring method specified for the product. Openings intended to terminate conduit are to be sealed. Openings intended for the entry of a conductor or conductors for a low-voltage or power limited circuit are not to be sealed unless seals are provided as part of the product.

115.4 Prior to the initial or repeated rain exposure, the product is to be examined to determine that all electrical parts, including motor windings, are not wetted and that there is no accumulation of water within the enclosures of electrical parts prior to rain exposure.

115.5 With reference to the requirements in 115.2, drying of the product prior to the second or subsequent exposure is not required if, without such preparation, the product complies with the requirement of 115.6.

115.6 After each rain exposure, the product shall have an insulation resistance between live parts and dead metal parts of not less than 50,000 ohms. The insulation resistance is to be measured within 1 minute after application of the voltage obtained by using the method described in 115.7, or equivalent means, and a DC circuit. After measurement of the insulation resistance, the complete unit is to be subjected to the Dielectric Voltage-Withstand Test, Section 40.

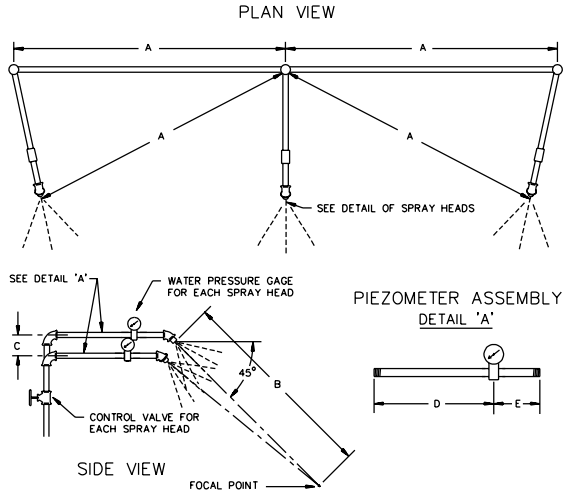
115.7 Insulation resistance is to be measured by means of a voltmeter having an internal resistance of 30,000 ohms and using a 250-volt direct-current circuit.

115.8 The rain test apparatus is to consist of three spray heads mounted in a water supply rack as shown in Figure 115.1. Spray heads are to be constructed as shown in Figure 115.2. The water pressure is to be maintained at 5 psi (34.5 kPa) at each spray head. The product is to be brought into the focal area of the three spray heads in such position and under such conditions that the greatest quantity of water will enter the unit. The spray is to be directed at an angle of 45 degrees from the vertical toward the louvers or other openings closest to live parts.

115.9 There shall not be entrance of water into enclosures above the lowest electrical component other than insulated wire, nor shall live parts be wetted.

Exception: Water may enter an enclosure above the lowest electrical component if the point of entrance is not in proximity to live parts and live parts are not wetted during the rain exposure.

Figure 115.1
Rain-test spray head piping



Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

116 Dust Test

116.1 The intended operation of a police station connected burglar alarm unit intended to be used outdoors shall not be impaired by an accumulation of dust.

116.2 To determine compliance with the requirement in 116.1, a de-energized sample in its intended mounting position is to be placed in an air tight chamber having an internal volume of at least 3 cubic feet (0.03 m^3), and approximately 2 ounces (0.06 kg) of cement dust, maintained at 20 – 50 percent relative humidity and capable of passing through a 200 mesh screen, is to be circulated for 1 hour by means of compressed air or a blower so as to completely envelop the sample in the chamber. The air flow is to be maintained at an air velocity of approximately 50 feet per minute (0.25 m/s).

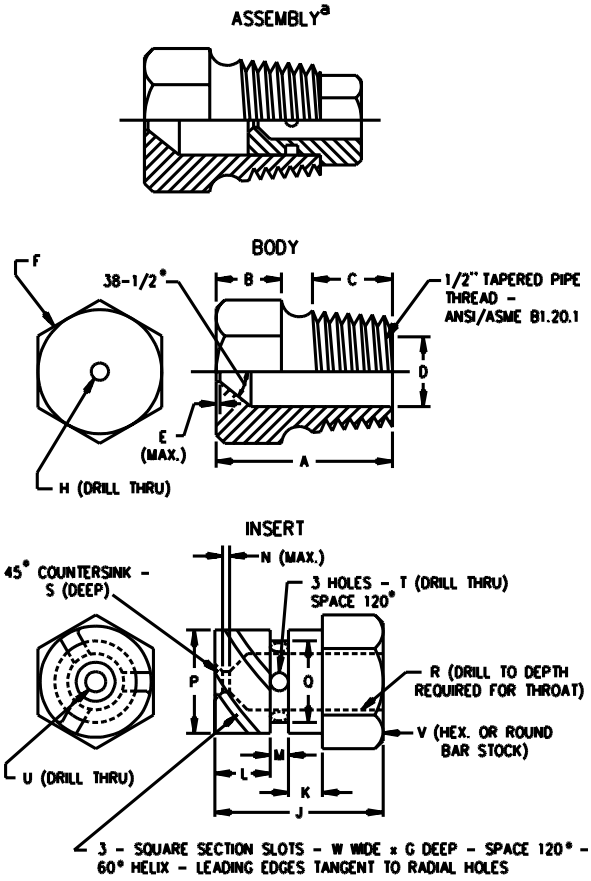
116.3 Following the exposure to dust, the product is to be removed carefully, mounted in its intended position, energized from a source of supply in accordance with 25.3.1, and shall comply with the requirements of the Normal Operation Test, Section 26.

117 Variable Ambient Test

117.1 A police station connected burglar alarm unit intended for outdoor use shall function as intended at the test voltage, with its related equipment connected, and at ambient temperatures of minus 35 and plus 66°C (minus 31 and plus 151°F).

117.2 The exposure to either of the temperatures specified in 117.1 shall be 4 hours or more.

Figure 115.2
Rain-test spray head



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No.9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional - To serve as a wrench grip.

RT100E

118 Metallic Coating Thickness Test

118.1 This test is to be used to determine coating thickness as described in 111.2.4(b) and 111.2.5 (b) and (c).

118.2 The solution to be used for this test is to be made from distilled water and is to contain 200 grams per liter of reagent grade chromic acid (CrO_3) and 50 grams per liter of reagent grade concentrated sulfuric acid (H_2SO_4). The latter is equivalent to 27 milliliters per liter of reagent grade concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4.

118.3 The test solution is to be contained in a glass vessel, such as a separatory funnel, with the outlet equipped with a stopcock and a capillary tube of approximately 0.025 inch (0.64 mm) inside bore and 5.5 inches (140 mm) long. The lower end of the capillary tube is to be tapered to form a tip, the drops from which are to be approximately 0.05 milliliter each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that, when the stopcock is open, the rate of dropping is 100 ±5 drops per minute. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping.

118.4 The sample and the test solution shall be kept in the test room long enough to acquire the room temperature, which shall be noted and recorded. The test is to be conducted at a room temperature of 70 to 90°F (21 to 32°C).

118.5 Each sample is to be cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed completely by means of a suitable solvent. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. The cleaned surface to be tested shall not be contacted.

118.6 The sample to be tested is to be supported 0.7 – 1.0 inch (17.8 – 25.4 mm) below the orifice. The surface to be tested should be inclined approximately 45 degrees from horizontal, so that the drops of solution strike the point to be tested and run off.

118.7 After cleaning, the sample to be tested is to be placed under the orifice. The stopcock is to be opened and the time in seconds is to be measured with a stopwatch until the dropping solution dissolves the metallic coating and exposes the base metal. The end point is the first appearance of the base metal recognizable by the change in color at that point.

118.8 Each sample of a test lot is to be subjected to the test at three or more points on the inside surface, excluding cut, stenciled, and threaded surfaces, and at an equal number of points on the outside surface, at places where the metallic coating may be expected to be the thinnest. On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation may have thin coatings.

118.9 To calculate the thickness of the coating being tested, the thickness factor appropriate for the temperature at which the test was conducted is to be selected from Table 118.1 and then multiplied by the time in seconds required to expose base metal as determined in 118.6.

Table 118.1
Coating thickness factors

Temperature,		Thickness factors, 0.00001 inches (0.0003 mm) per second	
°F	(°C)	Cadmium platings	Zinc platings
70	21.1	1.331	0.980
71	21.7	1.340	0.990
72	22.2	1.352	1.000
73	22.8	1.362	1.010
74	23.3	1.372	1.015
75	23.9	1.383	1.025
76	24.4	1.395	1.033
77	25.0	1.405	1.042
78	25.6	1.416	1.050
79	26.1	1.427	1.060
80	26.7	1.438	1.070
81	27.2	1.450	1.080
82	27.8	1.460	1.085
83	28.3	1.470	1.095
84	28.9	1.480	1.100
85	29.4	1.490	1.110
86	30.0	1.501	1.120
87	30.6	1.513	1.130
88	31.1	1.524	1.141
89	31.7	1.534	1.150
90	32.2	1.546	1.160

119 Corrosion Tests

119.1 General

119.1.1 In order to determine the equivalency of other finishes to galvanized sheet steel, see 111.2.1, a set of three samples of G60 or G90 (as applicable) hot-dipped, mill-galvanized sheet steel and a set of three samples of the alternately-finished sheet steel both are to be subjected to the applicable tests specified in 119.1.3 – 119.4.1 and the Ultraviolet Light and Water Exposure Test, Section 120. The tests specified in 119.1.3 – 119.4.1 are to be conducted until equivalency or nonequivalency is established.

119.1.2 The samples are to be of identical size. Prior to exposure, one sample of each set is to have its coating inscribed with a narrow groove that exposes the base metal. A separate set of six samples is to be used for each test.

119.1.3 During the test exposures the samples are to be supported in plastic racks at a 15 degree angle from vertical.

119.2 Salt spray (fog)

119.2.1 The apparatus for salt-spray (fog) testing is to consist of a fog chamber having inside dimensions of 48 by 30 by 36 inches (1.2 by 0.8 by 0.9 m), a salt solution reservoir, a supply of conditioned compressed air, a dispersion tower that produces a salt fog, constructed in accordance with Salt Spray (Fog) Testing, ASTM B117-90, sample supports, provision for heating the chamber, and necessary means of control.

119.2.2 The dispersion tower is to be located in the center of the chamber and is to be supplied with humidified air at a pressure of 17 to 19 psi (117 to 131 kPa) so that the salt solution is aspirated as a fine mist or fog into the interior of the chamber.

119.2.3 The salt solution is to consist of 5 percent by weight of common salt [sodium chloride (NaCl)] and distilled water. The pH value of the collected solution is to lie between 6.7 and 7.2, at a specific gravity of 1.0255 to 1.0400 and a temperature of 25°C (77°F). The temperature of the chamber is to be maintained at 35 plus 1 or minus 2°C (95 plus 2 or minus 3°F) throughout the test.

119.2.4 Drops of solution that accumulate on the ceiling or cover of the chamber are to be diverted from dropping on the samples, and drops of solution that fall from samples are not to be recirculated but are to be removed by a drain located at the bottom of the chamber.

119.3 Moist hydrogen sulfide (H_2S) – air mixture

119.3.1 The test samples are to be supported in a closed chamber having openings for gas inlet and outlet.

119.3.2 Hydrogen sulfide (H_2S) is to be supplied to the test chamber from a commercial cylinder containing this gas under pressure. An amount of hydrogen sulfide equivalent to 1 percent of the volume of the test chamber is to be introduced into the chamber each working day, but prior to the introduction of the gases the gas remaining from the previous day is to be purged from the chamber. A small amount of water is to be maintained at the bottom of the chamber for humidity. The chamber is to be maintained at room temperature during the test period.

119.4 Moist carbon dioxide (CO_2) – sulphur dioxide (SO_2) – air mixture

119.4.1 The test samples are to be supported as intended in service in a closed chamber having openings for gas inlet and outlet. A water jacket and thermostatically controlled heater are to be provided in order to maintain a temperature of 35 ±1°C (95 ±2°F).

119.4.2 Sulfur dioxide (SO_2) and carbon dioxide (CO_2) are to be supplied to the test chamber from commercial cylinders containing these gases under pressure. An amount of sulfur dioxide equivalent to 1 percent of the volume of the test chamber, and an equal volume of carbon dioxide are to be introduced into the chamber each working day, but prior to the introduction of the gases the gas remaining from the previous day is to be purged from the chamber. A small amount of water is to be maintained at the bottom of the chamber for humidity.

120 Ultraviolet Light and Water Exposure Test

120.1 Polymeric materials and rubber compounds subject to direct exposure to outdoor environments shall comply with the requirements of 120.2 – 120.4, without evidence of deterioration to the extent that intended performance of the product may be impaired.

120.2 The samples are to be subjected to ultraviolet light (carbon arc) and water spray for 1000 hours as described in 120.3 and 120.4.

120.3 The apparatus used is to provide ultraviolet light from two enclosed carbon arcs formed between vertical electrodes 1/2 inch (12.7 mm) in diameter, located at the center of a revolvable vertical metal cylinder that is 31 inches (787 mm) in diameter and 17-3/4 inches (451 mm) high. The arcs are to operate with approximately 15 to 17 amperes AC and the potential across the arcs is to be approximately 120 to 145 volts. The arcs are to be enclosed by clear globes of No. 9200-PX Pyrex glass.

120.4 The samples are to be mounted vertically on the inside of the cylinder, facing the arcs, and the cylinder is to be rotated around the arcs at one revolution per minute. A system of nozzles is to be provided so that each sample is sprayed in turn with water as the cylinder revolves. During each 20 minute operating cycle, each sample is to be exposed only to light from the arcs for 17 minutes and to both water spray and light for 3 minutes. The temperature within the cylinder while the apparatus is in operation is to be 63 ±5°C (145 ±9°F).

121 Accelerated Aging Tests for Gaskets, Sealing Compounds, and Adhesives

121.1 The requirements in 121.2 – 121.7 apply to gaskets and sealing compounds required for electrical enclosures as determined during the Rain Test, Section 115. The requirement in 121.8 applies to adhesives required to secure such gaskets to enclosures or covers.

121.2 Neoprene or rubber compounds, except foamed materials, shall have physical properties as indicated in Table 121.1 before and after accelerated aging under the conditions indicated in Table 121.2. The temperature indicated in Table 121.2 corresponds to the maximum temperature rise measured on the gasket during the Temperature Test, Section 41.

Table 121.1
Physical properties for gaskets

Physical property	Neoprene or rubber compound		Polyvinyl-chloride materials	
	Before test	After test	Before test	After test
Recovery – Maximum set when 1 inch (25.4 mm) gage marks are stretched to 2-1/2 inches (63.5 mm), held for 2 minutes and measured 2 minutes after release.	1/4 inch (6.4 mm)	–	Not specified	
Elongation – Minimum increase in distance between 1 inch (25.4 mm) gage marks at break.	250 percent (1 – 3-1/2 inches) (25.4 – 88.9 mm)	65 percent of original	250 percent (1 – 3-1/2 inches) (25.4 – 88.9 mm)	75 percent of original
Tensile Strength – Minimum force at breaking point.	850 psi (5.86 MPa)	75 percent of original	1200 psi (8.27 MPa)	90 percent of original

121.3 Foamed neoprene or rubber compounds are to be subjected to accelerated aging under the conditions indicated in Table 121.2. The components shall not harden or otherwise deteriorate to a degree that will affect their sealing properties.

121.4 Thermoplastic materials are to be subjected to accelerated aging under the conditions indicated in Table 121.2. Thermoplastic material shall not deform, melt, or otherwise deteriorate to the extent that its sealing properties are affected. Solid polyvinyl chloride gasket material shall have physical properties as indicated in Table 121.1 before and after the accelerated aging.

Table 121.2
Accelerated aging condition

Table 121.2 revised July 31, 1997

Measured temperature rise, °C	Measured temperature rise, (°F)	Material	Test program
35	63	Rubber or neoprene	70 hours in an air-circulated oven at 100° ±1°C (212° ±1.8°F)
35	63	Thermoplastic	168 hours in an air-circulated oven at 87° ±1°C (189° ±1.8°F)
50	90	Rubber or neoprene	168 hours in an air-circulated oven at 100° ±1°C (212° ±1.8°F)
50	90	Thermoplastic	240 hours in an air-circulated oven at 100° ±1°C (212° ±1.8°F)
55	99	Rubber, neoprene, or thermoplastic	168 hours in an air-circulated oven at 113° ±1°C (235.4° ±1.8°F)
65	117	Rubber or neoprene	240 hours in an air-circulated oven at 121° ±1°C (249.8° ±1.8°F)
65	117	Thermoplastic	168 hours at 121° ±1°C (249.8° ±1.8°F) or 1440 hours at 97° ±1°C (206° ±1.8°F) in an air-circulated oven
80	144	Rubber, neoprene, or thermoplastic	168 hours in an air-circulated oven at 136° ±1°C (276.8° ±1.8°F)

121.5 Tensile strength and elongation are to be determined using the test methods and apparatus described in the Tests for Rubber Properties in Tension, ASTM D412-87.

121.6 Gaskets of materials other than those mentioned in 121.2 – 121.4 shall be nonabsorptive and shall provide resistance to aging and temperatures equivalent to the materials mentioned in 121.2 – 121.4.

121.7 Sealing compounds are to be applied to the surface they are intended to seal. A representative sample of the surface with the sealing compound applied is to be subjected to accelerated aging under the conditions indicated in Table 121.2 for air-circulated oven exposure. The sealing compound shall not melt, become brittle, or otherwise deteriorate to the extent that its sealing properties are affected, as determined by comparing an aged sample to an unaged sample.

121.8 If gaskets are secured by adhesives, samples of the gasket adhesive and mounting surface are to be subjected to accelerated aging under the conditions indicated in Table 121.2 for air-circulated oven exposure and immersion in distilled water for 72 hours. The force required to peel the gasket from its mounting surface after the specified exposures shall not be less than 50 percent of the value determined for ″as-received″ samples, and in no case shall the force be less than 2 pounds (8.82 N) for each inch (25.4 mm) of gasket width.

121.8 revised July 31, 1997

MARKING

122 General

122.1 A nameplate on outdoor use equipment is to be of corrosion resistant material.

122.2 Among the factors taken into consideration when evaluating the acceptability of a nameplate attached by adhesives, is the resistance of the nameplate to defacement or removal at temperatures and in atmospheres to which it may be subjected under conditions of use. See the Marking Permanency Tests, Section 109.

122.3 A unit or accessory that has been investigated and determined to be acceptable for outdoor use shall be legibly marked with the wording ″Outdoor Use″ or similar wording on or near the nameplate.

ACCESSORY EQUIPMENT

123 General

123.1 The requirements in 123.2 – 126.3 are, in addition to the provisions in the preceding sections of this standard, applicable to accessory equipment.

123.2 For the purposes of these requirements, accessory equipment is defined as equipment designed to be attached or added to a police station connected burglar alarm unit by qualified service personnel and of such size that it may be marked for identification by a catalog number or its equivalent. Accessory equipment usually is dependent upon a basic unit of a system for mechanical support, or electrical input, or both, and may or may not, by itself, perform a complete function.

123.3 The term ″accessory equipment″ is not intended to cover individual items of circuitry or components that, for reasons of improving, modifying, or repairing the product, are added to the product subsequent to the time of initial assembly, and that lose their identity in the process.

124 Construction

124.1 Accessory equipment shall be constructed so that it can be added to a product without creating a risk of fire, electric shock, or injury to persons.

124.2 The installation of accessory equipment shall:

a) Permit the mechanical positioning to be accomplished by common hand tools, such as screwdrivers, hexagonal wrenches, and the like, or by special tools provided by the manufacturer as a part of the installation kit, and

b) Permit the electrical connections to be accomplished by making use, wherever possible, of existing terminals and connections in the product.

124.3 The requirement in 124.2 does not preclude the addition, removal, or rerouting of insulated conductors to accomplish the desired installation as long as the alterations in the wiring:

a) Can be accomplished by reference to instructions and

b) Do not require the use of makeshift or substitute parts not used in the basic construction of the product.

