

# UL 201

## Garage Equipment





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UL Standard for Safety for Garage Equipment, UL 201

Second Edition, Dated January 27, 2005

Revisions: This Standard contains revisions through and including January 18, 2008.

### ***Summary of Topics***

***The revisions are being issued to make an editorial change to move exception to 9.2.2 to 9.2.1 and to correct word usage error in 9.2.1.***

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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 revisions dated January 18, 2008 include a reprinted title page (page1) for this Standard.

The revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated November 16, 2007.

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://ulstandardsinfo.net/ulforeword.html>

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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, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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

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**ANSI/UL 201-2008**

**1**

**UL 201**

**Standard for Garage Equipment**

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**Second Edition**

**January 27, 2005**

The most recent designation of ANSI/UL 201 as an American National Standard (ANSI) occurred on January 18, 2008.

This ANSI/UL Standard for Safety, which consists of the Second edition with revisions through January 18, 2008 is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc. and is not part of the ANSI standard.

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. 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>.

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover garage equipment, rated not more than 600 volts, for use in accordance with the National Electrical Code, NFPA 70.

1.1 effective January 27, 2007

1.2 These requirements cover equipment used in servicing and repairing automobiles, such as dynamometers, battery testers, roll-up brake lathes, distributor testers, driveway signals, engine analyzers, exhaust emissions testers, generator-alternator-regulator testers, growlers, ignition testers, rectifier diode testers, timing lights, fluid changing equipment, tire changers, tune-up testers, wheel alignment and balance equipment, and other similar equipment primarily for use in garages and service stations.

1.2 effective January 27, 2007

1.3 Garage equipment intended for use in Class I, Division 1, and Class I, Division 2 hazardous locations as defined in the National Electrical Code, NFPA 70, is investigated under these requirements, and, in addition, is investigated with respect to its acceptability for the particular application.

1.3 effective January 27, 2007

1.4 This standard covers only the electrical requirements for automotive lifts. All other requirements for automotive lifts, including such additional electrical requirements for automotive lifts that are intended to be installed out-of-doors, are included in ANSI/ALI ALCTV, Standard for Automotive Lifts – Safety Requirements for the Construction, Testing, and Validation.

1.4 effective January 27, 2007

1.5 This standard covers only the electrical requirements for portable automotive lift devices. All other requirements for portable automotive lift devices are included in ANSI/ASME PALD, Safety Standard for Portable Automotive Lift Devices.

1.5 effective January 27, 2007

1.6 These requirements do not cover arc-welders, automotive battery chargers, electric automotive tools, vacuum cleaners, equipment using refrigerants, equipment that has no electrical connection, or other equipment that is covered by individual requirements.

1.6 effective January 27, 2007

## 2 Glossary

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

2.1 effective January 27, 2007

2.2 AUTOMATICALLY CONTROLLED EQUIPMENT – Equipment is considered to be automatically controlled if:

- a) The repeated starting of the equipment, beyond one complete predetermined cycle of operation to the point where some form of limit switch opens a circuit, is independent of any manual control;
- b) During any single predetermined cycle of operation, the motor is caused to stop and restart one or more times;
- c) Upon energizing the equipment, the initial starting of the motor may be intentionally delayed beyond normal conventional starting; or
- d) During any single predetermined cycle of operation, automatic changing of the mechanical load may reduce the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

2.2 effective January 27, 2007

2.3 BARRIER – A part providing protection against direct contact from any usual direction of access.

2.3 effective January 27, 2007

2.4 CLASS 2 SOURCE – A source having a limited voltage and energy capacity. Requirements for voltage and energy are as indicated in 29.4. See the Low-Voltage, Limited-Energy Measurements, Section 64.

2.4 effective January 27, 2007

2.5 DECORATIVE PARTS – A part of the equipment, outside the fire enclosure, which has no safety function.

2.5 effective January 27, 2007

2.6 ELECTRICAL ENCLOSURE – A part of the equipment intended to reduce the risk of contact with parts at potentials other than low-voltage, limited-energy circuits.

2.6 effective January 27, 2007

2.7 ENCLOSURE – A part of the equipment providing one or more of the functions described in 2.6, 2.8, or 2.14.

2.7 effective January 27, 2007

2.8 FIRE ENCLOSURE – A part of the equipment intended to minimize the spread of fire or flames from within.

2.8 effective January 27, 2007

2.9 HIGH VOLTAGE CIRCUIT – A circuit having a potential in excess of 2500 volts peak.

2.9 effective January 27, 2007

2.10 IN-SERIES MOTOR – A motor connected directly to the line voltage supply.

2.10 effective January 27, 2007

2.11 ISOLATING TRANSFORMER – A device that consists of a primary winding electrically connected to the supply wiring, and one or more secondary windings which are not conductively connected to the primary windings, and as such are isolated from the supply wiring.

2.11 effective January 27, 2007

2.12 LEAKAGE CURRENT – Any currents, including capacitively coupled currents, which may be conveyed between exposed conductive surfaces of equipment and ground or other conductive surfaces of equipment.

2.12 effective January 27, 2007

2.13 LOW-VOLTAGE, LIMITED-ENERGY CIRCUIT – A circuit involving a potential of not more than 30 volts rms (42.4 volts peak) or a direct voltage of not more than 60 volts and supplied by a battery, a Class 2 source, or a combination of an isolating transformer and a fixed impedance that, as a unit, limits the available energy as described in 29.4.

2.13 effective January 27, 2007

2.14 MECHANICAL ENCLOSURE – A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

2.14 effective January 27, 2007

2.15 OPERATOR ACCESS AREA – An area in which, under normal operating conditions, one of the following applies:

- a) Access can be gained without the use of a tool;
- b) the means of access is deliberately provided to the operator; or
- c) the operator is instructed to enter regardless of whether or not a tool is needed to gain access.

