

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**April 4, 1995****Revision pages for****Standard for****Burglary-Resistant Electric Locking Mechanisms****UL 1034, Fourth Edition**

Attached to this transmittal notice is a revision of the fourth edition of UL 1034.

A CHANGE ON A PAGE DATED APRIL 4, 1995 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THIS REVISION IS BEING ISSUED TO CORRECT (1) A TYPOGRAPHICAL ERROR IN PARAGRAPH 1.2 AND (2) THE EXCEPTION TO PARAGRAPH 12.2.3.2, WHICH WAS INADVERTENTLY LOCATED AFTER PARAGRAPH 12.2.3.1. THE REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR PARAGRAPH 1.2 WHICH BECOMES EFFECTIVE FEBRUARY 1, 1996 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL FEBRUARY 1, 1996, DO NOT DISCARD THE PREVIOUS PAGE CONTAINING THE REQUIREMENT SPECIFIED ABOVE UNTIL THIS FUTURE EFFECTIVE DATE.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect 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.

Attention is directed to the note on the title page of this standard identifying that the Department of Defense has adopted the text of UL 1034.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 1034-1995.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	July 27, 1994 (Reprinted April 4, 1995)
2	—
3 – 6	July 27, 1994
7	April 4, 1995
8 – 26	July 27, 1994
27	April 4, 1995
28 – 72, A1	July 27, 1994

JULY 27, 1994
(Title Page Reprinted: April 4, 1995)



1

UL 1034

Standard for

Burglary-Resistant Electric Locking Mechanisms

First Edition – July, 1974
Second Edition – September, 1980
Third Edition – September, 1987

Fourth Edition

July 27, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated July 27, 1994. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI SE2.11-1975, November 20, 1975
Approved as ANSI/UL 1034-1981, August 20, 1981
Approved as ANSI/UL 1034-1987, June 4, 1987
Approved as ANSI/UL 1034-1995, January 3, 1995

The Department of Defense (DoD) has adopted UL 1034 on July 1, 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 published set of revision pages.

ISBN 1-55989-619-1

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INTRODUCTION

1 Scope

1.1 These requirements apply to the construction, performance, and operation of burglary-resistant electric locking mechanisms and their related devices, such as control units, control switches, and power supplies, and the like used to secure and release doors.

1.2 A burglary-resistant electric locking mechanism shall be rated according to the three elements used to determine its maximum effectiveness:

- a) Static strength rating of 500 pounds-force (2224 N), 1000 pounds-force (4448 N), or 1500 pounds-force (6673 N). See 53.2.1.
- b) Dynamic strength rating of 33 foot-pounds-force (45 J), 50 foot-pounds-force (68 J), or 70 foot-pounds-force (95 J). See 53.3.1.
- c) Endurance rating of 100,000 or 250,000 cycles. See 37.2.1.

A burglary-resistant electric locking mechanism shall be rated with its maximum static strength, dynamic strength, and endurance.

Revised 1.2 effective February 1, 1996

1.3 A burglary-resistant electric locking mechanism is intended to be used in conjunction with an access control system or a manual-release mechanism. A burglary-resistant electric locking mechanism shall be constructed so that it either does not interfere with egress through the door or other opening cover that it is used to control, or its locking action shall be capable of being released as required by the authority having jurisdiction if an emergency egress is required.

Added 1.3 effective February 1, 1996

1.4 These requirements do not pertain to the fire-retardant classification of a door and releasing-device assembly.

1.5 The term "product" as used in this standard refers to all types of burglary-resistant electric locking mechanisms.

1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involve a risk of injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.6 added July 27, 1994

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component need not comply with a specific requirement that:

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

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

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

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 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 potential of not more than 30 volts alternating current (ac) rms, 42.4 volts direct current (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.

3.3 CORD-CONNECTED PRODUCT — A product intended for connection to the power source by means of a supply cord. By the nature of its design, such a product is intended to be moved for interchange or realignment of the component of a system.

3.4 ELECTRIC LOCKING MECHANISM — An electrically-operated door strike, dead-bolt, or the like.

3.4 added July 27, 1994

12.2.3 Qualified application

12.2.3.1 Any of the following terminal configurations may be used for connection of field wiring if all of the conditions specified in 12.2.3.2 are complied with.