124.4 All wiring provided as a part of an item of accessory equipment or related to its installation shall be rated for use at the highest voltage and temperature encountered in the area in which the wire is to be installed.

125 Performance (Installation) Test

125.1 Each piece of accessory equipment shall be installed in its intended manner on the product for which it is intended by following the instructions provided by the manufacturer. See 126.3.

125.2 With the item of accessory equipment installed and operating, the police station connected burglar alarm unit shall comply with the requirements of this standard.

126 Markings

126.1 Each item of accessory equipment shall be marked with the manufacturer's name and a distinctive catalog number or equivalent identification.

126.2 If the accessory equipment is supplied with power from a separate branch-circuit source of supply, it shall be marked with an input rating and related information as required in Marking, General, Section 108.

126.3 Each item of accessory equipment shall have instructions that provide a step-by-step outline of the mechanical and electrical alterations necessary for intended installation and operation. The instructions shall be provided either on or packed with each item of accessory equipment or shall be included in the service manual.

Appendix A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard − UL Standard Designation

Attachment Plugs and Receptacles – UL 498
Capacitors – UL 810
Capacitors for Radio- and Television-Type Appliances, Across-the-Line, Antenna-Coupling and Line-by-Pass – UL 1414
Class 2 Power Units – UL 1310
Cord Sets and Power-Supply Cords – UL 817
Fittings for Conduit and Outlet Boxes – UL 514B
Flexible Cord and Fixture Wire – UL 62
Fuseholders – UL 512
Locks, Key – UL 437
Marking and Labeling Systems – UL 969
Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures – UL 489
Outlet Boxes, Flush-Device Boxes, and Covers, Nonmetallic – UL 514C
Outlet Boxes, Metallic – UL 514A
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94
Polymeric Materials – Use In Electrical Equipment Evaluations – UL 746C
Printed-Wiring Boards – UL 796
Signal Appliances, Audible – UL 464
Switches, Clock-Operated – UL 917
Switches, General-Use Snap – UL 20
Switches, Special-Use – UL 1054
Tape, Polyvinyl Chloride, Polyethylene, and Rubber Insulating – UL 510
Terminal Blocks – UL 1059
Terminals, Electrical Quick-Connect – UL 310
Transformers, Specialty – UL 506
Tubing, Extruded Insulating – UL 224
Wire Connectors and Soldering Lugs for Use With Copper Conductors – UL 486A
Wires and Cables, Rubber-Insulated – UL 44
Wires and Cables, Thermoplastic-Insulated – UL 83

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Superseded requirements for
the Standard for
Police Station Connected Burglar Alarm Units and Systems

UL 365, Third Edition

The requirements shown are the current requirements that have been superseded by requirements in revisions issued for this Standard. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

1.4 Police station connected mercantile burglar-alarm systems are designated as Grade AA or Grade A, and are designated as to their acceptability for use either on mercantile premises or on mercantile safes and vaults.

1.5 Police station connected bank burglar-alarm systems are designated as Grade AA, Grade A, Grade BB, or Grade B and are for use on bank safes and vaults.

1.7 Regardless of the grade of equipment and service determined by this standard, devices installed on individual properties are further classified as to extent of protection at each location. Rules covering installation and classification (of extent) of alarm equipment at individual locations are published in the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681, which should be consulted by burglar-alarm installers.

3.3 ALARM SOUNDING DEVICE HOUSING – A housing, or the equivalent, that is used to protect an alarm sounding device from being silenced by physical attack. There are three versions:

a) Outside – A housing intended to be located outside of the protected area. See 68.4 and 68.10.

b) Inside/Visible – A housing intended to be located within the protected area where it can be seen by an intruder. See 68.8 and 68.10.

c) Inside/Concealed – An alarm sounding device without an additional alarm housing intended to be located within the protected area where it will be concealed from being seen by an intruder or it is outside of easy reach. See 68.9 and 68.11.

Exception: These requirements are for alarm sounding device housings used in mercantile burglar alarm systems. For requirements for alarm sounding device housings used in bank alarm systems, see the Attack Test, Section 76; Bank Safe and Vault Alarm Systems, Grade A Requirements, Tamper Protection, Section 78; and Grade B Requirements, Tamper Protection, Section 81.

43.4.2 Input/output circuits are to be tested as specified in 43.4.3 – 43.4.5. The signaling equipment connected to these circuits shall:

a) Not false alarm,

b) Operate as intended, and

c) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit

when subjected to transient voltage pulses as described in 43.4.3. Supplemental information stored within the unit need not be retained.

57.1 Basic line security is provided if the connection between the protected premises and the police station or central station complies with the requirements in either 54.2 or 55.9.

58.1 Intermediate line security is considered to be provided if the connection between the protected premises and the police station or central station complies with the requirements in 58.2 and 58.3.

58.2 The alarm transmission line between the police station or central station and the protected premises shall be supervised so as to detect automatically, and within 6 minutes, a compromise attempt by methods of resistance substitution, potential substitution, or any other single compromise attempt.

58.3 With reference to the requirements in 58.2, detection of a single compromise attempt means that the connecting line is provided with more than one kind of supervision.

59.1 The connecting line between the police station or central station and the protected premises shall be supervised so as to detect automatically, and within 6 minutes, a compromise attempt by any of the methods described in 59.3.

Exception: During the disarmed period, the time to detect a compromise may be longer than 6 minutes, but shall not be longer than 60 minutes, if (a) – (d) are met.

a) The method used to detect and report a compromise attempt shall be applied at a statistically random rate. The minimum time of a random check for a compromise attempt shall be 5 minutes or less.

b) The system shall check for substitution of premises equipment when it is armed. If substitution has occurred the system shall provide an alarm signal to the police station or central station. The check shall be made by some automatic means, such as an identifying code built into read only memory, rather than relying on some action or acknowledgment by the user that a return signal has been received from the police station or central station, indicating that the police station or central station has received a normal closing signal.

c) A protection system that uses this method of checking for a compromise attempt shall use two methods of signal transmission to the police station or central station. Each method of signal transmission shall monitor the other and if either method of signal transmission becomes unable to transmit to the police station or central station, a signal shall be sent by the other, informing the police station or central station of the condition.

d) An alarm signal shall be sent to the police station or central station over both methods of signal transmission. Only one of the transmission methods need comply with the line security requirements. The other shall comply with the requirements of one of the methods of signal transmission of this standard.

63.1 Alarm units shall comply with the applicable requirements for construction and performance in this standard and shall, in addition, comply with the requirements in Mercantile Premises Alarm Systems, Grade A Requirements, Circuit and Operation, Section 64, and Maintenance, Section 65.

66.1.1 These tests are to be conducted as required to verify compliance with the requirements for Mercantile Premises Alarm Systems, Grade A Requirements, Tamper Protection, Section 68.

67.1 A product complying with the requirements of Grade A Requirements, Tamper Protection, Section 68, shall resist the attack specified in Grade A Requirements, the Attack Tests, Section 66, for the length of time required to transmit the off premises signal to the alarm receiving location specified in 1.8.

67.3 If an attack against a control unit to silence the local alarm sounding device can prevent the complete transmission of a signal to the off premises receiving location, the attack resistance time shall be as follows:

a) For a transmitter system, the complete transmission of at least three complete code rounds. If the number of pulses in each round affects the length of time required to transmit the round, an average length of transmission shall be used to determine the attack time. A unit that can be set for 111 – 999 shall use the code 555 or 456.

b) For a digital alarm communicator transmitter complying with the requirements for the Standard for Digital Alarm Communicator Units and Systems, UL 1635, sufficient time to allow the transmitter to contact its digital alarm communicator receiver, transmit an acceptable signal, and receive a shut down signal, assuming that contact is made with the receiver on the first attempt. The slowest transmission time is to be used. A seven digit number is to be used assuming that the receiver is in the same area code. The transmission shall be over a local public telephone system. Ten transmissions shall be made and the average time to complete the transmission shall be the required attack resistance time.

c) For a one-way radio system, sufficient time to allow the radio to make contact with its receiver and deliver a complete alarm signal.

d) For a two-way radio system that does not comply with the multiplex requirements of the Standard for Central-Station Burglar-Alarm Units, UL 1610, sufficient time for the transmitter to contact its receiver and deliver a complete alarm signal.

Exception: For (b), the manufacturer may specify the slowest transmission format suitable for use in an alarm system installed in accordance with the requirements of the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681.

68.8 An inside/visible alarm housing (see 3.3), shall be equivalent in strength to a 0.053 inch (1.53 mm) thick sheet steel enclosure having a steel baffle plate over all louvers or direct sounding openings. Opening the outer door or cover of the housing shall result in an alarm signal when the alarm system is set for duty.

68.9 An inside/concealed audible alarm sounding device (see 3.3) is not required to be in a protective housing.

68.10 The alarm housings described in 68.4 and 68.8 shall be provided with an opening or knockout for the connection of conduit or electrical metallic tubing in the mounting surface of the housing that is to be used for the conductors used to supply power to the alarm sounding device. The opening or knockout in the housing described in 68.4 shall only be accessible when the cover of the inner housing or lining is removed.

Exception: Such an opening is not required if the power supply for the alarm sounding device is located within the alarm housing.

68.11 The audible alarm sounding device of 68.9 shall provide for the connection of conduit or electrical metallic tubing or shall provide for mounting to an electrical back box that will provide for such connection.

69.1 Grade AA systems shall comply with requirements for Grade A in Sections 63 – 68 and High Line Security, Section 59.

70.1 Grade A systems for mercantile safes or vaults shall comply with the requirements for Grade A police station connected burglar alarms for mercantile premises, or shall provide equivalent protection, and shall comply with the requirements in Mercantile Safe and Vault Alarm Systems, Grade A Requirements, Circuit and Operation, Section 71. See also 60.2.

72.1 Grade AA systems shall comply with the requirements for Grade A in Mercantile Safe and Vault Alarm Systems, Grade A Requirements, General, Section 70, and Circuit and Operation, Section 71, and High Line Security, Section 59.

73.1 Grades A and B police station connected bank safe and vault burglar alarm units shall comply with requirements specified in Grade A in Mercantile Safe and Vault Alarm Systems, Grade A Requirements, General, Section 70, and Circuit and Operation, Section 71; and with the requirements in Bank Safe and Vault Alarm Systems, Common Requirements for Grades A and B, Circuit and Operation, Section 74, and Maintenance, Section 75.

76.5 The measuring instruments and tools used in the attack tests described in 78.3 and 81.2 shall include not more than four multimeters, jumper wires with clips or needle point probes, wire cutters, wire strippers, needle point pliers, and knives.

77.1 Grade A alarm systems for bank safes and vaults shall comply with the requirements specified in Sections 73 – 76, and the following requirements in Bank Safe and Vault Alarm Systems, Grade A Requirements, Tamper Protection, Section 78, and Circuit and Operation, Section 79.

80.1 Grade B bank safe and vault alarm systems shall comply with the requirements specified in Sections 73 – 76, and the requirements in Bank Safe and Vault Alarm Systems, Grade B Requirements, Tamper Protection, Section 81, and Circuit and Operation, Section 82.

81.1 The alarm housing shall be at least equal in strength and protection to a 0.123 inch (3.12 mm) sheet steel enclosure with an electrically connected lining completely covering the interior of the housing. The housing protection shall be such that it will resist for a period of 4 minutes all attempts to stop the alarm by use of the tools specified in 76.1.

81.2 The cable connecting the safe or vault with the alarm sounding device shall have a system of balanced electrical circuits arranged to resist an attack on the cable by a person familiar with burglar alarms in general and using the measuring instruments and tools specified in 76.5.

82.1 Supervisory equipment shall be provided for indicating or testing all sources of electrical power.

82.2 A key, switch, or button shall be provided to permit the user to test the operation of the outside alarm and its controlling devices.

83.1 Grade AA systems shall comply with common requirements for Grades A and B in Sections 73 – 76, Grade A requirements in Sections 77 – 79, and High Line Security, Section 59.

83.2 Grade BB systems shall comply with common requirements for Grades A and B in Sections 73 – 76, Grade B requirements in Sections 80 – 82, and High Line Security, Section 59.

108.2 A marking to identify the function of the product shall be permanently marked and visible after installation. The marking may be located on the inside of the unit, if the unit is opened when serviced.

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Subject 1023(365, 864, 985, 1610)
(In reply, refer to Subject 1023)

333 Pfingsten Road
Northbrook, IL 60062
January 26, 2001

TO: **Industry Advisory Conference of UL for Burglary Protection Systems and Services**
Industry Advisory Conference of UL for Burglary Protection Equipment
Burglary Protection Council of Underwriters Laboratories Inc.
Subscribers to UL's Standards Service for:
Household Burglar-Alarm System Units,
Police Station Connected Burglar Alarm Units and Systems,
Control Units for Fire Protective Signaling Systems,
Household Fire Warning System Units, and
Central-Station Burglar-Alarm Units
Subscribers to UL's Listing Service for:
Central Station Alarm Units (AMCX),
Local Alarm Units (AOTX),
Police Station Alarm Units (APAW),
Household Burglar Alarm System Units (NBSX),
Control Units, System (UOJZ), and
Control Units and Accessories-Household System Type (UTOU)

SUBJECT: **New Classification Service for Products Evaluated Under ANSI/SIA CP-01-2000, Control Panel Standard – Features for False Alarm Reduction**

Underwriters Laboratories Inc. (UL) is now accepting submittals for product evaluations under the Security Industry Association's (SIA's) ANSI/SIA CP-01-2000, Control Panel Standard – Features for False Alarm Reduction. Products found to comply with the requirements in ANSI/SIA CP-01-2000 will be eligible to bear a complementary UL Classification marking.

The ANSI/SIA CP-01-2000 standard includes performance and installation instruction requirements for alarm system control panels and their associated arming and disarming devices which are intended to reduce false alarms. These requirements address false alarms caused by alarm system users, alarm initiating devices and those caused by power failures. ANSI/SIA CP-01-2000 was developed by the SIA with input from interested members of industry including UL.

In order to be eligible for UL's new Classification Service, the alarm system must be:

(1) Listed with a local sounding device,

(2) Listed with provision for off premise transmission of alarm signals, and

(3) UL Listed under at least one of the following product categories:

- Central Station Alarm Units (AMCX).
- Local Alarm Units (AOTX).
- Police Station Alarm Units (APAW).

- Household Burglar Alarm System Units (NBSX).
- Control Units, System (UOJZ).
- Control Units and Accessories-Household System Type (UTOU).

Compliance with ANSI/SIA CP-01-2000 will be noted under the product's main Listing category in the Automotive, Burglary Protection & Mechanical Equipment and/or Fire Protection Equipment Directory. The product's Listing Mark will also bear the text:

"ALSO CLASSIFIED BY Underwriters Laboratories Inc.® IN ACCORDANCE WITH ANSI/SIA CP-01-2000 CONTROL PANEL STANDARD FEATURES FOR FALSE ALARM REDUCTION"

Companies interested in submitting products under this Classification Service or obtaining information regarding this new Classification Service should contact the Engineering Services staff at the UL office where they normally conduct business.

This bulletin should be kept with your copy of the standard.

Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix A of this bulletin regarding designated responsibility for the subject product categories.

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APPENDIX A

DESIGNATED RESPONSIBILITY FOR UL PRODUCT CATEGORIES

AMCX – CENTRAL STATION ALARM UNITS
AOTX – LOCAL ALARM UNITS
APAW – POLICE STATION ALARM UNITS
NBSX – HOUSEHOLD BURGLAR ALARM SYSTEM UNITS
UOJZ – CONTROL UNITS, SYSTEM
UTOU – CONTROL UNITS AND ACCESSORIES-HOUSEHOLD SYSTEM TYPE

The individuals shown in the following tables are involved with the investigation of products covered under the subject categories. The Primary Designated Engineer (shown in UPPERCASE letters) coordinates the establishment and uniform interpretation of UL requirements applicable to the product categories. The Designated Engineers (shown in lowercase letters) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding the interpretation of the requirements proposed in this bulletin or any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

The Industry Advisory Conference (IAC) Chairman for the subject categories is Isaac Papier at UL's Northbrook office. The IAC Chairman oversees the significant interpretations made by the Primary Designated Engineer and arbitrates any differences regarding interpretation of UL requirements.

CCN	Office/Subsidiary	Responsible Engineer	Extension
AMCX, AOTX, APAW, NBSX, UTOU	Melville	Al Gengler	22562
	Northbrook	J.E. LESNIAK	42163
	Santa Clara	Michael Fung	32158

CCN	Office/Subsidiary	Responsible Engineer	Extension
UOJZ	Melville	Al Gengler	22562
	Northbrook	LAWRENCE SHUDAK	42791
	Santa Clara	Michael Fung	32158

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UL 681

ISBN 1-7629-0353-8

Installation and Classification of Burglar and Holdup Alarm Systems

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681

Thirteenth Edition, Dated February 26, 1999

Revisions: This Standard contains revisions through and including January 19, 2001.

UL is in the process of converting its Standards for Safety to the Standard Generalized Markup Language (SGML), and implementing an SGML compliant document management and publishing system. SGML - an international standard (ISO 8879-1986) - is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Significant benefits that will result from UL's use of SGML and these new systems include increased productivity, reduced turnaround times, and data and information consistency, reusability, shareability, and portability. However, the fonts, pagination, and general formatting of UL's new electronic publishing system differ from that of UL's previous publishing system. Consequently, when revision pages are issued for a Standard with the new publishing system, these differences may result in the printing of pages on which no requirements have been changed - these additional pages result from relocation of text due to repagination and reformatting of the Standard with the new publishing system.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The new and/or revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated February 25, 2000. The bulletin(s) is now obsolete and may be discarded.

The revisions dated January 19, 2001 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

UL will attempt to answer support requests concerning electronic versions of its Standards. However, this support service is offered on a reasonable efforts basis only, and UL may not be able to resolve every support request. UL supports the electronic versions of its Standards only if they are used under the conditions and operating systems for which it is intended. UL's support policies may change from time-to-time without notification.

UL reserves the right to change the format, presentation, file types and formats, delivery methods and formats, and the like of both its printed and electronic Standards without prior notice.

Purchasers of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgement (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

If a single-user version electronic Standard was purchased, one copy of this Standard may be stored on the hard disk of a single personal computer, or on a single LAN file-server or the permanent storage device of a multiple-user computer in such a manner that this Standard may only be accessed by one user at a time and for which there is no possibility of multiple concurrent access.

If a multiple-user version electronic Standard was purchased, one copy of the Standard may be stored on a single LAN file-server, or on the permanent storage device of a multiple-user computer, or on an Intranet server. The number of concurrent users shall not exceed the number of users authorized.

Electronic Standards are intended for on-line use, such as for viewing the requirements of a Standard, conducting a word search, and the like. Only one copy of the Standard may be printed from each single-user version of an electronic Standard. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of an electronic Standard. Because of differences in the computer/software/printer setup used by UL and those of electronic Standards purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-3	January 19, 2001
4	February 26, 1999
5-7	January 19, 2001
8-9	February 26, 1999
10-12B	January 19, 2001
13-16	February 26, 1999
17-18B	January 19, 2001
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47-48	February 26, 1999
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C1-C2	February 26, 1999

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FEBRUARY 26, 1999
(Title Page Reprinted: January 19, 2001)

1

UL 681

Standard for Installation and Classification of Burglar and Holdup Alarm Systems

The first through the sixth editions were titled Installation, Classification, and Certification of Burglar-Alarm Systems.

The seventh through the eleventh editions were titled Installation and Classification of Mercantile and Bank Burglar-Alarm Systems.

First Edition – October, 1941
Second Edition – January, 1947
Third Edition – September, 1949
Fourth Edition – April, 1953
Fifth Edition – February, 1959
Sixth Edition – June, 1965
Seventh Edition – October, 1971
Eighth Edition – June, 1972
Ninth Edition – October, 1977
Tenth Edition – December, 1984
Eleventh Edition – July, 1991
Twelfth Edition – June, 1994

Thirteenth Edition

February 26, 1999

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

The Department of Defense (DoD) has adopted UL 681 on January 2, 1992. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

ISBN 1-7629-0353-8

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements provide criteria for the installation of protective wiring and devices for burglar alarm systems covering premises, stockrooms, closed areas, safes, vaults, night depositories, automated teller machines, and other security containers. The amount of alarm protection installed in a system is designated as extent of protection.

1.2 Burglar-alarm systems are classified by type of system. The types of systems covered by these requirements include central station, mercantile, bank, proprietary, and national industrial security systems. Requirements for residential burglar systems are covered in the Standard for Installation and Classification of Residential Burglar Alarm Systems, UL 1641.

1.3 These requirements also cover the installation of holdup alarm initiating devices used to send holdup or duress signals to an off premises location.

1.4 These systems employ Class 2 remote-control and signal circuits as defined by Article 725 of the National Electrical Code, ANSI/NFPA 70.

1.5 The requirements assume that standard telephone operating practices are acceptable for leased or other lines connecting to a police or central station as defined by Article 800 of the National Electrical Code, ANSI/NFPA 70.

1.6 A central station burglar alarm system shall transmit signals to a central station operated by the alarm signal company and complying with the Standard for Central-Station Alarm Services, UL 827.

1.7 A bank or mercantile burglar alarm system that provides signal transmission to a remote location shall transmit the signals to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

1.8 A proprietary burglar alarm system shall transmit signals to a proprietary central supervising station operated by the alarm signal company and complying with the Standard for Proprietary Burglar Alarm Units and Systems, UL 1076.

1.9 An alarm service that is new or different from that covered in this standard shall be evaluated using the appropriate additional service requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A service that conflicts with the specific service provisions in this standard shall not be judged to comply with this standard. Where appropriate, the revision of service requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2.1 Units of measurement

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

2.1.1 revised January 19, 2001

2.2 Components

2.2.1 All detection devices, including floor traps, intrusion detection devices, holdup alarm initiating stations, and similar devices; power supplies, relays, sounding devices (alarm, trouble, warning), cellular telephone communicator units, code transmitters, digital alarm communicator transmitters, one-way and two-way radio units, and other auxiliary devices; interconnecting wire; and protective wiring in excess of that required shall be equivalent to devices and material required for the application.

2.2.2 The requirement specified in 2.2.1 applies to the protection of a separate building area or floor outside of the premise covered and to additional protection within the premises that is in excess of the protection required. Such protection shall be connected in the circuit so that shunting or tampering will not defeat the protection of the primary area.

2.2.3 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.

2.2.4 To permit entry into or exit from mercantile systems, a shunting device or timer may be employed. When an external key-activated switch is used, it shall be trapped against removal.

2.2.5 Each burglar alarm system shall be provided with a complete physical boundary. See 3.7.

2.3 Undated references

2.3.1 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.

3 Glossary

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

3.2 ALARM SOUNDING DEVICE – An audible signal appliance (bell, horn, siren, or speaker) that is used to signal unauthorized entry into a protected area and which complies with the requirements for an alarm sounding device in the Standard for Police Station Connected Burglar Alarm Units and Systems, UL 365.

3.3 ALARM SOUNDING DEVICE HOUSING – A housing, or an equivalent enclosure, that complies with the applicable requirements in the Standard for Police Station Connected Burglar Alarm Units and Systems, UL 365. See Alarm Sounding Devices, Section 21.

a) For MERCANTILE SYSTEMS – A housing equivalent enclosure used to provide attack resistance for an alarm sounding device that is mounted outside of the protected area.

b) For BANK SYSTEMS – A housing, or the equivalent, used to provide attack resistance for an alarm sounding device that is mounted outside of the protected area.

3.3 revised January 19, 2001

3.4 APPROVED GSA CONTAINER – A security container that conforms to federal specifications and bears a GSA ″Test Certification Label″ attesting to the security capabilities of the container and integral combination lock.

3.5 APPROVED VAULT – An assembly of brick, concrete, tile or other masonry material which has been constructed in accordance with the construction requirements in ″National Industrial Security Program Operation Manual (NISPOM)″ DOD 5220.22-M. This vault must also have a GSA approved door, frame and combination lock.

3.5 revised January 19, 2001

3.6 AUTOMATED TELLER MACHINE (ATM) – An unattended machine available to the public that will dispense cash, and may also accept deposits or perform other banking functions, or both, when accessed by an authorized user. The cash and deposits are protected by a security container.

3.7 BOUNDARY, PHYSICAL – A barrier such as a wall, premises or ceiling, floor, partition, window, wire and mesh screening (22.4.1) or door enclosing an alarm system. An opening that is covered with protective wiring such as an alarm screen is also considered to have a physical boundary.

3.8 CABLE, ELECTRICALLY PROTECTED – Installation wiring with both the positive and negative polarities of the protection circuit surrounding the wiring.

3.9 CABLE, EMBEDDED – PROTECTIVE WIRING installed in a monolithic concrete, or equivalent, structure at the time of construction.

3.10 CIRCUIT, DOUBLE – Protective wiring of opposite polarities, applied and arranged ″one and three″ or ″one and four.″ In the ″one and three″ arrangement, alternate protective conductors are of opposite polarity; in the ″one and four″ arrangement, the first and fourth conductors are one polarity and the second and third are the other.

3.11 CIRCUIT, SINGLE – Protective wiring of a single polarity.

3.12 CLOSED AREA – An enclosed area meeting the construction requirement in the ″National Industrial Security Program Operation Manual (NISPOM)″ DOD 5220.22-M.

3.12 revised January 19, 2001

3.13 CONNECTOR – A device installed in a burglar alarm system that is intended to join various parts of protective circuit devices and installation wiring and which complies with the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634.

3.14 CONTACT – A device complying with the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634 that is installed on a movable opening and that, when actuated, initiates an alarm condition. A contact provides partial protection, see 3.27.

3.15 GROOVED STRIPPING – Wooden strips grooved to accept fine wire, secured to a surface or across an opening to be protected.

3.16 INTRUSION DETECTOR – One or more unit assemblies of electrical components that are intended to detect the presence, movement, sound, or other activity of an intruder.

3.17 LACING – A circuit of Fine wire or foil applied to a door or similar surface in continuous parallel strips, a maximum of 4 inches (102 mm) center to center and mechanically protected by covering. Also see 3.43.

3.18 MAINTENANCE – Required inspections and tests at prescribed intervals that are performed to keep the burglar alarm system and all installed equipment in a fully operative condition. See 3.31 and Service and Maintenance, Section 24.

3.19 MOTION DETECTOR – A special form of an intrusion detector that is intended to detect the movement of an intruder.

3.20 NIGHT DEPOSITORY OR NIGHT SAFE – A safe located within a building and connected by a metal chute or equivalent to a depository head on the outside of the building wall to permit deposits after hours. See 3.29.

3.21 OPENING – A point at which entry can be gained through an aperture of manhole size without cutting or tearing down any part of the building structure. An opening can be fixed or movable and may singly or in combination be nailed, bolted, screwed, welded, barred shut, or boarded-over. When secured by screws, the screws shall be nonremovable. See 11.1.2 or 22.1.2

3.22 OPENING, ACCESSIBLE – An opening that does not comply with the requirements for an inaccessible opening.

3.23 OPENING, INACCESSIBLE – An opening:

a) More than 18 feet (5.5 m) above either the ground or the roof of an adjoining building;

b) More than 14 feet (4.3 m) from a directly or diagonally opposite window, fire escape, or roof; or

c) More than 3 feet (0.9 m) from an opening, fire escape, ladder, and the like, that is in or projecting from the same or adjacent wall and leads to other premises. See Figures 22.1 – 22.5.

3.24 OPENING, MANHOLE SIZE – An opening with a clear cross-section area of 96 square inches (619 cm^2) or more, and with the smallest dimension exceeding 6 inches (152 mm).

3.25 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.

3.26 PROTECTION, COMPLETE – Protective wiring or intrusion detection units installed to protect an opening (fixed or movable), a wall, a floor, a ceiling, or surface. A movable opening shall include the installation of contacts.

3.27 PROTECTION, PARTIAL – Contacts installed on a movable opening.

3.28 ROOF HATCH – A covered and secured opening that allows access to the roof of a building. May be secured by a thermal link that will open the hatch in the event of a fire and allow the venting of smoke and heat.

3.29 SAFE – An iron or steel, or equivalent, container that has its door(s) equipped with a combination lock.

3.30 SCREEN – A fully framed assembly of grooved-wood dowels having fine wire secured in the grooves. Polymeric material or insect screening may be used to support the fine wire and polymeric or metal may be used for the frame and cross members. The entire assembly shall comply with the Standard for Linings and Screens for Use with Burglar-Alarm Systems, UL 606.

3.31 SERVICE – Inspection, testing and repair of alarm equipment or a system to restore to proper operating condition. See 3.18 and Service and Maintenance, Section 24.

3.32 SERVICE CENTER – A location that may be separate from the alarm service company's main business location providing alarm investigator (where required), installation, maintenance, and repair service to systems served by the company. If keys for protected premises are required, they are retained at the service center. The service center is to keep maintenance records for the systems that it serves unless the records can be accessed from another location.

3.33 SERVICE PERSON – A person(s) from an alarm service company that provides service and maintenance for the alarm equipment that forms an alarm system.

3.34 SERVICE VEHICLE – A vehicle used to provide alarm investigator (where required), installation, maintenance, and repair service to systems served by the company.

3.35 SHOWCASE WINDOW – A Structure of clear glass or other glazing material that forms a part of the perimeter of the premises and is used to display or store merchandise or other material.

3.36 SHOW WINDOW – A fixed window constructed of clear or opaque glazing material.

3.37 STOCK CABINET – A fully enclosed container that is used for the display or storage of materials, goods, records, or the like.

3.38 STOCKROOM – A room with a complete physical boundary that is used for the storage of materials, goods, records, or the like.

3.39 STREET OR HIGHWAY, PUBLIC – A street or highway that is accessible by the public for vehicular traffic.

3.40 SWITCH (CONTACT) – A device complying with the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634, and which is intended for use in protective circuits to supervise doors, windows, hatches, vents, trapdoors, and the like to initiate an alarm condition when activated. A switch is usually referred to as a contact. See 3.14.

3.41 TRANSOM – A fixed or movable window constructed of glazing material, either transparent, translucent, or opaque, mounted in a frame and located immediately above a door or show window.

3.42 TRAP – A conductor or device fastened between a building structure and a screen, stripping, foiled or wired panel, fan, removable air conditioner or heating unit, or similar device so that the two cannot be separated without initiating an alarm.

3.43 VAULT – A room constructed of iron, steel, brick, concrete, stone, tile, or similar masonry units permanently built into or assembled on the premises and having an iron or steel, or equivalent, door and frame with a combination lock. A vault may also consist of a door and modular panels constructed in compliance with the requirements in the Standard for Burglary Resistant Vault Doors and Modular Panels, UL 608.

3.44 VISIBLE (FROM PUBLIC STREET OR HIGHWAY) – Any point on a building up to 400 feet (122 m) from a public street or highway, that can be seen by an observer positioned on a public street or highway is considered ″visible from the public street or highway.″

3.45 WIRE, FINE – Bare, hard-drawn, solid copper wire not larger than No. 24 AWG (0.21 mm^2) or film-coated solid copper wire not larger than No. 26 AWG (0.13 mm^2), or the equivalent.

3.46 WIRING, INSTALLATION – Alarm system wiring that is used to interconnect equipment (contacts, intrusion detection units, foil, sounding devices, controls, protective wiring, and the like) installed to form a burglar alarm system or holdup alarm system.

3.47 WIRING, OPEN (LACING) – A form of protective wiring consisting of bare, hard-drawn solid copper wire not larger than No. 24 AWG (0.21 mm^2). This type of wiring may be used for protection under limited circumstances and must be mechanically supported at its ends with additional support at required intervals. See Open Wiring, Lacing and Stapled Wire, Section 7.

3.48 WIRING, PROTECTIVE – Conductor such as foil, fine wiring, open-wiring, grooved stripping, a screen, or other wiring that is installed on an opening or on a wall, floor, or ceiling to form protection within an alarm system.

EXTENT OF PROTECTION FOR PREMISES

4 General

4.1 Central station, mercantile, and proprietary systems

4.1.1 Details

4.1.1.1 An individual alarm system protecting a premises, stockroom, or stock cabinet shall provide a level of protection designated as Extent Number 1, as specified in 4.1.2.1; Extent Number 2, as specified in 4.1.3.1 and 4.3.2; or Extent Number 3, as specified in 4.1.4.1– 4.1.4.3; or Extent Number 4 as specified in 4.2.1 and 4.2.2.

4.1.1.2 Premises with more than one room or area shall be protected by protective wiring applied to all openings or vulnerable surfaces, by the use of an acceptable sensing device including an intrusion detection unit, or by any combination of protective wiring or devices so that the same extent of protection is provided in each room or area as required by the alarm system. Motion detection is not required to be installed in an area such as a washroom, furnace room, clothes closet, utility closet, janitor's closet, stairway, telephone room or sprinkler room, or above a suspended ceiling (see 22.3.1) within the physical boundary of the alarm system. Any opening in such an area that leads outside of the area covered by the alarm system shall be provided with complete protection or the door into the area shall be protected as required by the method used in the alarm system.

4.1.1.2 revised January 19, 2001

4.1.2 Extent Number 1

4.1.2.1 Extent Number 1 protection shall consist of either of the following methods of installing alarm protection. Extent Number 1 protection shall apply to a central station alarm system only. An alarm system may utilize a single method or a combination of methods:

a) Perimeter Only – Complete protection of all openings, ceilings, floors, and walls enclosing the premises with the use of protective wiring.

b) Sound or Vibration Detection – Partial protection of all movable openings leading from the premises and an acceptable sound or vibration system installed on all openings, ceilings, floors, and walls enclosing the premises and adjusted so that an alarm will be initiated if a manhole size opening is made in any opening, ceiling, floor or wall.

4.1.3 Extent Number 2

4.1.3.1 Extent Number 2 protection shall consist of any of the following methods of installing alarm protection. Accessible ceiling, floors, and walls constructed of monolithic concrete or pre-cast concrete building panels do not require protection. Inaccessible ceiling, floors, and walls of any construction do not require protection. An alarm system can utilize a single method or any combination of methods:

a) Perimeter Only – Complete protection of all accessible openings, ceilings, floors, and walls enclosing the premises.

b) Motion Detection – Partial protection of all accessible movable openings leading from the premises, and a system of intrusion detection in all sections of each enclosed area that has any surface common to the outside of the premises so as to detect movement as specified in 10.3.2 or 10.3.3.

c) Sound Detection – Partial protection of all accessible movable openings leading from the premises, and a sound detection system in all sections of each enclosed area that has any surface common to the outside of the premises in accordance with 10.4.1 – 10.4.8.

d) Channels –

1) Complete protection of all accessible openings leading from the premises and

2) A network of invisible beams or motion detectors arranged to subdivide the floor space of each floor or separate section of the protected area that has any surface common to the outside of the premises into at least three approximately equal areas. Each subdivision shall not exceed 1000 square feet (93 m^2) of floor space.

4.1.3.1 revised January 19, 2001

4.1.3.2 For the type of protection specified in 4.1.3.1(d), where merchandise is concentrated in wall cases, additional beams or channels of radiation shall span the entire length of the cases to detect the approach of an intruder to the cases.

4.1.4 Extent Number 3

4.1.4.1 Extent Number 3 protection shall consist of any of the following methods of installing alarm protection. An alarm system can utilize a single method or any combination of methods:

a) Perimeter Only – Complete protection of all accessible openings.

b) Motion Detection – Partial protection of all accessible doors leading from the premises and a system of intrusion detection in all sections of each enclosed area that has exterior openings so as to detect movement as specified in 10.3.2 or 10.3.3.

c) Sound Detection – Partial protection of all accessible movable openings leading from the premises and a sound detection system in all sections of each enclosed area that has exterior openings in accordance with 10.4.1– 10.4.8.

d) Channels – Partial protection of all movable accessible openings leading from the premises and a system of invisible beams or motion detectors arranged so that the minimum length of the beams or radiation is equal to the longest dimension of each enclosed area that has an exterior opening. The channels shall be arranged to provide the most effective coverage of the premises. A channel of protection along one wall, with or without openings, does not meet the intent of this requirement.

4.1.4.2 For the type of protection specified in 4.1.4.1(d), irregularly-shaped areas are to be divided into sections approximating rectangles as closely as possible. The longest dimension is then considered to be the sum of the longest dimension of each section.

4.1.4.3 For an Extent Number 3 system a movable window fronting and within 50 feet (12.4 m) of a public street or highway and between 14 and 18 feet (4.3 and 5.5 m) above ground and not otherwise accessible (as from a ledge, fire escape, adjacent opening, and the like), need only be provided with partial protection. A fixed window under these conditions does not require protection.

4.2 Extent Number 4

4.2.1 Extent Number 4 shall consist of any of the following:

a) Partial protection on accessible doors and on two or more interior doors. See 4.2.2;

b) Partial protection on accessible doors and motion or sound detection in one or more selected areas; or

c) Partial protection on accessible doors and one or more channels of radiation to limit movement within the premises.

4.2.2 If the premises has only one interior door or no interior door, 4.2.1(a) shall not be used. The requirement in 4.2.1 (b) or (c) shall be used. Protection of a door to an area such as a washroom, furnace room, clothes closet, utility closet, or janitor’s closet, will not meet the requirement of 4.2.1(a).

4.3 National industrial security systems

4.3.1 Details

4.3.1.1 An individual alarm system that is installed in a closed area, and which is operated by a contractor providing services to the U.S. government, shall provide a level of protection designated as:

a) Extent Number 3 as specified in 4.3.2.1 – 4.3.2.3 or

b) Extent Number 5 as specified in 4.3.3.1.

4.3.1.2 A closed area or strongroom with more than one room or area shall be protected by:

a) Protective wiring applied to all openings by the use of an acceptable sensing device including an intrusion detection unit or

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b) Any combination of protective wiring or devices so that the same extent of protection is provided in each room or area as required by the alarm system.

Motion detection is not required to be installed in an area such as a washroom, furnace room, clothes closet, utility closet, janitor's closet, telephone room, or sprinkler room, or above a suspended ceiling within the physical boundary of the alarm system. Any opening in such an area that leads outside of the area covered by the alarm system shall be provided with complete protection, or the door or suspended ceiling tiles that provide access into the area shall be protected as required by the method used in the alarm system.

4.3.2 Extent Number 3

4.3.2.1 Extent Number 3 protection shall consist of any of the following methods of installing alarm protection. An alarm system can utilize a single method or any combination of methods:

a) Perimeter Only – Complete protection of all accessible openings.

b) Motion Detection – Partial protection of all accessible doors leading from the premises and a system of intrusion detection in all sections of each enclosed area that has exterior openings so as to detect movement as specified in 10.3.2 or 10.3.3.

c) Channels – Partial protection of all movable accessible openings leading from the premises and a system of invisible beams or motion detectors arranged so that the minimum length of the beams or radiation is equal to the longest dimension of each enclosed area that has an exterior opening. The channels shall be arranged to provide the most effective coverage of the premises. A channel of protection along one wall, with or without openings, does not meet the intent of this requirement.

4.3.2.2 For the type of protection specified in 4.3.2.1(c), irregularly-shaped areas are to be divided into sections approximating rectangles as closely as possible. The longest dimension is then considered to be the sum of the longest dimensions of each section.

4.3.2.3 For an Extent Number 3 system a movable window fronting and within 50 feet (12.4 m) of a public street or highway and between 14 and 18 feet (4.3 and 5.5 m) above ground and not otherwise accessible (as from a ledge, fire escape, adjacent opening, and the like), need only be provided with partial protection. A fixed window under these conditions does not require protection.