- a) Telephone Type Terminals – Nonferrous terminal plates employing a narrow, V-shaped slot for securing of a conductor in a special post construction. 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. Solid conductors are pushed into slots containing spring type contacts. The leads can be removed by means of a tool inserted to relieve the spring tension on the conductor. Aluminum conductors shall not be used with push-in terminals. 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 used if found to be equivalent to (a) – (e) and limited to the same restrictions.

12.2.3.1 revised April 4, 1995

12.2.3.2 Any of the terminal configurations listed in 12.2.3.1 may be used for connection of field wiring if they comply with all of the following conditions:

- a) If a special tool is required for connection, its use shall be indicated on the installation wiring diagram by name of manufacturer and model number or equivalent, along with information as to where the tool may be obtained.
- b) The range of wire sizes shall be indicated on the installation wiring diagram. The minimum permissible wire size to be used shall not be less than No. 22 AWG (0.32 mm²).
- c) The wire size to be used shall have the current-carrying capacity for the circuit application.
- d) The terminal configuration shall comply with the requirements of the Special Terminal Assemblies Tests, Section 48.

Exception: Terminals complying with the requirements in any of the standards specified in 12.2.1.2 are not required to be subjected to the Special Terminal Assemblies Tests, Section 48.

12.2.3.2 revised April 4, 1995

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 mm²).

Exception No. 1: A lead may be less than 6 inches in length if it is evident that the use of a longer lead:

- a) May result in damage to the lead insulation or product;*
- b) May result in a risk of fire, electric shock, or injury to persons; or*
- c) Is not required for the intended operation of the product.*

Exception No. 2: Solid copper leads as small as No. 26 AWG (0.13 mm²) may be used if:

- 1) 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);*
- 2) There are two or more conductors and the conductors are covered by a common jacket or the equivalent;*
- 3) The assembled conductors comply with the requirement of 45.2.1 for strain relief; and*
- 4) The installation instructions indicate that the lead shall not be spliced to a conductor larger than No. 18 AWG (0.82 mm²).*

12.3.2 For connection of a line voltage source, the leads shall not be smaller than No. 18 AWG (0.82 mm²).

12.3.3 Leads intended for field connection shall be provided with a strain relief if stress on the lead may be transmitted to terminals, splices or internal wiring. See Strain Relief Test, Section 45.

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 which is connected to the screw shells of lampholders, and to which no primary overcurrent-protective devices or switching device of the single-pole type are connected.

12.4.2 A terminal intended for the connection of a grounded supply conductor shall be 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 which require grounding; see Bonding for Grounding, Section 17.



Underwriters Laboratories Inc.®

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March 8, 1995

Revision pages for

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Burglary-Resistant Electric Locking Mechanisms

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Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 1034-1995.

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2	—
3 – 72, A1	July 27, 1994

JULY 27, 1994
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ISBN 1-55989-619-1

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UL 1034

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Burglary-Resistant Electric Locking Mechanisms



**a century of
public safety
1894-1994**



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Underwriters Laboratories Inc., founded in 1894, is chartered as a not-for-profit organization without capital stock, under the laws of the State of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems and materials to determine their relation to hazards to life and property, and to ascertain, define and publish standards, classifications and specifications for materials, devices, products, equipment, constructions, methods, and systems affecting such hazards.

UL Standards for Safety are developed under a procedure which provides for participation and comment from the affected public as well as industry. The procedure takes into consideration a survey of known existing standards and the needs and opinions of a wide variety of interests concerned with the subject matter of the standard. Thus manufacturers, consumers, individuals associated with consumer-oriented organizations, academicians, government officials, industrial and commercial users, inspection authorities, insurance interests and others provide input to UL in the formulating of UL Standards for Safety, to keep them consonant with social and technological advances.

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July 27, 1994

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Burglary-Resistant Electric Locking Mechanisms

UL 1034, Fourth Edition

Accompanying this transmittal notice is a copy of the fourth edition of UL 1034.

A CHANGE IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR PARAGRAPHS 1.2, 1.3, 25.4.1, 25.4.2, 26.2, 30.1, 31.1, 31.2, 36.1.1, 37.1.2, 53.1.1, 53.1.2, 53.2.1, 53.2.2, 53.3.1 – 53.3.6, 54.1 – 54.4, AND 60.1, SECTION 55, AND FIGURES 53.1 AND 53.2, WHICH BECOME EFFECTIVE FEBRUARY 1, 1996 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEMS.