4.3.3 Extent Number 5

4.3.3.1 To provide Extent Number 5 protection, an alarm system shall include all of the following methods:

a) Complete protection of all fixed and movable accessible openings that are not visible to patrolling personnel.

b) Contacts installed on all movable accessible openings that are visible to patrolling personnel.

c) Electrical supervision in the form of traps on all accessible openings that are visible to patrolling personnel but can be removed and replaced without the disassembly being noticed by the patrol. Examples of openings needing traps are metal grates, removable panels, and wall-mounted air conditioners.

Exception: Under Extent Number 5, protection need not be provided for plate-glass window panels and for other openings if the panels and openings are:

a) Visible to patrolling personnel,

b) Fixed in place, and

c) Deny access unless broken or removed by disassembly.

5 Wiring

5.1 General

5.1.1 Installation wiring complying with the requirements for burglar alarm wire and cable shall be used to interconnect various detection, control, and sounding device equipment installed to form a burglar alarm system. This wire shall not be smaller than No. 22 AWG (0.32 mm^2) copper wire and shall comply with Article 725 of the National Electrical Code, ANSI/NFPA 70.

5.1.2 Telephone cable installed in accordance with standard telephone company practices is acceptable for wiring used to connect a control unit to the telephone network.

5.1.3 Special purpose wiring such as RF cable shall be installed to interconnect a device to special equipment such as an antenna as required by a manufacturer's installation instructions for the device.

5.1.4 The size of installation wiring between a battery or power supply and a sounding device shall comply with Table 5.1.

Table 5.1
Wire size for an alarm sounding device

Wire size,		Maximum wire length,	
AWG	(mm^2)	feet	(m)
16	1.30	more than 60	18.3
18	0.82	60	18.3
20	0.52	40	12.2
22	0.32	20	6.1

5.2 Running and fastening

5.2.1 Installation wiring shall be located where it will be least subject to damage. A nonjacketed wire routed over a sharp corner or projection shall be protected from abrasion by two layers of electrical tape or the equivalent electrical insulation.

5.2.2 Installation wiring shall be attached to gypsum wallboard (dry wall) or plaster or wood by staples, drive rings, wire ties, or the equivalent. Wire shall be attached to a masonry surfaces by expansion bolts, plugs and eyelets, drive rings, or the equivalent.

5.2.3 Staples or brads shall be spaced not more than 2 feet (610 mm) apart on gypsum wallboard (dry wall), or wood or plaster.

Exception No. 1: A wire resting on top of a molding, cabinet, and the like, may be stapled at intervals of 4 feet (1.2 m) or less.

Exception No. 2: Areas that are not accessible, such as a duct, a plenum, the space above a suspended ceiling, and the like, where the wiring is supported and protected from damage, need not comply with these requirements.

5.3 Splices and connections

5.3.1 A conductor shall be spliced or joined with a splicing device acceptable for this purpose. A splice intended to be soldered shall be joined mechanically before being soldered. Each splice and joint shall be covered with an insulation equivalent to that of the conductors or with not less than two layers of electrical tape. A splice located in an area subjected to dampness shall be treated with an acceptable sealant or equivalently treated.

5.4 Connectors

5.4.1 A connector intended to carry a circuit onto a movable opening shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634.

5.5 Separation of wiring

5.5.1 Alarm system wiring shall be spaced at least 2 inches (51 mm) from conductors of any electric light, power, or Class 3 circuits unless one of the circuits is in conduit.

5.6 Entrance to building and remote areas

5.6.1 The point of entrance of an overhead outside wire shall be as inaccessible as practicable. A wire passing through a wall shall have an insulating bushing, conduit, or electrical metallic tubing slanting upward from the outside. If slanting is impossible, a drip loop shall be used. Conduit shall be equipped with a service head.

5.6.2 Installation wiring connected to a separate building, garage, storeroom, or to another floor outside the main premises shall comply with the applicable requirements specified in Premises Control Units, General, Section 19.

5.7 Grounding

5.7.1 A control unit shall be connected to an earth ground as required by the installation instructions for the product. Grounding shall be to a cold-water pipe where possible.

5.7.2 The system shall test free of grounds with the exception of those circuits that are intended to be connected to the ground side of the protective circuit. Also see 21.4.5.

6 Foil

6.1 General

6.1.1 The requirements in 6.2.1 – 6.7.3 apply when foil is used to protect an opening or a surface.

6.2 Glass

6.2.1 Foil used on a glass surface shall be not more than 1/2 inch (13 mm) wide and not more than 0.0015 inch (0.038 mm) thick for ordinary window, heat treated or tempered, or plate (float) glass and not more than 0.003 inch (0.08 mm) thick for wired glass. It shall be applied evenly and secured to the surface so that it will not blister or loosen in service. It shall be protected by a varnish covering or the equivalent.

6.2.2 Any protective covering applied to or over foil or glass that may hinder breakage of the foil shall not be used.

6.2.3 A single conductor of foil connected in the ungrounded side of the protection circuit is acceptable for the protection of glass.

6.2.4 Foil on ordinary window glass shall be applied to the sides and across the bottom of each section of glass, and spaced 2 to 4 inches (51 to 102 mm) from the edge of the glass. See Figure 6.1(A).

6.2.5 If an ordinary glass panel is 16 inches (406 mm) or less in width, a single, centrally located strip of foil may be applied to the longest dimension of the pane.

6.3 Wired, laminated, polymer-coated glass or polymeric glazing

6.3.1 Foil on wired glass, laminated glass, laminated tempered glass, polymer-coated glass, or polymeric glazing material shall be spaced 2 to 4 inches (51 to 102 mm) from the edge of the glazing and arranged in parallel lines over the entire surface. The distance between centers of adjacent strips of foil shall not exceed 8 inches (203 mm).

6.3.2 Show windows, transoms, or side panels visible from a public street or highway and constructed of glazing material complying with the requirements in the Standard for Burglary Resisting Glazing Material, UL 972, do not require foil protection for Extent Number 3.

6.4 Heat treated or tempered glass

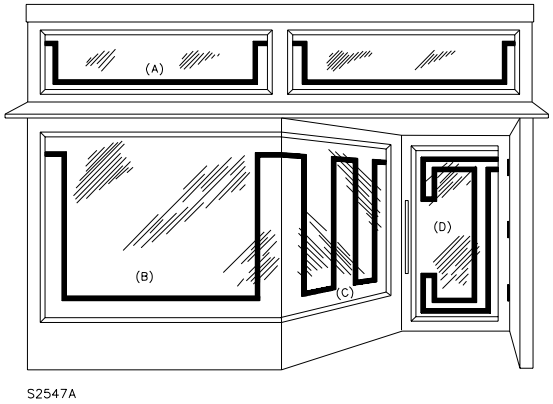
6.4.1 Glazing material of heat-treated or tempered glass may be protected by a single strip of foil extending completely across the top, at least 6 inches (152 mm) from the frame. If the sides are foiled, the construction shall comply with 6.5.1. See Figure 6.2(C).

6.4.2 Heat treated or tempered-glass side panels that are framed on three edges or less may be protected by a closed-circuit loop of foil extending on the glass either vertically or horizontally, between 6 inches (152 mm) and 24 inches (610 mm), from the top frame member. See Figure 6.2(A). For laminated tempered glass, see 6.3.1.

6.5 Plate (float) glass

6.5.1 Foil on plate (float) glass show windows shall be spaced not less than 3 inches (76 mm) nor more than 6 inches (152 mm) from the edges of the glass. See Figure 6.1(C). For laminated tempered glass, see 6.3.1.

Figure 6.1
Foil installation



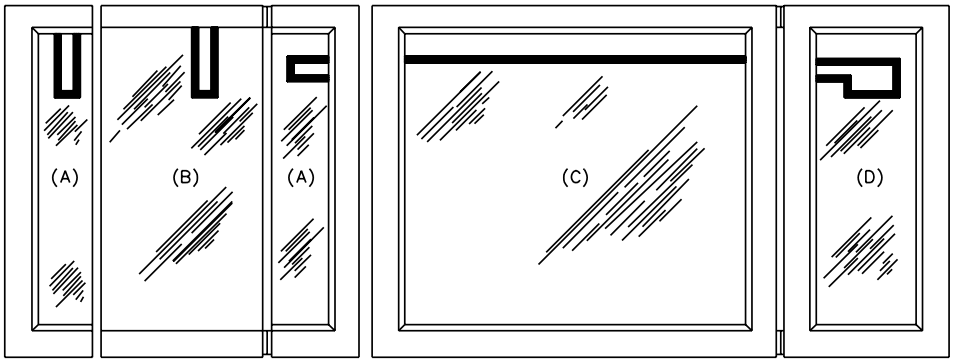
(A) Plate or Ordinary Glass

(B) Plate glass

(C) Wired Glass, Laminated Glass, Polymeric-Coated Glass, or Polymeric Glazing Material

(D) Plate or Ordinary Glass

Figure 6.2
Foil installation



(A) Heat-treated or tempered glass side panel, framed on three sides.

(B) Unframed heat-treated or tempered glass door.

(C) Heat-treated or tempered glass show-window, fully framed.

(D) Heat-treated or tempered glass fully framed door.

6.5.2 Where permanent display platforms prevent foiling at the specified location on a show window, the horizontal run of foil shall be run as low as practicable, but not more than 3 inches (76 mm) above the lowest platform level.

6.5.3 Foil shall extend across the bottom and up the sides of each section of the show window to a height of not less than 7 feet (2.1 m) from grade level, or within 3 inches (76 mm) of the top of the show window.

6.6 Door panel

6.6.1 For a glass panel mounted in a door, a single circuit of foil may be applied in accordance with the requirements for the application of foil to glass surfaces. For a glass door, foil shall be applied 2 to 4 inches (51 to 102 mm) from the framed edges of the glass and shall extend along the top, bottom, and sides to cover not less than 75 percent of the perimeter. See Figure 6.1(D).

6.7 Walls, ceilings, floors, and doors

6.7.1 Foil used on a wall, ceiling, floor, or door shall be not less than 3/8 inch (9.5 mm) nor more than 1 inch (25 mm) wide and not more than 0.003 inch (0.08 mm) thick. It shall be applied using a moisture-resistant insulating adhesive.

6.7.2 Foil shall be applied double circuit. The distance between centers of adjacent strips of foil shall not be more than 6 inches (152 mm).

Exception: Single-circuit foiling of metal doors is acceptable, provided the foil is acceptably insulated from the metal and is covered or concealed.

6.7.3 A foiled panel prepared for mounting on a surface shall be trapped to the structure at all four corners so that the traps will not be visible from the outside of the premises and the panel cannot be moved more than 2 inches (51 mm) without actuating an alarm.

7 Open Wiring, Lacing and Stapled Wire

7.1 Open wiring shall be arranged double circuit, with the distance between conductors not greater than 4 inches (102 mm).

7.2 Open wiring on skylights shall consist of two layers or banks of wires. The wires in the upper layer shall be installed at right angles to those in the lower layer. The two layers shall be separated by a distance of 2 to 6 inches (51 to 152 mm) and each shall be double circuit.

Exception: Open wiring is acceptable on a ceiling less than 8 feet (2.44 m) above the floor in a closed-off or unused portion of the premises, and in situations where the wiring is not subject to mechanical damage.

7.3 Fine wire applied directly to a wood door or like surface that is in good condition and in a dry location shall be:

a) Stapled at intervals not exceeding 8 inches (203 mm) and

b) Covered with hardboard, or similar moisture-resistant material.

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7.4 A prewired panel shall be trapped to the building structure at all four corners so that the:

a) Traps will not be visible from the outside and

b) The panels cannot be moved more than 2 inches (51 mm) without actuating an alarm.

8 Grooved Stripping

8.1 Fine wire in grooved stripping may be used on a surface (such as a wall or ceiling), on a door and over an opening.

8.2 The wiring shall be arranged double circuit. The distance between conductors shall not be more than 4 inches (102 mm).

8.3 The fine wire shall be firmly fastened in grooves at intervals of not more than 18 inches (457 mm) and in such a manner that their removal from the groove is difficult.

8.4 Grooved stripping used over an opening shall be secured to cross pieces that are spaced no more than 18 inches (457 mm) apart or shall be applied or trapped to the building so that the strips cannot be spread to give an opening of more than 6 inches (152 mm) without initiating an alarm. The fine wire in the groove of a strip over an opening shall be completely covered by a hard drying compound.

9 Screens

9.1 A screen over an opening shall not leave an unprotected space in excess of 4 inches (102 mm) between the building structure and top, bottom, or side members of the screen.

9.2 A removable screen shall be mounted so that an alarm will result if any portion of the screen frame is moved more than 2 inches (51 mm). The fixed portion of the screen contacts shall be trapped to the building structure.

9.3 A fixed screen shall be trapped to the building structure at all four corners so that:

a) The traps will not be visible from the outside and

b) The screen cannot be moved more than 2 inches (51 mm) without actuating an alarm.

10 Intrusion Detection Units and Systems

10.1 General

10.1.1 Intrusion detection equipment complying with the Standard for Intrusion-Detection Units, UL 639, may be used in combination with or in place of protective wiring.

10.1.2 When an intrusion detection unit used in a mercantile system is controlled by a shunt switch, there shall be a positive indication of whether or not the shunt circuit is closed. The indication shall be located at, or be visible outside, the entrance/exit door where the shunt switch is installed.

Exception: Such indication is not required when an exit time-delay shunt is used.

10.1.3 A tamper switch provided as part of an intrusion detection unit shall be connected in the protection circuit. See 19.7.

10.1.3 revised January 19, 2001

10.2 Photoelectric units

10.2.1 A photoelectric unit used for channel type protection shall be installed so that the beam is not less than 18 inches (457 mm) nor more than 36 inches (914 mm) from the floor.

10.2.2 A photoelectric unit used to protect a specific opening shall be installed in accordance with the requirements for the protection of the opening. See Doors, Windows, And Other Openings, Section 11.

10.3 Motion detection units

10.3.1 Motion detection units used for channel-type protection of Extent Numbers 2 and 3 shall initiate an alarm when a person walks across each channel at any point at the rate of one step, 30 ±3 inches (760 ±80 mm) per second.

10.3.2 If motion detection (full area) coverage is used for protection of Extent Numbers 2 and 3 the system shall respond to the movement of a person walking not more than four consecutive steps at a rate of one step, 30 ±3 inches (760 ±80 mm), per second. The four-step movement shall constitute a ″trial,″ and a sufficient number of detection units shall be installed so that, upon test, an alarm will be initiated in at least three out of every four such consecutive ″trials″ made moving progressively through the protected area. The test is to be conducted by taking a four step trial, stopping for 3 to 5 seconds, taking a four step trial, stopping for 3 to 5 seconds, repeating the process throughout the protected area. Whenever possible, the direction of the next trial is to be in a different direction.

10.3.3 If the area protected by full area motion detection can be traversed in four steps or less in any direction, movement shall be detected when the walk test in that direction is made.

10.3.4 Each system shall be provided with a test device or method to indicate the overall operability of the system.

10.3.5 A motion detection unit shall be installed so that it will not be influenced by movement outside the protected area.

10.3.6 A motion detection unit shall not be installed within a protected area if it will be influenced by moving objects, air turbulence or movement, noise, electrical interference, and the like in a manner that will cause the motion detector to go into an alarm condition.

10.4 Sound detection units

10.4.1 These requirements are for sound detection equipment used in premises for the detection of forcible entry through openings or building structure.

10.4.2 The use of sound detection equipment shall be limited to buildings of substantial construction in which a forcible entry through a ceiling, roof, wall, or floor will create a significant amount of sound energy. Also, the construction shall be such as to reduce extraneous outside noise.

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10.4.3 The requirement specified in 10.4.2 restricts applications of such systems to building or areas constructed of masonry, metal, and glass, except that wood deck roofs of the built-up, fire-resistive type are acceptable for sound detection protection. For a construction other than that specified, additional protection is required.

10.4.4 Sound detection equipment shall not be used for protection of a building or area where the average ambient sound exceeds 65 dbA during the protection ″on″ period unless such sound can be shown not to affect the system detection or monitoring capability.

10.4.5 Sound detection equipment shall be installed, adjusted and calibrated using the manufacturer's recommended procedures and equipment so as to respond to attack sounds on the protected building or area.

10.4.6 Sound levels are to be measured by a sound-level meter designed, constructed, and calibrated in accordance with the Specification for Sound-Level Meters, ANSI S1.4.

10.4.7 The area covered by a single detector shall not exceed the area of coverage specified by the detector manufacturer. Detectors shall be located to provide coverage of the protected area(s) as required in 10.4.5.

10.4.8 A sound detection system shall be provided with a test device or method which tests operation of the system.

10.4.9 Sound detection shall not be used for a National Industrial Security System.

11 Doors, Windows, and Other Openings

11.1 General

11.1.1 A door, window, and other opening may be protected as specified in 11.1.2 – 11.8.1, depending on the construction, location, and material of the opening. These requirements cover complete protection of the opening as required in 4.1.2.1, 4.1.3.1 (a) and (d), 4.1.4.1(a), and 4.3.2.1(a). If a normally movable opening is provided with partial protection, contacts only are to be installed on the opening. See Table 11.1 for a summary of the protection requirements for doors.

11.1.2 Contacts are not required on a normally movable opening that has been permanently sealed to prevent it from being opened. This includes a metal door or window welded to its frame, doors or windows secured with one way screws or screws that have had the slots or the like destroyed to prevent the engagement of a tool, and a door or window secured with nails or screws that have their heads recessed.

11.1.3 A double door shall have contacts on each door or be equivalently protected.

11.1.4 Contacts or an equivalent device complying with the requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm System, UL 634, shall be installed so that a door or other movable opening cannot be opened more than 2 inches (51 mm) without initiating an alarm.

Exception: Wide overhead doors require more than one contact if either side of the door can be lifted more than 6 inches (152 mm) without initiating an alarm.

11.1.5 Protective wiring applied to a door shall be double circuit and extend to within 6 inches (152 mm) of the edge of the door at the top, bottom, and sides. At the junction of double doors, the distance between protective conductors shall not be more than 6 inches. All such wiring shall be protected against mechanical damage and covered so as not to be visible.

11.1.6 A door or other opening having an opening less than manhole size but large enough to provide access to its contact shall have the contact or its wiring protected against circumvention.

Exception: Protection is not required if the alarm system is installed in compliance with 4.1.3.1(b), 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c).

11.2 Metal, metal-sheath, solid wood doors

11.2.1 A grade level metal door, metal-sheath door, or solid wood door not less than 1-1/2 inches (38 mm) thick, and visible from a public street or highway may be protected for an Extent Number 3 installation by means of contacts.

Table 11.1
Summary of protection requirements for doors

Type of door	Extent number 3	Extent number 2
Metal, metal-sheath or solid wood door – visible from public street or highway	(1) Contacts if grade level	(1) Contacts and protective wiring or (2) Contacts and motion detector or shock sensor
Metal, metal-sheath or solid wood door – not visible from public street or highway	(1) Contacts and protective wiring, or (2) Contacts and motion detector or shock sensor, or (3) Contacts and floor trap or PE beam	(1) Contacts and protective wiring or (2) Contacts and motion detector or shock sensor
Heat treated, tempered glass door – visible or not visible from public street or highway	(1) Contacts and foil loop, or (2) Contacts and motion detector or shock sensor/glass break detector	(1) Contacts and foil loop, or (2) Contacts and motion detector or shock sensor/glass break detector
Laminated, wired glass or plastic glazed door – visible or not visible from public street or highway	(1) Contacts and foil on 8 inch centers, or (2) Contacts and motion detector or shock sensor/glass break detector	(1) Contacts and foil on 8 inch centers, or (2) Contacts and motion detector or shock sensor/glass break detector
Door of any construction – visible from public street or highway	(1) Contacts and protective wiring, or (2) Contacts and motion detector or shock sensor/glass break detector, or (3) Contacts and a PE beam	(1) Contact and protective wiring, or (2) Contacts and motion detector or shock sensor/glass break detector
Door of any construction – not visible from public street or highway	(1) Contact and protective wiring, or (2) Contacts and motion detector or shock sensor/glass break detector, or (3) Contacts and two PE beams	(1) Contacts and protective wiring, or (2) Contacts and motion detector or shock sensor/glass break detector
Trap doors	(1) Contact and protective wiring, or (2) Contacts and motion detector or shock sensor, or (3) Contacts and floor trap or PE beam	(1) Contact and protective wiring, or (2) Contacts and motion detector or shock sensor, or (3) Contacts and floor Trap or PE beam

11.2.2 A manhole size glass panel or a removable panel of other material installed in a metal, metal-sheath, or solid wood door shall have complete protection of the panel. This is required for panels in doors that are both visible or not visible from a public street or highway.