THE CURRENT REQUIREMENTS IN EFFECT FOR THE REQUIREMENTS HAVING FUTURE EFFECTIVE DATES ARE LOCATED IN THE BACK OF THE STANDARD.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect 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.

Some of the requirements in this standard are substantially in accordance with UL's bulletins for Subject 1034 dated January 31, 1994, and Subject 291 dated February 24, 1994. These bulletins are now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

JULY 27, 1994

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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 differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, 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 apply to the construction, performance, and operation of burglary-resistant electric locking mechanisms and their related devices, such as control units, control switches, and power supplies, and the like used to secure and release doors.

1.2 A burglary-resistant electric locking mechanism shall be rated according to the three elements used to determine its maximum effectiveness:

- a) Static strength rating of 500 pounds-force (2224 N), 1000 pounds-force (4448 N), or 1500 pounds-force (6773 N). See 53.2.1.
- b) Dynamic strength rating of 33 foot-pounds-force (45 J), 50 foot-pounds-force (68 J), or 70 foot-pounds-force (95 J). See 53.3.1.
- c) Endurance rating of 100,000 or 250,000 cycles. See 37.2.1.

A burglary-resistant electric locking mechanism shall be rated with its maximum static strength, dynamic strength, and endurance.

Added 1.2 effective February 1, 1996

1.3 A burglary-resistant electric locking mechanism is intended to be used in conjunction with an access control system or a manual-release mechanism. A burglary-resistant electric locking mechanism shall be constructed so that it either does not interfere with egress through the door or other opening cover that it is used to control, or its locking action shall be capable of being released as required by the authority having jurisdiction if an emergency egress is required.

Added 1.3 effective February 1, 1996

1.4 These requirements do not pertain to the fire-retardant classification of a door and releasing-device assembly.

1.5 The term "product" as used in this standard refers to all types of burglary-resistant electric locking mechanisms.

1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involve a risk of injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.6 added July 27, 1994

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component need not comply with a specific requirement that:

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

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

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

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 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 potential of not more than 30 volts alternating current (ac) rms, 42.4 volts direct current (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.

3.3 CORD-CONNECTED PRODUCT — A product intended for connection to the power source by means of a supply cord. By the nature of its design, such a product is intended to be moved for interchange or realignment of the component of a system.

3.4 ELECTRIC LOCKING MECHANISM — An electrically-operated door strike, dead-bolt, or the like.

3.4 added July 27, 1994

3.5 ELECTROMAGNETIC LOCK – An electrically-powered lock using an electromagnet magnetically coupled to an armature to provide locking power.

3.5 added July 27, 1994

3.6 LINE-VOLTAGE – The voltage at any field connected source of supply, nominally 50-60 hertz (Hz); 115, 208, or 230 volts.

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	$5.0 \times V_{\max}^a$	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 only	$0.030 \times V_{\max}^a$	0.030	0.030
NOTE – Reproduced in part from the National Electrical Code, ANSI/NFPA 70, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.			
^a $V_{\max}$: Maximum output voltage regardless of load with rated input applied.			
^b $I_{\max}$: Maximum output after 1 minute of operation under any non-capacitive load, including short circuit.			

Table 3.1 revised July 27, 1994

3.7 STANDBY CONDITION – The ready-to-operate condition which exists prior to being operated to unlock.

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

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

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, VA (volt-amperes)		Current (amperes)	Current limitation $I_{\max}^b$ (amperes)	Power limitation $(VA)_{\max}^c$ (volt-amperes)	Maximum overcurrent protection (amperes)
0 to 20	$5.0 \times V_{\max}^{a,d}$		5.0	$1000/V_{\max}^a$	250	5.0
over 20 to 100	100		$100/V_{\max}^a$	$1000/V_{\max}^a$	250	$100/V_{\max}^a$
over 100 to 150	100		$100/V_{\max}^a$	1.0	NA	1.0

NOTE — Reproduced in part from the National Electrical Code, ANSI/NFPA 70, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

^a $V_{\max}$: Maximum output voltage regardless of load with rated input applied.

^b $I_{\max}$: Maximum output after 1 minute of operation under any non-capacitive 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.

Table 3.2 revised July 27, 1994

4 Installation and Operating Instructions

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

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

- Typical installation instructions and drawings and complete representative installation wiring diagram(s) for the product(s) indicating recommended wiring methods which shall be in accordance with the National Electrical Code, ANSI/NFPA 70-1993.
- A concise description of the operation, testing, and maintenance procedures for the product(s), and recommended testing frequency.
- Replacement parts, such as lamps or batteries, identified in the instructions by a part number, manufacturer's model number, or the equivalent.
- A description of the conditions which might be anticipated to result in impaired operation of the product(s).
- A description of any features provided to reduce the risk of fire or electric shock, 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 General (Markings), Section 60.