Exception: Protection is not required if the alarm system is installed in compliance with 4.1.3.1 (b) or (d), or 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c).

11.2.3 A metal door, metal-sheath door or solid wood door not less than 1-1/2 inches (38 mm) thick and not visible from a public street or highway, may be accepted for an Extent Number 3 installation if, in addition to contacts, a floor trap or photoelectric beam is installed across the protected door not more than 24 inches (610 mm) from the inner surface and not less than 6 inches (152 mm) nor more than 36 inches (914 mm) from the floor.

11.2.4 A wood door base less than 10 inches (254 mm) high may be protected by single circuit wiring.

11.2.5 A trapdoor in the floor of a mercantile premises may be protected with contacts on the door and a floor trap arranged so that its conductor spans the entire length of the door away from the hinges at a height of not less than 6 inches (152 mm) nor more than 10 inches (254 mm) away. If the floor trap cannot be arranged to extend the full length of the trapdoor, two traps shall be installed across the width of the door. A photoelectric beam may be used in place of the floor trap.

11.3 Heat treated or tempered glass doors

11.3.1 A frameless, heat-treated or tempered glass door, at least 1/2 inch (13 mm) thick may be protected by contacts and a closed circuit foil loop extending on the glass, either vertically or horizontally, between 6 and 24 inches (152 and 610 mm) from the top frame member. See Figure 6.2(B).

11.3.2 A heat treated or tempered glass side panel that is framed on three edges or less may be protected by a closed circuit foil loop extending on the glass, either vertically or horizontally, between 6 and 24 inches (152 and 610 mm) from the top frame member. See Figure 6.2(A).

11.3.3 A fully framed, heat treated or tempered glass door may be protected by contacts, and a closed circuit foil loop across the top of the glass. The spacing of the foil from the top and sides of the frame shall comply with the requirements specified in 6.4.1. See Figure 6.2(D).

11.4 Doors of any construction

11.4.1 A door of any construction that is visible from a public street or highway may be protected with contacts and an intrusion detection unit for Extent Number 3.

a) If a motion detector is used, it shall be installed so that an alarm will be initiated if an intruder enters the protected area by penetrating the opening and before the intruder advances 10 feet (3.05 m) into the premises.

b) If a photoelectric beam is used, the beam shall be located not more than 24 inches (610 mm) from the door and not less than 6 inches (152 mm) nor more than 36 inches (914 mm) from the floor.

11.4.2 A door of any construction that is not visible from a public street or highway may be protected with contacts and an intrusion detection unit for Extent Number 3.

a) If a motion detector is used, it shall be installed so that an alarm will be initiated if an intruder enters the protected area by penetrating the opening and before the intruder advances 10 feet (3 m) into the premises.

b) If a photoelectric beam is used, two beams shall be used and located not more than 24 inches (610 mm) from the door. The lower beam shall be horizontal and shall be located between 6 inches (152 mm) and 24 inches from the floor. The second beam shall be horizontal or diagonal with a height above the floor level at the center of the door of 4 feet (1.2 m).

11.4.3 The view of a motion detection unit used to protect a door shall be arranged so that it will not be obstructed.

11.5 Windows

11.5.1 Complete protection of a window shall consist of a contact installed on a movable window and either protective wiring applied to the window or an appropriate intrusion detection unit installed to signal breakage or penetration of the window or movement of an intruder in the vicinity of the window. See 11.5.2 and 11.5.3.

11.5.2 A window that is visible from a public street or highway may be protected with a motion detector or photoelectric beam for Extent Number 3.

a) If a motion detector is used, it shall be installed so that an alarm will be initiated if an intruder enters the protected area by penetrating the window and before the intruder advances 10 feet (3 m) into the premises.

b) If a photoelectric beam is used, the beam shall be not more than 12 inches (305 mm) from the wall that the window is in and not less than 6 inches (152 mm) nor more than 24 inches (610 mm) above the window sill; except that if the window is 48 inches (1.2 m) or less in height, the beam shall not be placed above the horizontal centerline of the window.

c) Contacts shall be used if the window is movable.

11.5.3 A window that is not visible from a public street or highway may be protected with a motion detector or two photoelectric beams for Extent Number 3.

a) If a motion detector is used, it shall be installed so that an alarm will be initiated if an intruder enters the protected area by penetrating the window and before the intruder advances 10 feet (3 m) into the premises.

b) If photoelectric beams are used, the beams shall be not more than 12 inches (305 mm) from the wall that the window is in. The lower beam shall be horizontal and between 6 inches (152 mm) and 12 inches above the window sill. The second beam shall be horizontal or diagonal and shall pass through the vertical centerline of the window or 36 inches (914 mm) above the window sill, whichever is lower.

c) Contacts shall be used if the window is movable.

11.5.4 The view of a motion detection unit used, to protect a window shall be arranged so that it will not be obstructed.

11.5.5 A shock sensor or glass break detector employed to protect a window shall be appropriate for the type of window involved and shall be installed in accordance with the product's installation instructions. It shall comply with the Standard for Intrusion-Detection Units, UL 639.

11.5.6 If foil is used to protect a window, refer to 6.2.1 – 6.5.3 for requirements pertaining to the installation of foil.

11.5.7 For Extent Number 3, show windows, transoms, or side panels visible from a public street or highway and constructed with glazing complying with the requirements in the Standard for Burglary Resisting Glazing Material, UL 972, do not require protection. If a transom is movable, contact protection shall be provided.

11.6 Showcases and showcase windows

11.6.1 Showcases and showcase windows manhole size or larger that normally form part of the perimeter of a premises shall be protected as required by 4.1.2.1– 4.1.4.3, and 4.3.2.1 – 4.3.2.3.

11.6.2 Showcases 3 feet (914 mm) or less in depth, as measured from the window to the main floor area of the premises may be protected utilizing the existing motion detection that is used to protect the main area of the premises.

11.6.3 Showcases deeper than 3 feet (914 mm) as measured from the window to main floor area of the premises shall be protected utilizing a method or intrusion detection device that is specifically intended for protection of the opening. See 4.1.2.1– 4.1.4.3, and 4.3.2.1 – 4.3.2.3.

Exception: Showcases that are deeper than 3 feet and that are fully partitioned from the main area of the premises (such as an entirely walled-off showcase or a shadow box type showcase window) may be accepted without protection of the showcases if the partition providing access to the showcase has protection consisting of motion detection or photoelectric units installed to protect the surface of each partition, panel or door providing access to the showcases. See 10.2.2, 10.3, 11.4, and 11.5.

11.6.3 revised January 19, 2001

11.6.4 If channel protection 4.1.3.1(d), 4.1.4.1(d), or 4.3.2.1(c) is used to provide protection for showcases or showcase windows, calculation of the longest dimension of the area is to include the showcase area.

11.7 Jalousie windows

11.7.1 For partial protection, a movable jalousie window shall be provided with a contact on one of the movable panes or on the mechanism used to open and close the window.

11.7.2 Complete protection of a fixed or movable jalousie window shall be provided by a protective screen, foil on each pane, or protection can be provided under the conditions in 4.1.3.1 (b) or (d), 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c). A movable jalousie window shall be provided with a contact as specified in 11.7.1.

11.8 Roof hatches

11.8.1 A roof hatch shall be protected as an opening that is not visible from a public street or highway. The roof hatch may be protected with a contact if the premises that it leads from is protected in accordance with 4.1.3.1 (b) or (d), or 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c).

12 Air Conditioners, Exhaust Fans, and Similar Units

12.1 For an Extent Number 2 or 3, alarm system, a removable air conditioner or heating unit, side walk hatch, metal coal chute cover, metal panelboard, or similar device whose removal will create a manhole size opening does not require complete protection but shall be electrically trapped to the building structure at two or more opposite points by traps or contacts.

Exception: Trapping is not required under the conditions in 4.1.3.1 (b) or (d) for Extent Number 2, and 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c) for Extent Number 3. This exception also applies to 12.2 – 12.5.

12.2 A manhole size opening adjacent to an air-conditioning unit or heating unit shall be filled. The filler shall be equivalent to construction of the adjacent wall or shall have complete protection.

12.3 If the internal assembly of an air-conditioning unit or heating unit can be removed from outside of the protected area by pushing or pulling the assembly, the movable section shall be trapped to the building structure.

12.4 An exhaust fan or blower, permanently mounted in a metal frame that limits the clear opening for access (disregarding the fan blades) to less than manhole size shall be trapped to the building at two or more opposite points, if removal of the frame will provide a manhole size opening.

12.5 If the opening specified in 12.4, disregarding the fan blades, is manhole size, complete protection is required. Cage screens, wired dowels, or grooved stripping trapped to the building structure are acceptable methods of complete protection.

13 Floors, Walls and Ceilings

13.1 Complete protection of an Extent Number 1 stockroom or premises floor, wall, or ceiling in accordance with 4.1.2.1(a) shall be in the form of double circuit lacing or foil linings installed so that the protection is guarded against mechanical damage, moisture, and corrosion.

13.2 Complete protection of an Extent Number 1 stockroom or premises floor, wall or ceiling in accordance with 4.1.2.1(b) shall include the installation of a recognized sound or vibration detection system that has been tested and found satisfactory for the type of floor, wall and ceiling construction involved in the installation.

EXTENT OF PROTECTION FOR SECURITY CONTAINERS

14 General

14.1 Complete protection shall consist of protection on all surfaces and contacts on each outer door or contacts on the lock and bolt mechanism of each outer door. Contacts mounted on the outside of a door shall be constructed for mounting outside the protected area and shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. Ordinary-use alarm contacts also complying with UL 634 are acceptable if mounted inside, or if mounted outside with a capacitance alarm unit.

14.2 Partial protection shall consist of protection of each outer door or the lock and bolt mechanism of each outer door with contacts. Contacts mounted on the outside of a door shall be constructed for mounting outside the protected area and shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. Ordinary-use alarm contacts also complying with UL 634 are acceptable if mounted inside.

14.3 A tamper switch provided as part of an intrusion detection unit shall be connected in the protection circuit. If the alarm system provides for a 24 hour supervision circuit that will provide a trouble or alarm signal when the system is disarmed and an alarm signal when the system is armed, the tamper switch shall be connected to that circuit. The tamper switch may be in the same supervision circuits as other tamper switches. See 15.1.1(a), 16.1.1(a), and 19.7.

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15 Complete Protection for Safes and Approved GSA Containers

15.1 General

15.1.1 Protection of all surfaces of a safe shall consist of any of the following:

a) Using a device intended for protection of a safe, and complying with the Standard for Intrusion-Detection Units, UL 639 or

b) Linings applied to a safe or safe cabinet complying with the Standard for Linings and Screens for Use with Burglar-Alarm Systems, UL 606, and that completely surround the safe.

15.1.2 The protection required by 15.1.1 shall be arranged so that an alarm will be initiated if an opening 4 inches (102 mm) in diameter or larger is made in the safe or safe door by any method of attack.

15.2 Doors

15.2.1 Contacts shall be installed so that a door cannot be opened more than 2 inches (51 mm) without causing an alarm condition. Contacts mounted on the outside of a safe door shall be constructed for mounting outside the protected area and shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. Ordinary-use alarm contacts complying with UL 634 are acceptable if mounted inside, or if mounted outside with a capacitance alarm unit.

16 Complete Protection for Vaults

16.1 General

16.1.1 Protection of a vault shall consist of any of the following:

a) Sound detectors, vibration detectors, or other products intended for vault protection that comply with the requirements of the Standard for Intrusion-Detection Units, UL 639.

b) Embedded cable,

c) Foil lining,

d) Grooved stripping, or

e) Protective screens.

16.1.2 The protection required in 16.1.1 shall be arranged so that an alarm will be initiated if a manhole size opening is made in any surface of the vault or vault door by any method of attack.

16.1.3 A flexible connector used for the connection of installation wiring to a vault door shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. A flexible connector shall be located where least subject to damage.

16.1.4 Each splice in installation wiring or protective wiring shall be mechanically secured and soldered, or joined with splicing devices acceptable for this purpose and where necessary covered with at least two layers of insulating tape or the equivalent. Each splice in cable embedded in concrete shall be protected against moisture. Wires connected to terminals by means of upturned lugs, washers, or equivalent types of pressure connectors do not require soldering.

16.2 Foil linings, grooved stripping, protective screens, and embedded cable

16.2.1 When foil linings, grooved stripping, protective screens, or embedded cable are used for vault protection, the protection shall be applied in accordance with the requirements in the Standard for Lining and Screens for Use with Burglar-Alarm Systems, UL 606.

16.2.2 Grooved stripping shall not be used for the protection of bank vaults.

16.2.3 A junction box for a protection circuit installed on the outside of the protected vault shall be electrically protected. Each knockout shall be plugged.

16.3 Sound and vibration detectors

16.3.1 The vault shall be of masonry construction, or at least 1/4 inch (6.4 mm) steel plate. Mortar used to bond the blocks together shall be equivalent in strength and hardness to portland cement mortar.

16.3.2 A vault having an interior maximum ambient sound level that exceeds 70 dbA for monolithic concrete or 55 dbA for block masonry construction shall not be protected by acoustical means. The sound levels are to be determined when the vault is empty.

16.3.3 A ″nonreverberant″ vault is one in which the average coefficient of sound absorption of exposed interior surfaces exceeds 0.05 or is variable because of merchandise in storage. All others are termed ″reverberant.″ Nonreverberant vaults require systems constructed for such use.

16.3.4 In reverberant vaults, systems shall be adjusted to transmit an alarm at sound levels of 80 to 90 dbA for a sound of impact origin. In nonreverberant vaults, systems shall be adjusted to transmit an alarm at a sound level 15 dbA above the intended ambient for the vault for impact-generated sounds.

16.3.5 Systems shall be adjusted to remain stable at the maximum normal ambient sound level in the vault under service conditions during the closed period.

16.3.6 Sound or vibration detection systems, or both, are not acceptable for protection against a cutting torch attack on nonreverberant vaults unless they have been specifically tested for this purpose.

16.3.7 Sound or vibration detection equipment, or both, shall be installed, adjusted and calibrated using the manufacturer's recommended procedures and equipment so as to respond to attack sounds on the vault.

16.3.8 A supervisory sound test device shall be adjusted to generate an interior sound level not to exceed 95 dbA for reverberant vaults nor 85 dbA for nonreverberant vaults as measured with the vault empty.

16.3.9 Sound levels are to be measured by a sound-level meter designed, constructed, and calibrated in accordance with the Specification for Sound-Level Meters, ANSI S1.4.

16.4 Doors

16.4.1 Contacts shall be installed so that a door cannot be opened more than 2 inches (51 mm) without causing an alarm condition.

16.4.2 Complete protection of a door having a total thickness of steel equal to or exceeding 1-1/2 inches (38 mm) may consist of a sound, smoke, or heat detector constructed for the purpose and mounted above the door.

16.4.3 A door having a net thickness of steel less than 1-1/2 inches (38 mm) shall be provided with complete protection to protect against mechanical as well as torch attack. This protection shall consist of an electrical lining of the door or an acceptable detector installed on the door that has been specifically tested for protection of a vault door of the type and thickness involved.

16.4.4 The thickness of the steel mentioned in 16.4.2 and 16.4.3 is the total thickness of all steel plates used to construct the vault door. Other door construction material such as glass, insulation, metal spacers, and the like is to be disregarded when measuring the door thickness.

16.4.5 An emergency vault door or ventilator and a vault ventilating port shall be provided with contacts. If the opening is manhole size, complete protection is required.

16.4.6 An emergency vault ventilator or port complying with the requirements in the Standard for Emergency Vault Ventilators and Vault-Ventilating Ports, UL 680, and also providing an opening less than manhole size does not require protection.

17 Extent of Protection for Night Depositories

17.1 Complete protection shall consist of protection for the outer door and body of the depository chest or vault, the connecting chute, and the outside entrance or head by the methods described in Sections 14 – 16 that specify protection for safes and vaults.

17.2 A sound and vibration detector that is not intended to be used for the protection of night depository shall not be used. A proximity detector shall not be used.

17.3 A night depository complying with the requirements in the Standard for Night Depositories, UL 771, shall be protected as specified in 17.1.

Exception: The outside entrance may be trapped or contacted to the building structure in place of complete protection.

17.4 Partial protection shall consist of contacts on the outer door or the lock and bolt mechanism of the depository chest or vault and protection of the outside entrance or head against removal by means of a trap or contacts. Contacts mounted on the outside of the chest or vault door shall be constructed for mounting outside the protected area and shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. Ordinary-use alarm contacts also complying with UL 634 are acceptable if mounted inside.

18 Extent of Protection for Automated Teller Machines (ATMs)

18.1 Complete protection shall consist of protection for the door and body of the security container and the customer access panel by the methods described in Sections 14 and 15 which specify protection for safes.

18.2 A sound and vibration detector that is not intended to be used for the protection of an automated teller machine shall not be used. A proximity detector shall not be used.

18.3 An ATM complying with the requirements in the Standard for Automated Teller Systems, UL 291, shall be protected as specified in 18.1.

Exception: The customer access panel may be trapped or contacted against removal in place of complete protection.

18.4 Partial protection shall consist of contacts on the door or the lock and bolt mechanism of the security container and protection of the customer access panel against removal by means of a trap or contacts. Contacts mounted on the outside of the security container door shall be constructed for mounting outside the protected area and shall comply with the applicable requirements in the Standard for Connectors and Switches for Use with Burglar-Alarm Systems, UL 634. Ordinary use alarm contacts also complying with UL 634 are acceptable if mounted inside.

PREMISES CONTROL UNITS

19 General

19.1 Depending on the type of service it is used for, a premises control unit shall comply with the Standard for:

a) Police Station Connected Burglar Alarm Units and Systems, UL 365,

b) Proprietary Burglar Alarm Units and Systems, UL 1076,

c) Central-Station Burglar-Alarm Units, UL 1610, or

d) Digital Alarm Communicator System Units, UL 1635.

19.2 The manufacturer's instructions for the installation of the alarm circuits, such as the location of end-of-line resistors in the initiating device circuits and the alarm sounding device, shall be followed.

19.3 The control unit and devices used to interconnect the control unit to protection devices shall be located within the area of greatest protection unless it is adequately protected.

19.4 The area of greatest protection for a safe or vault alarm system is considered to be the interior of the safe or vault.

19.5 A control unit, transmitter and devices that are located outside of the area of greatest protection and are used to interconnect the control unit to protection devices are considered to be adequately protected if they are:

a) Electrically lined,

b) Protected by shock sensor or vibration detector complying with the requirements for intrusion detection units, UL 639,

c) Protected by a proximity detector complying with the requirements of UL 639, or

d) Located within an area of the property that is protected by an alarm system that complies with 4.1.2.1 (Extent number 1), 4.1.3.1 (Extent number 2), or 4.1.4.1 (Extent number 3). Both the alarm system is the area of greatest protection and this alarm system shall be armed and disarmed at the same time.

Exception No. 1: The control unit for a safe or vault with partial protection need not comply with this requirement.

Exception No. 2: Item d) does not apply to National Industrial Security Systems.

19.5 revised January 19, 2001

19.6 Installation wiring from a control unit or intrusion detection unit to a complete safe, complete vault, Extent Number 1 stockroom, or Extent Number 1 premises, or between complete safes, complete vaults, Extent Number 1 stockrooms, or Extent Number 1 premises shall be:

a) Installed in electrically protected cable, or

b) An interrogate/respond type circuit that will detect tampering with or disconnection of the circuit, or

c) Installed in rigid metal conduit, or

d) Installed in electrical metallic tubing, or

e) Entirely concealed within building walls, floors, or ceilings that are fixed in place in such a manner that access to the wiring can not be made without breaking or otherwise destroying the enclosing surface(s). Lift-out ceiling panels and similar materials are not considered fixed in place, or

f) Installed in flexible metal tubing where routed above ceilings that are provided with lift-out panels.

Exception: These requirements do not apply to a partial safe, partial vault, nor an Extent Number 2 or 3 stockroom, or Extent Number 2 or 3 premises in which the installation wiring is run within the protected area.

19.6 revised January 19, 2001

19.6.1 Removable covers or plates of conduit boxes or junction boxes shall be electrically tampered or permanently secured with one-way screws or similar type fastening device. Each unused knockout shall be plugged. Connectors used to join lengths of tubing need not be permanently secured, but shall be secured in a manner that prevents disassembly without hand tools.

19.6.1 added January 19, 2001

19.7 A cover of a control unit, power supply, or accessory unit containing circuits that can be tampered with to defeat the alarm system or silence the local alarm sounding device, shall be protected by a tamper switch. The tamper switches of an outside and an inside/visible alarm sounding devicehousing shall be connected into an alarm initiating device circuit. If the alarm system provides a 24-hour supervision circuit that will provide a trouble signal or alarm signal when the system is disarmed and an alarm signal when the system is armed, the tamper switches shall be connected to that circuit. The tamper switches may be in the same supervision circuit as the tamper switches required by 10.1.3.

19.8 A control unit that has a field programmable alarm sounding circuit shall be programmed:

a) To conduct a test of the sounding device when the system is armed unless a signal is transmitted to a central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827, or in a law enforcement center at the occurrence of each alarm condition.

b) To activate the sounding device of a mercantile alarm system at normal power for not less than 15 minutes upon alarm.

c) To activate the sounding device of a bank alarm system at normal power for not less than 15 minutes upon alarm. A bank alarm system may be programmed to be silenced after 5 minutes of alarm if the cause of the alarm has cleared and the alarm system is reset and will react to another alarm condition.

19.8 revised January 19, 2001

19.9 The maximum time that a control unit shall be programmed to delay the transmission of a signal to a remote monitoring location, or to delay the energizing of a local alarm sounding device to permit the alarm system user to enter and disarm the system, or to arm the system and exit shall not exceed:

a) 60 seconds for a system with standard line security or encrypted line security,

b) 120 seconds for a system without standard line security or encrypted line security, or

c) 120 seconds for a system that does not transmit an alarm signal to a remote monitoring location.

20 Power Supplies

20.1 A system shall not depend solely on commercial power at the premises.

20.2 The requirement specified in 20.1 requires standby power to maintain the system in normal condition automatically in case of interruption of the commercial power source for periods as follows:

a) Bank Vault Alarm Systems – 72 hours.

Exception: If the standby power source can be accessed while the bank vault is under timelock and the standby power renewed, the standby power requirement is 24 hours.

b) Mercantile and Central-Station Mercantile – 4 hours.

c) Proprietary – 24 hours.

Exception: Standby capacity of less than 24 hours may be provided if a signal indicating that the protected area unit is operating on standby power is transmitted to the central supervising station before the capacity of the standby power has decreased below 4 hours.

d) Holdup Alarm Systems – 8 hours

e) National Industrial Security Systems– 4 hours.

ALARM SOUNDING DEVICES

21 General

21.1 Details

21.1.1 An appropriate sounding device shall be installed in a mercantile, or bank alarm system, and in a National Industrial Security System that requires a sounding device. When the alarm sounding device is mounted outside of the protected area, an appropriate alarm housing shall enclose the sounding device. See 3.3 and Table 21.1.

21.1.1 revised January 19, 2001

21.1.2 An alarm sounding device is optional for a central station or proprietary system. When one is used, it shall comply with 3.3 and Table 21.1.

21.1.3 The installation requirements specified in 21.1.4 – 21.4.5 for alarm housing and connections are applicable for any alarm system requiring a local alarm sounding device.

21.1.4 A mercantile alarm housing enclosing a sounding device mounted outside of the protected area shall be an ″Outside″ type housing. See 3.3.

21.1.5 Deleted January 19, 2001

21.1.6 A mercantile alarm sounding device mounted within the protected area shall be an ″Inside″ type alarm sounding device. See 3.3 and 21.3.3. An ″Outside″ type housing may also be used.

21.1.6 revised January 19, 2001

21.1.7 An alarm housing and alarm sounding device used in a bank alarm system shall be suitable for that type of service whether it is mounted outside or inside. See 3.3 and Table 21.1.

21.2 ″Outside″ alarm housing

21.2.1 An alarm housing installed outdoors shall be mounted to the building structure in a manner that will prevent the rear tamper switch from opening the installation wiring circuit due to jarring and vibration.

21.2.1 revised January 19, 2001

21.2.2 The alarm housing for a bank or mercantile alarm system without a remote alarm transmission connection shall be mounted on the outside of the building, visible from a public street or highway. It shall be accessible for examination and repair. It shall also be located not more than four stories above the street level unless:

a) A second alarm sounding device and housing rated for Outside service is mounted adjacent to the premises or area of the building in which the alarm system is installed or

b) A second alarm sounding device rated for Inside service is mounted within the premises.

In either case, the outside alarm sounding device and housing may be mounted as high as the seventh floor.

21.2.2 revised January 19, 2001

21.2.3 When the alarm housing for a mercantile or bank alarm system without a remote connection is concealed by an ornamental grille, the words ″Burglar Alarm″ shall be visibly displayed on the grille covering.

21.3 ″Inside″ alarm housings

21.3.1 In a bank burglar alarm system, a bank alarm sounding device and housing that is located anywhere within a building is acceptable provided that alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

21.3.1 revised January 19, 2001

21.3.2 In a mercantile burglar alarm system, a mercantile alarm sounding device located within a building but outside the protected area, is acceptable provided it is rated for outside service (See 3.3) and alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

21.3.2 revised January 19, 2001

Table 21.1
Summary of alarm sounding device requirements

Table 21.1 revised January 19, 2001

Type of system	Alarm sounding device required	Location of alarm sounding device and housing	Type of alarm sounding device
Bank (no remote connection)	Yes	Outdoors, visible to street	Bank
Bank (with remote connection)	Yes	Outside protected area or within protected area	Bank
Mercantile (no remote connection)	Yes	Outside, visible to street	Outside type
Mercantile (with remote connection)	Yes	Outside protected area Within protected area	Outside type Inside
Central station or proprietary	Optional	Outside protected area Within protected area	Outside type Inside
National Industrial Security system	Where required	Outside protected area Within protected area	Outside type Inside

21.3.3 In a mercantile burglar alarm system, an alarm sounding device located within the area of greatest protection or outside the area of greatest protection but within an area protected by an alarm system that complies with 4.1.2.1 (Extent number 1), 4.1.3.1 (Extent number 2), 4.1.4.1 (Extent number 3), or 4.2.2 (Extent number 4) and that shares a common control unit with the system installed in the area of greatest protection, is acceptable provided it is rated for inside service and alarm conditions are transmitted to:

a) The dispatch location of the law enforcement agency having jurisdiction over the protected property or

b) A central station or residential monitoring station complying with the Standard for Central-Station Alarm Services, UL 827.

21.3.3 revised January 19, 2001

21.3.4 An inside sounding device shall be mounted at least 10 feet (3.05 m) above the floor or at the surface of the ceiling. When there is fixed construction within the area that could provide access for an intruder, the alarm sounding device shall also be mounted at least 4 feet (1.2 m), as measured horizontally, away from the edges for the fixed construction or at least 10 feet (3.05 m) above it so as to minimize access by an intruder.

21.3.4 added January 19, 2001

21.4 Wiring

21.4.1 For an alarm system using a local sounding device, the wiring used for the sounding device energy between the power source and the sounding device shall be:

a) Housed in rigid metal conduit or electrical metallic tubing when exposed on interior surfaces of the protected area.

b) Installed in flexible metal tubing where routed above ceilings that are provided with lift-out panels.

c) Housed in jacketed cable when entirely concealed within building walls, floors, or ceilings that are fixed in place in such a manner that access to the wiring can not be made without breaking or otherwise destroying the enclosing surface(s). Lift-out ceiling panels and similar materials are not considered fixed in place.

21.4.1 revised January 19, 2001

21.4.2 Removable covers or plates of conduit boxes or junction boxes shall be electrically tampered or permanently secured with one-way screws or similar type fastening device. Each unused knockout shall be plugged. Connectors used to join lengths of tubing need not be permanently secured, but shall be secured in a manner that prevents disassembly without hand tools.

21.4.2 revised January 19, 2001

21.4.3 When the mechanical protection, described in 21.4.1, enclosing the sounding device energy wiring is located outside of the boundaries of a premises system or an alarmed area, additional protection consisting of one of the of the following shall be provided:

a) Electrically protected cable installed within rigid metal conduit or electrical metallic tubing,

b) Electrically protected cable installed within flexible metal tubing where routed above ceilings that are provided with lift-out panels,

c) Installation of the rigid metal conduit or electrical metallic tubing so that it is entirely concealed by the building structure, or

d) Located within an area of the property that is protected by an alarm system that complies with 4.1.2.1 (Extent 1), 4.1.3.1 (Extent number 2), or 4.1.4.1 (Extent number 3).

21.4.3 revised January 19, 2001

21.4.3.1 When the mechanical protection described in 21.4.1 enclosing the sounding device energy wiring is located outside an Extent Complete safe, vault, ATM, or Stockroom Extent 1, 2, 3, or 4, additional protection of the portion of the wiring that is outside consisting of any of the following shall be provided:

a) Electrically protected cable installed within rigid metal conduit or electrical metallic tubing,

b) Electrically protected cable installed within flexible metal tubing where routed above ceilings that are provided with lift-out panels,

c) Installation of the rigid metal conduit or electrical metallic tubing so that it is entirely concealed by the building structure, or

d) Located within an area of the property that is protected by an alarm system that complies with 4.1.2.1 (Extent 1), 4.1.3.1 (Extent number 2), or 4.1.4.1 (Extent number 3).

21.4.3.1 added January 19, 2001

21.4.4 Conduit shall be securely attached to the alarm housing and the premises control unit by means of locknuts and washers or the equivalent.

21.4.5 For a ″normally grounded″ protective circuit, the outer enclosure of the alarm housing attached to the building shall be connected to the grounded side of the power supply. All single-circuit foil, protective wiring, and contacts shall be connected to the ungrounded side of the protective circuit. There shall be no protective wiring between the ground and the outer enclosure of the alarm housing.

INTERPRETATIONS

22 General

22.1 Details

22.1.1 An opening in a building wall filled in by glass blocks bonded together with mortar is not considered to be an opening.

22.1.2 A window, door, or similar opening in a building structure may no longer be considered to be an opening requiring protection if the frame is removed and replaced with construction equivalent to the adjacent wall. This construction is not required to exceed 8 inches (203 mm) in thickness. A recessed door or window is not required to be removed if an 8 inch thick wall can be built over the opening with the door or window still in place.

22.1.3 An opening facing an adjacent building wall without openings where the walls are spaced not more than 6 inches (152 mm) apart does not require protection for Extent Number 3.

22.1.4 An opening 18 feet (5.5 m) or less above an adjoining or adjacent roof or any accessible horizontal supporting surface is considered accessible if this supporting surface is at least 6 feet (1.8 m) wide.

22.1.5 A 14-foot (4.3-m) distance determines the accessibility of an opening or ledge from another opening or ledge under the following conditions:

a) Openings or ledges in adjacent walls on the same floor level where a line between them forms a 45-degree angle with each wall. See Figure 22.1.

b) Openings or ledges in opposite walls and on the same floor level where a line between them forms an angle of 90 degrees, consisting of 45 degrees to the left and 45 degrees to the right. See Figure 22.2.

c) Openings or ledges in opposite walls and directly above or below where a line between them forms a 150-degree angle consisting of 75 degrees above and 75 degrees below. See Figure 22.3.

d) Openings on the same wall above a ledge between 3 feet, 6 inches (1.07 m) and 5 feet, 11 inches (1.80 m) in width. See 22.1.7.

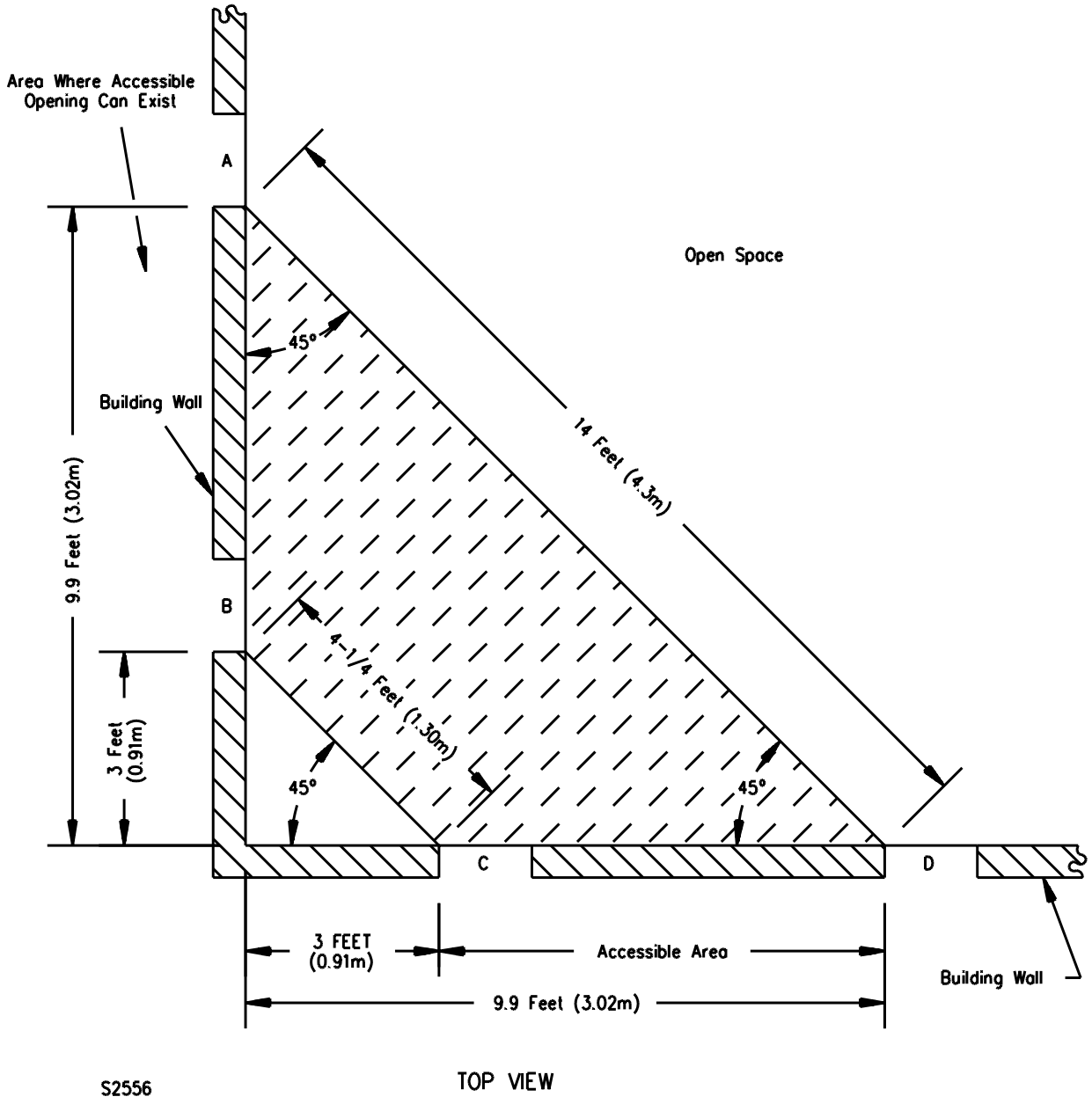
22.1.6 An opening on the same wall is accessible from a ledge that is between 1 foot (0.30 m) to 3-1/2 feet (1.07 m) wide, if the width of the ledge is at least one-fourth the vertical distance to the opening. See Figure 22.4.

22.1.7 Any opening or ledge within 3 feet (0.91 m) of another opening or ledge is accessible regardless of the angle or direction between them, except for openings or ledges in the same wall and below. See Figure 22.5.

22.1.8 Accessible ledges between 4 to 12 inches (102 to 305 mm) in width make openings along the ledge accessible only if there are handholds at intervals of 3 feet (0.91 m) or less in the wall above the ledge. Noncontinuous footholds similar to a ledge are considered to provide accessibility only if they occur at intervals of 3 feet or less, and with handholds.

22.1.9 When the requirements for accessibility are applied, any opening, ledge, roof, fire escape, or other building projection that is accessible from any other opening, ledge, roof, fire escape, or other building projection makes the other location mutually accessible. For example, if an opening is accessible from the roof of an adjoining building, the roof is also to be considered accessible from the opening in question.

Figure 22.1
Accessibility of openings from adjacent wall on same level



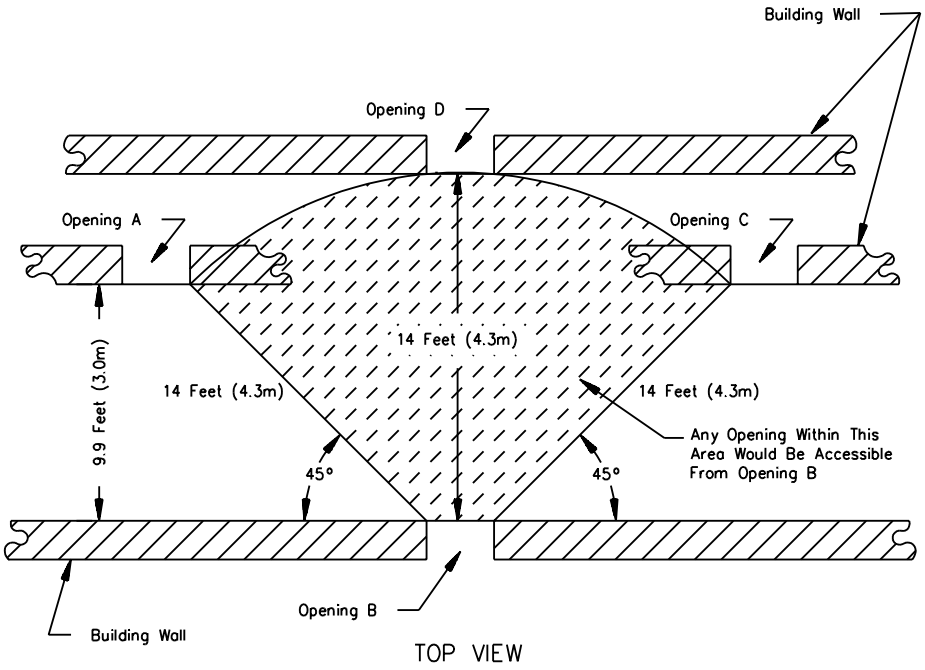
1. Opening B is accessible from opening C.