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 essential components necessary for its intended function when installed (used) as intended. The product may be shipped from the factory as two or more major subassemblies. See the subassembly requirement in 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 final assembly without requiring alteration, cutting, drilling, threading, welding, or similar tasks by the installer. Two or more subassemblies, which must bear a definite relationship to each other for the correct installation or operation of the product, shall be arranged and constructed to permit them to be incorporated into the complete assembly only in the intended 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. However, this requirement does not apply to the alteration, cutting, drilling, threading, welding, or similar tasks by the installer on the door, door jamb, or the like to install and mount the product to perform its intended function.

5.2 Electrical protection

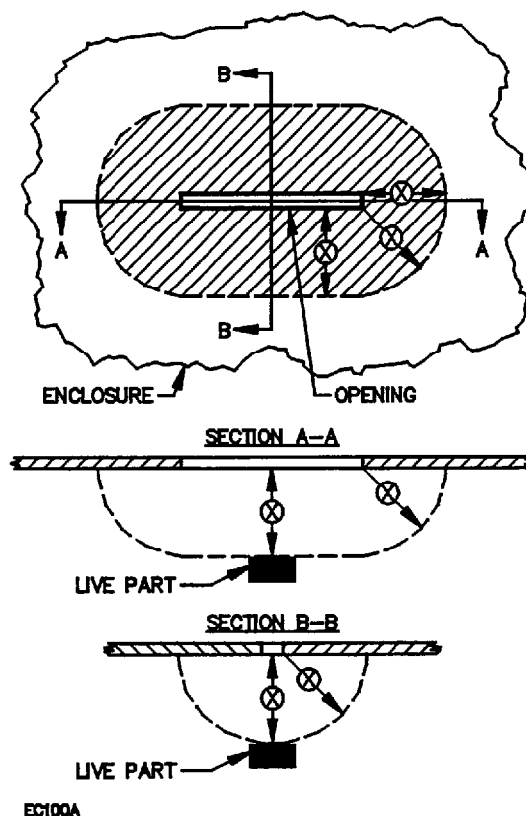
5.2.1 Louvers and other openings in an enclosure shall be constructed and located to reduce the risk of unintentional contact with uninsulated high-voltage live parts. In determining compliance with this requirement, parts such as covers, panels, and grilles used as part of the enclosure are to be removed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

5.2.2 Uninsulated high-voltage live parts shall be located, covered, 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 unless the configuration prevents direct entry to uninsulated high-voltage live parts and complies with the requirements of 5.2.4 or 5.2.5. See Figure 7.2 for examples of top cover constructions that may be considered to prevent direct entry.

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 electrical part (other than low-voltage) when inserted through the opening in a straight or articulated position.

Figure 5.2
Openings in enclosure



The opening may be used if, within the enclosure, there is no uninsulated live metal 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 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 an enclosure shall be located, covered, or enclosed so as to reduce the risk of unintentional contact by persons performing service functions which may be performed while the equipment is energized.

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

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

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 frame and enclosure of a product shall have the strength and rigidity to resist total or partial collapse and the attendant reduction of spacings, loosening or displacement of parts, or other defects. See Mechanical Strength Tests for Enclosures, Section 47.

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

7.1.3 An enclosure containing other than power limited circuits shall be constructed to reduce the risk of emission of flame, molten metal, flaming or glowing particles, or flaming drops. See Ignition Through Bottom-Panel Openings, Section 46.

7.1.4 The requirement specified in 7.1.3 necessitates either a nonflammable bottom as specified in 7.4.2, or a barrier as described in Figure 7.1 under all areas containing combustible materials. However, see 7.4.3 for further specifications.

7.1.5 A construction using individual barriers under components, groups of components or assemblies, as specified in Figure 7.1, is to be considered as complying with the requirement specified in 7.1.3.

7.2 Product enclosure mounting

7.2.1 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 may be performed.