2. Opening A is accessible from opening D.

3. Opening B is not accessible from opening D because the angle formed with the building wall is not 45 degrees.

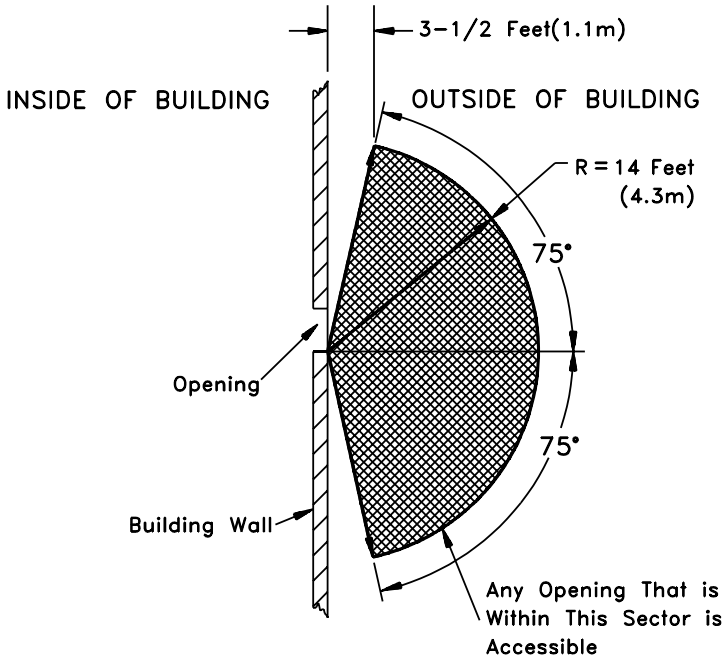
4. Opening A is not accessible from opening C because the angle formed with the building wall is not 45 degrees.

Figure 22.2
Accessibility of opening from opposite wall (horizontal plane)



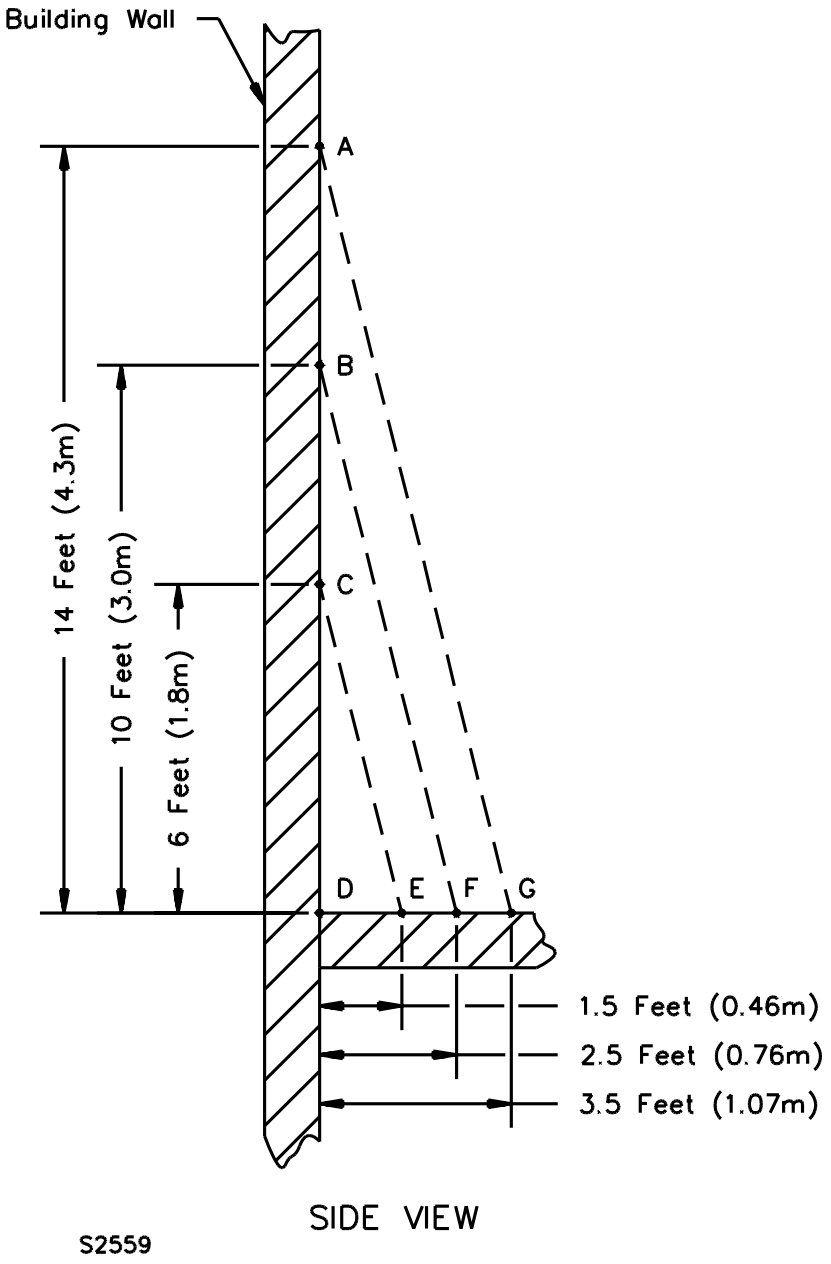
S2557

Figure 22.3
Accessibility of openings from opposite wall



S2558B SIDE VIEW

Figure 22.4
Accessibility of openings from same wall



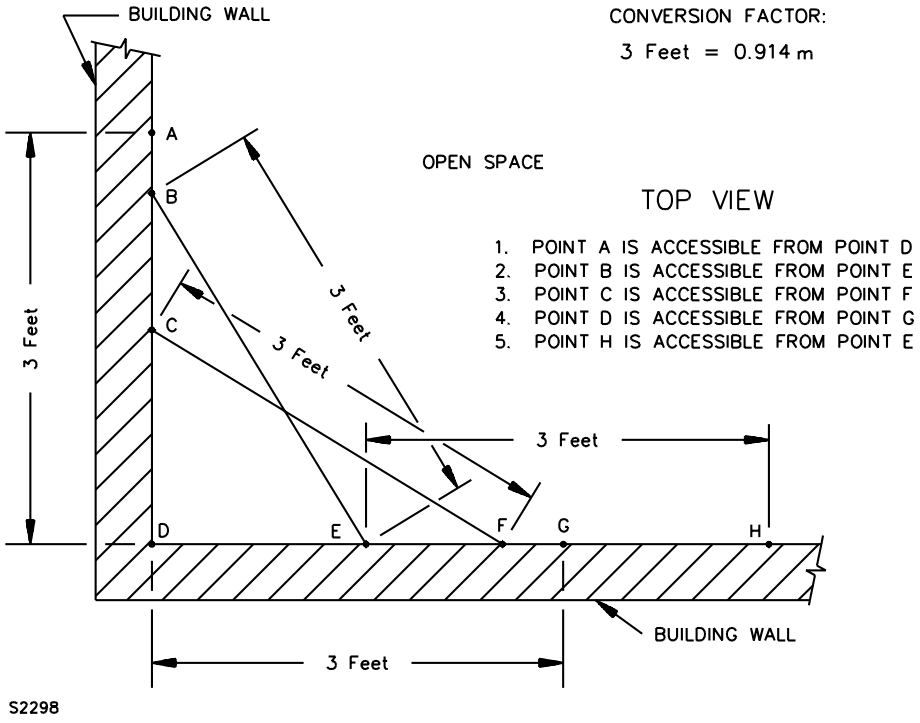
1. Any opening within C D is accessible from E.

2. Any opening within B D is accessible from F.

3. Any opening within A D is accessible from G.

Each distance is determined by the ratio 1 to 4.

Figure 22.5
Accessibility of openings from adjacent wall and on same wall on same floor level



22.2 Ventilating shafts and ducts

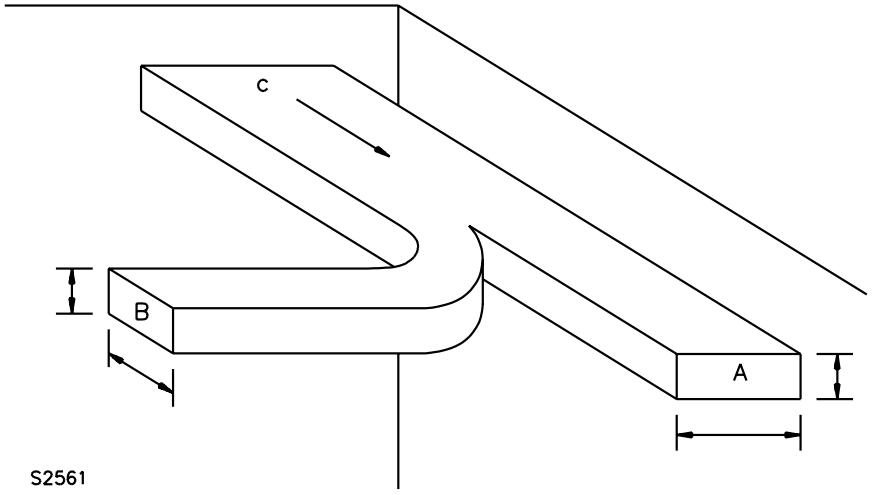
22.2.1 For an Extent Number 3 system, a ventilating shaftway or duct exceeding 144 square inches (930 cm^2) in area with the smallest dimension exceeding 6 inches (152 mm) is an opening and shall be protected where it crosses the boundary of the protected property or at the point where it opens into the protected area. A ventilating shaftway or duct having approximately a right-angle bend shall require protection over the opening only if the cross-section area of the duct exceeds 192 square inches (1240 cm^2) and the smallest dimension is not less than 8 inches (203 mm). Such protection is not required if the area is protected as specified in 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c). See Figure 22.6.

22.2.2 For Extent Number 3 installations, an unperforated access door on a metal duct may be protected by contacts only if the door is of the same material as the duct.

22.2.3 Small louvered registers may be protected by contacts or trapped if it is necessary to remove the entire register in order to create an opening of manhole size. Such protection is not required by the specifications in 4.1.3.1 (b) or (d), 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c).

22.2.4 For an Extent Number 1 or Extent Number 2 system, a ventilating shaftway or duct exceeding 96 square inches (619 cm^2) in area with the smallest dimension exceeding 6 inches (152 mm) is an opening and shall be protected at the point where it crosses the boundary of the protected area. For an Extent Number 2 system, such protection is not required if the area is protected as specified in 4.1.3.1 (b) or (d). See Figure 22.7.

Figure 22.6
Protection of ducts for extent number 3



If the duct area at outlet A exceeds 144 square inches (930 cm^2) and the minimum dimension is more than 6 inches (152 mm), protection is required at A or C. If the duct area at outlet B exceeds 192 square inches (1240 cm^2) and the minimum dimension exceeds 8 inches (203 mm), protection is required at B or C. Such protection is not required by the specifications in 4.1.4.1 (b) or (d), or 4.3.2.1 (b) or (c).

22.3 Removable ceilings

22.3.1 If the area above a liftout ceiling is common to more than one premises and party walls extend only to the ceiling:

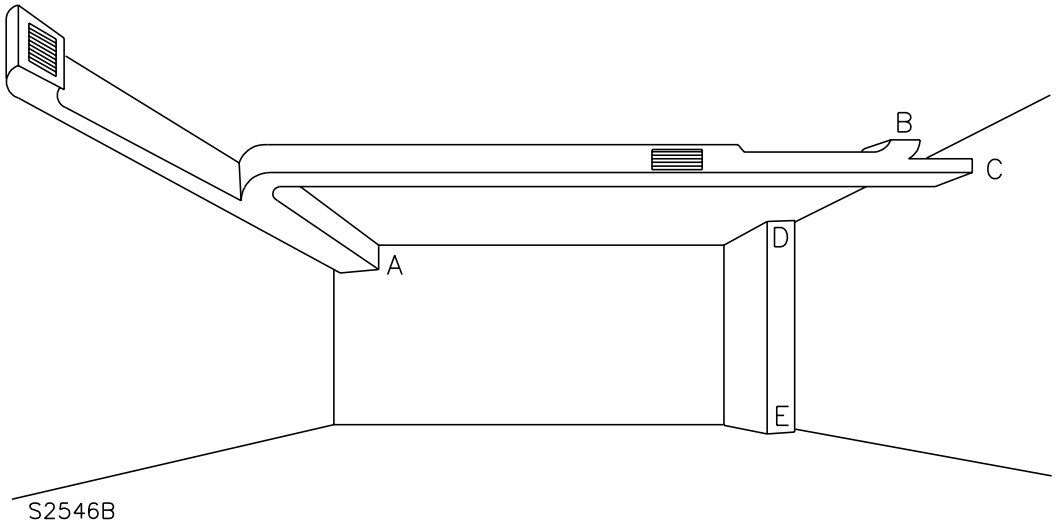
a) For Extent Number 2, the premises shall be protected in accordance with 4.1.3.1 (b) or (d).

b) For Extent Number 3, the premises shall be protected in accordance with 4.1.4.1 (b) or (d) or 4.3.2.1 (b) or (c).

22.4 Wire-mesh screening

22.4.1 For Extent Numbers 3 and 4 installations, wire-mesh screening is considered a wall and does not require protection if it is constructed of at least 0.053 inch (1.35 mm) minimum thickness expanded sheet steel or No. 10 AWG (0.10 inches diameter) (5.3 mm^2) steel wire with openings not greater than 2 inches (51 mm). Protection, such as alarm screens or linings and similar devices, is required for Extent Number 1 and for compliance with 4.1.3.1 (a) or (d) for Extent Number 2 installations.

Figure 22.7
Protection of ducts for extent number 1 and 2



Points where ventilating ducts enter a premises (A, B, C, D, and E) shall be protected unless the cross sectional area of the duct is less than 96 square inches (619 cm^2) or the minimum dimension is 6 inches (152 mm) or less. For Extent Number 2, such protection is not required by the specifications in 4.1.3.1 (b) or (d).

HOLDUP ALARM INSTALLATIONS

23 Installation of Holdup Alarm Initiating Devices

23.1 General

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

23.1.2 Holdup alarm initiating devices may be installed as supplementary devices in central station burglar alarm systems, police station connect burglar alarm systems, and proprietary burglar alarm systems, or as an independent holdup alarm system of the semiautomatic or manual type.

23.1.3 Holdup alarm initiating devices shall comply with the Standard for Holdup Alarm Units and Systems, UL 636.

23.1.4 Initiating devices shall be located in such a manner that the risk of unintentional operation by employees, by janitors, by cleaners, and the like, working about the premises, by falling objects, by customers, by building vibration, and by similar causes is unlikely.

23.1.5 A holdup alarm initiating device shall lock into the alarm position when it is operated and shall require being manually reset or it shall display a visual indication of having been operated at the device or at the control unit or at the location where the holdup alarm signal is received. The visual indication shall require manual reset.

23.1.6 Each holdup alarm initiating device shall require positive, intentional action to initiate a holdup alarm signal.

23.1.7 Operation of a holdup alarm initiating device shall not result in an audible signal at the protected premises or a visual signal that can be observed by a holdup person.

23.1.8 Each manually operated holdup alarm initiating device shall be installed so that it cannot be observed by the public and so that it can be operated in a manner that will not be obvious to an attacking party. Each semiautomatic holdup alarm initiating device shall be installed so that it is not noticeable to an attacking party during a holdup attempt and is not noticeable to the public or an attacking party prior to a holdup attempt.

23.1.9 Each employee that might use a holdup alarm initiating device during a holdup attempt shall be instructed in the proper operation of the device. They shall be instructed that if they are directly confronted by the attacking party, they shall not attempt to operate a manual holdup alarm initiating device. In addition they shall be trained to follow the procedures provided by their employer and the law enforcement agency having jurisdiction.

23.2 Supplementary holdup alarm initiating devices

23.2.1 Holdup alarm initiating devices may be installed as a supplement to a burglar alarm system. When a complete holdup alarm system is required, it shall be installed in accordance with the requirements for a semiautomatic holdup alarm system, 23.3.1 – 23.3.7, or for a manual holdup alarm system, 23.4.1 – 23.4.9.

23.2.2 Holdup alarm initiating devices installed in conjunction with and incidental to a burglar alarm system shall be installed in selected locations where they can be operated during an attack without attracting the attention of the attacking party. See 23.1.8 and 23.1.9.

23.2.3 Bill traps and other cash drawer initiating devices shall be installed in pairs and arranged so that the bills must be withdrawn from both in order to initiate a holdup alarm signal. If only one initiating device is operated, there shall be a visual signal at the protected premises. See 23.1.7.

23.3 Semiautomatic holdup alarm systems

23.3.1 A semiautomatic holdup alarm system shall provide the types and number of initiating stations specified in 23.3.2 – 23.3.7.

23.3.2 Bill traps or other cash drawer initiating devices shall be installed in pairs in each cash drawer and arranged so that the bills must be withdrawn from both in order to initiate a holdup alarm signal. If only one initiating device is operated, there shall be a visual signal at the protected premises. See 23.1.7.

23.3.3 Each door leading from the public space to work spaces shall be equipped with an automatic lock and closer and, in addition, shall have means whereby an employee can, without detection by a bandit, initiate an alarm when commanded to open the door when the bandit and employee are on the public space side.

23.3.4 Each fixture between the public space and the work space shall be equipped so that an alarm will be initiated automatically if an attempt is made to climb over a fixture.

23.3.5 Each vault that is open during business hours shall have at least one manual initiating device.

23.3.6 There shall be at least one initiating device located near an employee least likely to be menaced by a bandit to permit the transmission of an alarm in the event that only counter currency is demanded.

23.3.7 Manually operated holdup alarm initiating devices shall be installed so that they can be operated during an attack without attracting the attention of the attacking party. See 23.1.8 and 23.1.9.

23.4 Manual holdup alarm systems

23.4.1 A manual holdup alarm system comprised of manually operated alarm initiating devices is intended primarily for application to mercantile premises or financial institutions having low counters or other fixture arrangements not easily adaptable to a semiautomatic holdup alarm system.

23.4.2 The construction, operation, and location of devices most acceptable for these installations will depend upon many factors for which only general requirements may be stated in 23.4.3 – 23.4.8.

23.4.3 Each cage in which money or securities are received or passed to customers shall have at least one alarm initiating device.

23.4.4 Each cage in which money or securities are handled but are not exchanged with customers shall have an alarm initiating device.

23.4.5 An alarm initiating device shall not be mounted where its operation can be viewed from the public space.

23.4.6 If open counter construction prevails, as in jewelry or other retail stores, alarm initiating devices shall be located at strategic points along the counters at intervals not exceeding 12 feet (3.7 m).

23.4.7 In banks, and the like, alarm initiating devices shall also be installed convenient to one or more officers or officials located adjacent to and commanding a view of the public space.

23.4.8 Alarm initiating devices shall be located where they can be operated during an attack without attracting the attention of the attacking party. See 23.1.8 and 23.1.9.

23.4.9 Bill traps and other cash drawer initiating devices shall be installed in pairs and arranged so that the bills must be withdrawn from both in order to initiate a holdup alarm signal. If only one initiating device is operated, there shall be a visual signal at the protected premises. See 23.1.7.

23.5 Outside wiring

23.5.1 For leased or other wires, standard telephone operation practice will be accepted. For requirements pertaining to protectors on each circuit, aerial or underground, refer to the National Electrical Code, ANSI/NFPA 70.

23.5.2 Wires used outside buildings to connect the protected premises with a remote station shall be run underground. The installation of outside wiring shall comply with the requirements for such wiring in the Standard for Central-Station Alarm Services, UL 827.

Exception: When not permitted by the installation, the wires may be run overhead.

SERVICE AND MAINTENANCE

24 General

24.1 Installations shall be maintained by the alarm service company under provisions of a service contract or agreement.

24.2 All parts of an installation shall have a visual inspection and operational test at least once a year by a representative of the alarm service company. A record of the inspection and test shall be kept in the alarm service company's file. Equipment found to be not working properly shall be adjusted, repaired, or replaced. Any alarm system found not in compliance with the requirements of this standard due to the following shall be promptly corrected:

a) Equipment faults,

b) The modification of the building or protected objects which affects the protection, or

c) The expansion of a building that leaves unprotected openings or the like.

The inspection and test may be done in parts throughout the year.