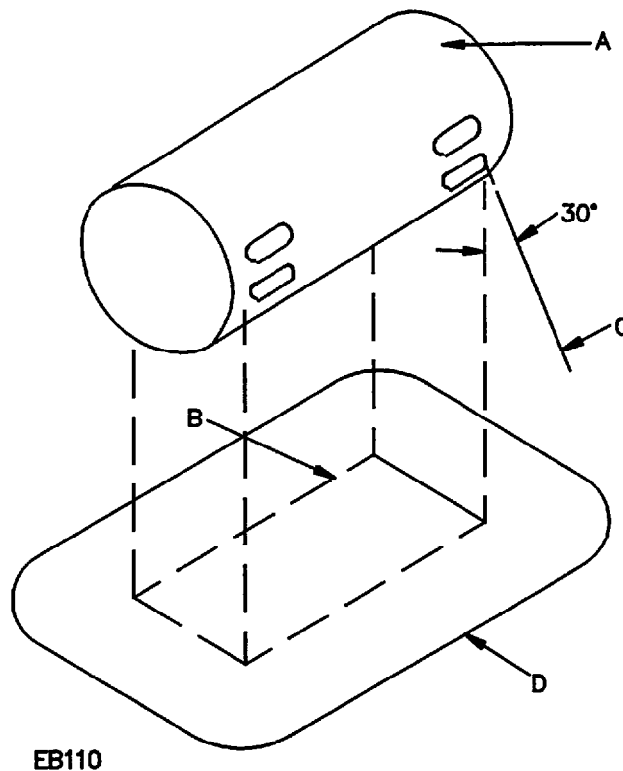
7.3 Doors and covers

7.3.1 An enclosure cover shall be hinged, sliding, or similarly attached so as to prevent its being removed if:

- a) It gives access to fuses or any other overcurrent protective device, the intended functioning of which requires renewal; or
- b) It is necessary to open the cover in connection with the intended operation of the product.

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

Figure 7.1
Barrier outline

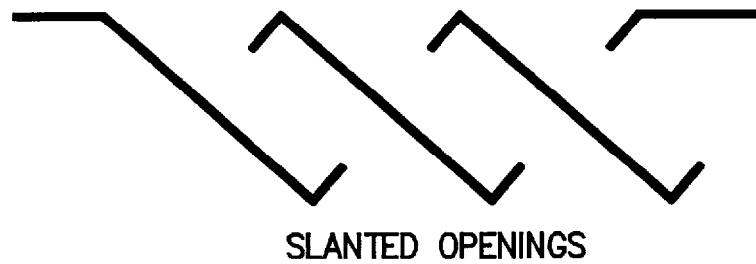


- a) The entire component under which a barrier (flat or dish with or without a lip or other raised edge) of noncombustible material is to be provided. The sketch above is of a metal enclosed component with ventilating openings to show that the barrier is required only for those openings from which flaming parts might come. If the component or assembly does not have its own noncombustible 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 needs 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 needs 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 noncombustible 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 (flat or dished with or without lip or other raised edge). The bottom of the barrier may be flat or formed in any manner if every point of area (D) is at or below the lowest point on the outer edge of the barrier.

7.4 Enclosure openings

7.4.1 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 top cover constructions that are considered to prevent direct entry. See also Figure 7.3 for examples of side openings.

Figure 7.2
Cross sections of top cover designs



EC500

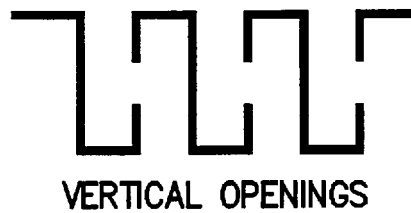
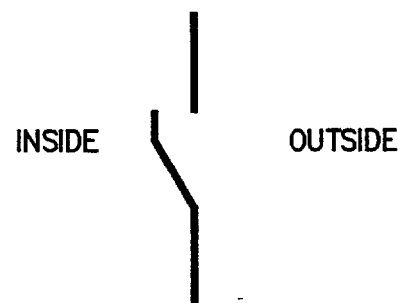
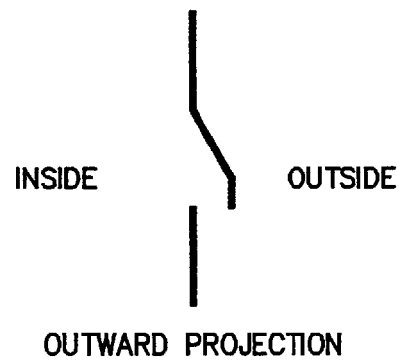


Figure 7.3
Louvers



EC510

INWARD PROJECTION