24.3 The alarm service company shall have a published telephone number.

24.4 The alarm service company shall maintain a means of receiving requests for service at all times and shall keep a record of the time and date that:

a) A request for service is received,

b) Service begins, and

c) The repairs are completed.

24.4.1 Upon completion of repairs of an alarm system, the representative of the alarm service company shall test and verify the operability of the part of the alarm system that was repaired, the control unit, and sounding device, if installed. The results of these tests shall be entered on the record of the repair.

24.4.1 added January 19, 2001

24.5 Requests for service shall be received by alarm service company personnel, or a method shall be devised that will result in the beginning of service within the time interval indicated in (a) – (f) below.

a) Repairs to a local or police station connect mercantile alarm system shall begin within 18 hours after the receipt of a service request. The maximum range of travel (driving time) from the company's main business location or a service center to an alarm system installation shall not exceed 3 hours in a land-based vehicle.

b) Repairs to a local or police station connect bank alarm system shall begin within 24 hours after the receipt of a service request. In cases where access to the protected property is controlled by a time lock that is not scheduled for release within 24 hours of the service request, service shall begin when the time lock releases. The maximum range of travel (driving time) from the company's main business location or service center to an alarm system installation shall not exceed 6 hours in a land-based vehicle.

c) Repairs to a holdup alarm system shall begin within 24 hours after the receipt of a service request. The maximum range of travel (driving time) from the company's main business location or service center to an alarm system installation shall not exceed 6 hours in a land-based vehicle.

d) Repair services for a central station or limited mercantile burglar alarm system shall begin within:

1) One hour plus the designated response time for the system after its scheduled closing time if the service request is received while the protected property is open for business.

2) One hour plus the designated response time for the system after the receipt of the service request if the request is made as a result of trouble that has developed:

i) At closing time,

ii) After the property has been closed and armed, or

iii) After an alarm investigation.

The designated response times for central station and limited mercantile systems are specified in the Standard for Central-Station Burglar-Alarm Systems, UL 611.

e) Repairs to a proprietary alarm system shall begin within 18 hours after the receipt of a service request or from the time that the central supervising station personnel have determined that service is required. The maximum range of travel (driving time) from the central supervising station or service center to an alarm system installation shall not exceed 3 hours in a land-based vehicle.

f) Repairs to a national industrial security system shall begin as specified in the Standard for National Industrial Security Systems for the Protection of Classified Material, UL 2050.

g) Records of trouble calls and repair service shall be kept for at least 1 year.

Exception No. 1: Regarding (a) – (f), the beginning of repair service may be extended to the time that the protected property is next open for business if the subscriber to the alarm service provides written or oral authorization. Authorization shall be given to alarm service company personnel when the subscriber makes the decision to delay service. If authorization is given, the alarm service company shall make a record of the:

a) Time and date of the authorization,

b) Name and identification code of the person giving the authorization, and

c) Name and address of the company receiving alarm service.

Exception No. 2: For a central station or limited mercantile system the beginning of repair service may be extended beyond the specified time if an authorized representative of the subscriber or the alarm service company remains at the premises until the arrival of the serviceperson.

24.6 The alarm service company shall provide the alarm service subscriber with written instructions on how to contact the company for service. The method of communication illustrated shall allow the subscriber to promptly report trouble conditions.

24.7 If the installation and maintenance of remote alarm receiving equipment is the responsibility of another company, this company shall be a qualified alarm service company. There shall be a written contract with cancellation notification between the two companies that provides for the same maintenance and service as would be provided if one company were responsible for the entire system.

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24.8 Service centers maintained by the alarm service company shall provide the same maintenance service as that available from the alarm service company's main center. A complete stock of equipment replacement parts and repair service shall be available.

24.9 The alarm service company responsible for the burglar alarm system or the holdup alarm system shall provide instructions to the users of the system on the proper operation of the system. See 23.1.9. These instructions shall be given in oral form when the system is put into service and the instructions shall then be provided to the users in written form.

25 Batteries

25.1 A battery, rechargeable or non-rechargeable, shall be serviced and replaced:

a) As recommended by the battery manufacturer,

b) As recommended by the manufacturer of the equipment in which the battery is used, or

c) When the control unit signals that the battery needs to be replaced.

RADIO ANTENNA AND ANTENNA CABLE

26 General

26.1 The installation of a one way radio (RF) signal transmitter or of a cellular telephone transceiver shall:

a) Locate the antenna and antenna cable inside of the building where the alarm system is located,

b) Protect the antenna with a motion detector that complies with the Standard for Intrusion-Detection Units, UL 639, whose alarm output is connected into an alarm initiating device circuit of the system with which it is used, and is armed when the alarm system is armed,

c) Install the antenna cable:

1) In rigid metal conduit or electrical metallic tubing when it is exposed and in flexible metal conduit when it is concealed by the building structure or

2) Protect it with a motion detector that complies with UL 639 whose alarm output is connected into an alarm initiating circuit of the system with which it is used, and is armed when the alarm system is armed.

d) Install the initiating device circuit wiring of the motion detector used for such protection:

1) In rigid metal conduit or electrical metallic tubing when it is exposed,

2) Concealed within the building structure, or

3) Located within the detection field of the motion detector.

Exception No. 1: Such protection is not required when a one way radio (RF) transmitter or cellular telephone transceiver is used with another independent signal transmission method, and each monitors the other so that an alarm or trouble signal will be transmitted when one detects a fault in the other.

Exception No. 2: Such protection is not required for a two-way radio (RF) system.

26.2 The motion detector shall be adjusted to detect the motion of an intruder within four steps or less.

APPENDIX A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard − UL Standard Designation

Burglar Alarm Units and Systems, Police Station Connected – UL 365
Burglar Alarm Units and Systems, Proprietary – UL 1076
Burglar-Alarm Units, Central-Station – UL 1610
Central-Station Alarm Service – UL 827
Digital Alarm Communicator System Units – UL 1635
Holdup Alarm Units and Systems – UL 636
National Industrial Security Systems for the Protection of Classified Material – UL 2050

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APPENDIX B

PROCEDURES FOR ISSUING AND CANCELING CERTIFICATES

B1 Certificates

B1.1 Underwriters Laboratories Inc. (UL) under its Certificate Service program authorizes the issuance of Certificates for burglar alarm system installations which a Listed Alarm Service Company (ASC) represents to be in compliance with requirements established for the Category of service. An issued Certificate indicates the type of service, extent of protection, name and location of protected property, period of issuance, and name and address of the ASC Service Center.

B1.2 An alarm system is considered to be Listed only if it is covered by a current Certificate. Only those alarm system installations for which a Certificate has been properly issued are covered under UL's Certificate Service. The verification of a Certificate on ″Underwriters Laboratories Certificate Verification Service″ (ULCVS) is a method UL provides to identify Certificated alarm systems actively covered under its Listing and Follow-Up Service.

B1.3 A certificate may also be verified by telephone if its serial number is known or the correct name, address, and zip code are known. Telephone UL's Northbrook, Illinois office and ask to be connected to the burglar alarm certificate service.

B1.4 UL regularly counterchecks representative Certificated alarm system installations of each ASC. Under the Follow-Up Service program UL Field Representatives conduct regular inspections and tests of representative alarm system installations to determine the correctness of installation of protective devices and wiring, quality of workmanship, operability of circuits, the maintenance procedures, and levels of protection. If an alarm system does not comply with UL's requirements it is subject to correction by the ASC or cancellation of the Certificate.

B1.5 UL makes no representations or warranties, expressed or implied, that the alarm system will prevent any loss by burglary, holdup, or otherwise, or that the alarm system will in all cases provide the protection for which it is installed or intended. UL may at times conduct inspections of the ASC, including inspections of representative installations made by it. UL does not assume or undertake to discharge any liability of the ASC or any other party. UL is not an insurer and assumes no liability which may result directly or indirectly from inspection of the equipment, failure of the equipment, failure to conduct inspections, incorrect Certification, nonconformity with the requirements, failure to discover nonconformity with the requirements, cancellation of the Certificate or withdrawal of the ASC from inclusion in UL's Directory prior to the expiration date on the Certificate.

B1.6 The following is a list of the Categories, and corresponding types of Certificates, under UL's Certificate Services for which ASCs may obtain Listings. As Listees, ASCs may issue only the Certificate types of each Category in which they are Listed. (ULCVS can be used to verify the Listing categories of the ASC.) The Category name is followed by the Category Control Number (CCN) used to reference the Listings in UL's Product Directories; and the types of Certificates that may be issued by the ASC for each Category.

CENTRAL STATION BURGLAR ALARM SYSTEMS – Reference CCNs: CPHZ and CPVX. Certificate types ″CENTRAL STATION BURGLAR ALARM SYSTEM CERTIFICATE.″

NATIONAL INDUSTRIAL SECURITY SYSTEMS – Reference CCNs: CPHZ and CRZH. Certificate type ″NATIONAL INDUSTRIAL SECURITY SYSTEM CERTIFICATE.″

BANK BURGLAR ALARM SYSTEMS – Reference CCNs: CPHZ and CPRH. Certificate type ″BANK BURGLAR ALARM SYSTEM CERTIFICATE.″

MERCANTILE BURGLAR ALARM SYSTEMS – Reference CCNs: CPHZ and CVSG. Certificate type ″MERCANTILE BURGLAR ALARM SYSTEM CERTIFICATE.″

PROPRIETARY BURGLAR ALARM SYSTEMS – Reference CCNs: CPHZ and CVWX. Certificate type ″PROPRIETARY BURGLAR ALARM SYSTEM CERTIFICATE.″

MANUAL HOLDUP ALARM SYSTEMS – Reference CCNs: MTCV and MTQT. Certificate type ″HOLDUP ALARM SYSTEM CERTIFICATE.″

SEMI-AUTOMATIC HOLDUP ALARM SYSTEMS – Reference CCNs: MTCV and MUER. Certificate type ″HOLDUP ALARM SYSTEM CERTIFICATE.″

B2 Forms and Instructions

B2.1 The following forms and instructions for their use are required:

a) Alarm System Certificate Request,

b) Alarm System Description for:

1) Central Station Burglar Alarm System,

2) National Industrial Security System,

3) Bank Burglar Alarm System,

4) Mercantile Burglar Alarm System,

5) Proprietary Burglar Alarm System,

6) Holdup System,

c) Certificate Cancellation Request.

Copies of these forms and instructions may be ordered by using the ″Certificate Service Forms Order Form″ or by writing, faxing, or telephoning the certificate service at UL's Northbrook, Illinois office.

B2.2 If a National Industrial Security System, Bank System with remote connection, Mercantile System with remote connection, or Holdup Alarm System changes the central-station residential monitoring station or law enforcement agency that the alarm system transmits its signals to, the current Alarm Certificate shall be canceled and a new Certificate issued that identifies the new central-station residential monitoring station or law enforcement agency.

B2.2 added February 26, 1999

B3 Procedure for Issuing a Certificate

B3.1 There are five steps to issuing a Certificate as follows:

a) The ASC may only issue Certificates in Categories for which the ASC maintains an active Listing. UL provides the ASC with ″Request for Certificate″ forms (common to all types of Certificates) and ″Alarm System Description″ (one form for each Category of Listing). These forms are used by the ASC to have UL process and print a Certificate.

b) The ASC initiates the Certificate issuing process by executing the ″Request for Certificate″ and an appropriately corresponding ″Alarm System Description″ form. The original of the Request for Certificate″ shall be attached to the ″Alarm System Description″ and sent to the UL Northbrook Office for processing. For faster service, the ASC may ″FAX″ a copy of the ″Request for Certificate″ and ″Alarm System Description″ forms. UL will then communicate a serial number to them. See Faster Service by FAX, Section B3.

c) When UL receives the original of both forms (Request for Certificate and System Description), a Certificate will be printed after verifying that the information on the ″Request for Certificate″ form and ″Alarm System Description″ form, is correct. Thirty days before the issue date, UL sends the ″Certificate″ to the ASC. The Certificate is then added to the ″Master Certificate File″ in a ″pending″ status.

d) The ASC signs the Certificate and distributes it to the representative of the protected property.

e) On the issue date indicated on the request, UL will activate the Certificate, and the installation becomes eligible for periodic view.

B3.2 Some categories of systems allow remote monitoring from different types of monitoring locations. Select the type of monitoring system and fill in the information requested for the selected type. The definitions of the various types of remote monitoring locations are:

a) Burglar Alarm Central Station – A Listed service center providing burglar alarm monitoring, runner response, and meeting all operational requirements for central station burglar alarm service as defined in the Standard for Central-Station Alarm Services, UL 827.

For a central station burglar alarm certificate, the remote monitoring location must be the same company and file number as the ASC, but may have a different location. The monitoring location must be Listed under UL 827 for central station burglar alarm service (CPVX).

An alarm service company Listed under UL 827 for central station burglar alarm, central station fire alarm, or as a residential monitoring station, may monitor mercantile and bank burglar alarm systems and need not be the same company as the ASC.

b) Police Dispatch Center – A police station or designated municipal facility whose primary purpose is to dispatch police and other emergency services.

c) Residential Monitoring Station – A Listed service center under UL 827 whose primary purpose is to monitor burglar alarm signals from residential alarm systems. It may also monitor signals from mercantile and bank burglar alarm systems.

d) Government Contractor Monitoring Station – A facility operated by a contractor of the US government for the purpose of monitoring national industrial security systems that are installed in areas occupied by that contractor and/or by a subcontractor(s) to that with the subcontractor(s) located in facilities owned, operated, or leased by that contractor. National industrial security systems may also be monitored by (a), (b), or (c) facilities.

B4 Faster Service by Fax

B4.1 If the serial number of the Certificate is needed sooner than would be possible by UL sending the Certificate through normal US mail service, UL provides for faster service through Speed Service. It can be used as follows:

a) After completing the ″Request for Certificate″ and ″Alarm System Description″ forms, FAX a copy of the forms to the Certificate Service Data Desk at Northbrook, Illinois. Phone the Northbrook office for the current fax number.

b) When the FAXed request is received, UL will then contact the Service Center by phone or FAX and provide the serial number of the Certificate. UL will add this number to the ″Master Certificate File″ in a ″Pending″ status.

c) The ASC shall then add to the ″Request for Certificate″ and ″Alarm System Description″ forms, the serial number given to them by the data desk. The number is to be entered in the lower portion of the box in the upper right hand corner of each form.

d) The steps then proceed the same as described in the Procedures for issuing a Certificate, Section B3.

e) This service will normally be available during UL's business hours. Requests and descriptions received by 2:30 p.m. Central Time will be responded to that day. If received after 2:30 p.m., they will be responded to the next business day. The FAX machines will receive transmissions at any time.

B5 Correction of Defects

B5.1 Should an inspection disclose that an alarm system does not comply with UL's requirements in effect at the time of issuance of the certificate, the ASC shall correct the alarm system within 30 days of being notified of the defect. A serious defect shall be corrected immediately (within the service period for the specific Category of service). A written report on the actions taken to correct the defect shall be made to UL. If the ASC fails to correct the defect UL will cancel the Certificate and notify the protected property of the action.

B5.2 Failure of the ASC to maintain an acceptable record of compliance with UL's requirements, shall warrant a special investigation of installation or service. If improvement is not shown during the special investigation period, the ability to issue Certificates is subject to suspension, or Listing for the service may be withdrawn.

B6 Master Certificate File

B6.1 A master file of all active Certificates (AKA Certificate Service Database) is maintained by UL and is accessible by Insurance Companies and Authorities Having Jurisdiction through ULCVS, see B1.2.

B6.2 ASCs may also have access to computer generated lists of their active Certificates. To obtain a list of Certificates, an ASC must make this request in writing, and also indicate who is to receive the list. The ASC is limited to two requests per year as part of the normal Certificate service. Additional copies will be provided for a nominal fee. Electronic-media copies are also available for a fee.

B7 Maintenance and Service

B7.1 An alarm system on which a burglar alarm Certificate is in effect, shall be under maintenance and service contacts or agreement with the ASC. The expiration date of the Certificate shall not exceed the expiration date of the contract or agreement.

B7.2 An alarm system on which a burglar alarm Certificate is in effect, shall be inspected at intervals sufficiently frequent to provide continuous service. The interval between regular maintenance inspections shall not exceed 1 year.

B7.3 For other maintenance requirements, refer to:

a) For central station systems, the Standard for Central-Station Alarm Services, UL 827;

b) For proprietary systems, the Standard for Proprietary Burglar Alarm Units and Systems, UL 1076;

c) For national industrial security systems, the Standard for National Industrial Security Systems for the Protection of Classified Material, UL 2050 and;

d) For service and maintenance, Section 24 of UL 681.

B8 Service Area

B8.1 For central station, limited mercantile, and national industrial security systems, the limits of coverage, as determined by time for alarm investigator response and response time for service and maintenance, are based on identification of a service territory through the use of United States Post Office zip codes. An alarm service company selects those zip codes (areas) it will service as verified through periodic audits of the response capability by Underwriters Laboratories Inc. The area coverage is defined by five-digit or nine-digit zip codes, or some of each. A response area need not include all zip codes within the general area. A zip code shall define the physical address of each Certificated installation.

B8.2 For all other alarm services, the limits of coverage, based on identification of a service territory through the use of United States Post Office zip codes, are determined by response time for service and maintenance only.

B8.3 See 24.4 for required travel and response times.

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APPENDIX C

Glossary

ALARM SERVICE COMPANY (ASC) – The company (Listee) providing, installing and maintaining the alarm system under UL's Certificate Service programs.

ALARM INVESTIGATOR – An employee of the ASC, on duty at all times at a central station, a satellite station, a service station, an alarm investigator's station, or in a vehicle in constant radio contact with the central station, available for prompt dispatching to the protected property.

ALARM SYSTEM – A protective signaling system which is the combination of interrelated signal initiating devices, signal transmitting devices, signal indicating devices, control equipment and interconnecting wiring installed for a particular application.

AUTHORITY HAVING JURISDICTION (AHJ) – A law enforcement agency, government agency, insurance underwriters, and others having final right of determination of specifications and requirements for alarm system.

CATEGORY (PRODUCT) – A generic grouping of products having common functional and design features to facilitate the application of uniform requirements as the basis of UL Listing, Classification, or Recognition.

CCN, (CATEGORY CONTROL NUMBER) – An alphanumeric system used to designate and identify the individual product categories covered by UL's Listing, Classification, Recognition, and Certificate Services. See ″CATEGORY.″

COMBINATION SYSTEM – A system that provides an alarm sounding device at the protected premises and employs either a code transmitter, direct wire unit, digital alarm communicator unit, multiplex unit, or radio transmitter to send signals to the central-station.

DIRECTORY (PRODUCT) – A publication issued annually by UL that contains the names of companies having products and services that comply with UL's requirements.

EXTENT OF PROTECTION – The designation used to describe the amount of alarm protection installed at the protected area.

FILE NUMBER – Refers to UL's reference file numbers for each ASC Listing. A number assigned by UL to identify a file for a Listee within a specific ″Product Category.″ (One each per Listing category.)

KEY – The word key has two meanings. The first refers to the keys that are in the possession of a central station. The second, a real key or key pad used to control or signal an alarm system that proper authorization has been received.

LINE SECURITY – An alarm signal transmission method that also incorporates equipment which provides a high degree of supervision on the signaling line or channel between the protected area and the remote monitoring location. This supervision increases the alarm system resistance to a compromise attack.

LISTEE – The party whose name appears under a product category (Listed) in one of UL's published Product Directories.

PROTECTED PROPERTY – The business, location, or area protected by the alarm system. The protected property is the alarm system user.

SERVICE CENTER NUMBER – This is a number, code or distinctive identification, assigned either by UL or the ASC, which when used in association with a client's file number uniquely defines a central station, service center, satellite station, monitoring station, or other service location of the Listee.

STANDARDS (UL) – Criteria used by UL as the primary basis for determining the eligibility of a product to use UL's Listing, Classification, or Recognition Mark and other Markings or Certificates that may be required.

TYPE OF SYSTEM – Is a general description of the area of the property being protected.