2.15 effective January 27, 2007

2.16 PORTABLE EQUIPMENT – Equipment that is moved to the workpiece in order to perform the function for which it is intended and then removed. Generally, portable equipment is hand-held or hand-supported.

2.16 effective January 27, 2007

2.17 PRESSURE-RELIEF DEVICE – A pressure-actuated valve or rupture member designed to relieve excessive pressures automatically.

2.17 effective January 27, 2007

2.18 PRIMARY CIRCUIT – A circuit involving a potential of not more than 600 volts that is directly connected to the supply circuit.

2.18 effective January 27, 2007

2.19 PROTECTIVE GROUNDING – A system for connecting noncurrent carrying conductive parts of the equipment to ground.

2.19 effective January 27, 2007

2.20 RATED CURRENT – The input current of the equipment as declared by the manufacturer.

2.20 effective January 27, 2007

2.21 RATED FREQUENCY – The primary power frequency as declared by the manufacturer.

2.21 effective January 27, 2007

2.22 RATED FREQUENCY RANGE – The primary power frequency range as declared by the manufacturer, expressed by its lower and upper rated frequencies.

2.22 effective January 27, 2007

2.23 RATED VOLTAGE – The primary power voltage as declared by the manufacturer.

2.23 effective January 27, 2007

2.24 RATED VOLTAGE RANGE – The primary power voltage range as declared by the manufacturer, expressed by its lower and upper rated voltages.

2.24 effective January 27, 2007

2.25 REMOTELY CONTROLLED EQUIPMENT – Equipment that is not within the sight of the operator at the location of the starting device.

2.25 effective January 27, 2007

2.26 SAFETY CIRCUIT – Any primary or secondary circuit that is relied upon to reduce the risk of fire, electric shock, or injury to persons.

2.26 effective January 27, 2007

2.27 SECONDARY CIRCUIT – A circuit supplied from a secondary winding of an isolating transformer.

2.27 effective January 27, 2007

2.28 SERVICE ACCESS AREA – An area, other than an operator access area, where it is necessary for service personnel to have access even with the equipment switched on.

2.28 effective January 27, 2007

2.29 SUPPLY CIRCUIT – The branch circuit supplying electrical energy to the equipment.

2.29 effective January 27, 2007

2.30 TOOL – A screwdriver or any other object which may be used to operate a latch, screw, or similar fixing means.

2.30 effective January 27, 2007

2.31 UNINSULATED LIVE PART – A part involving a risk of fire or electric shock that is bare or has insulation that is not rated for the end use operating conditions, such as voltage, temperature, or the like.

2.31 effective January 27, 2007

2.32 USER SERVICING – The replacing, cleaning, or adjusting done by the user as described in Section 32, User Servicing.

2.32 effective January 27, 2007

### 3 Units of Measurement

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

3.1 effective January 27, 2007

3.2 Values of voltage and current are rms values, unless otherwise indicated.

3.2 effective January 27, 2007

### 4 Undated References

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

4.1 effective January 27, 2007

### 5 Components

5.1 Except as indicated in 5.2, 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.

5.1 effective January 27, 2007

5.2 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.

5.2 effective January 27, 2007

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

5.3 effective January 27, 2007

5.4 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.

5.4 effective January 27, 2007

## 6 Operating Conditions

6.1 All garage equipment shall be investigated for use indoors, with an operating ambient range of 5 – 40°C (41– 104°F). Other environmental conditions specified by the manufacturer in the user manual shall also be considered.

6.1 effective January 27, 2007

## CONSTRUCTION

### 7 General

7.1 Transformers shall comply with the requirements outlined in Transformers, Section 28, for construction of transformers.

7.1 effective January 27, 2007

7.2 Power supplies complying with the Standard for Information Technology Equipment Safety - Part 1: General Requirements, UL 60950-1 shall be considered to comply with the requirements of this standard.

7.3 Information Technology Equipment, such as computers, monitors, printers, drives, and modems, employed in garage equipment shall comply with the Standard for Information Technology Equipment Safety - Part 1: General Requirements, UL 60950-1.

7.4 A liquid crystal display that is not covered by 7.3 shall comply with the Test for Liquid Crystal Displays, Section 68.

7.4 effective January 27, 2007

7.5 An adhesive that is relied upon to reduce the risk of fire, electric shock, or injury to persons, shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.5 effective January 27, 2007

## 8 Frame and Enclosure Construction

### 8.1 General

8.1.1 The enclosure of garage equipment shall be formed and assembled so that it has the strength and rigidity required to resist the abuses to which it may be subjected without resulting in a risk of fire, electrical shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other defects.

8.1.1 effective January 27, 2007

## 8.2 Fire enclosures

8.2.1 The fire enclosure of all equipment shall prevent molten metal, burning insulation, flaming particles, or similar materials from falling on combustible materials outside the enclosure.

8.2.1 effective January 27, 2007

8.2.2 A fire enclosure is required to cover all parts that are not contained within a low-voltage, limited-energy circuit. This includes components, wiring, motors, transformers, and the like.

8.2.2 effective January 27, 2007

8.2.3 Openings provided in the top of a fire enclosure shall comply with one of the following:

- a) Not exceed 5 mm (1/5 inch) in any dimension;
- b) Not exceed 1 mm (1/25 inch) in width regardless of length; or
- c) Be so constructed that direct, vertical entry of a falling object is prevented from reaching such bare parts by means of a trap or restriction.

8.2.3 effective January 27, 2007

8.2.4 Openings provided in the sides of a fire enclosure shall comply with one of the following:

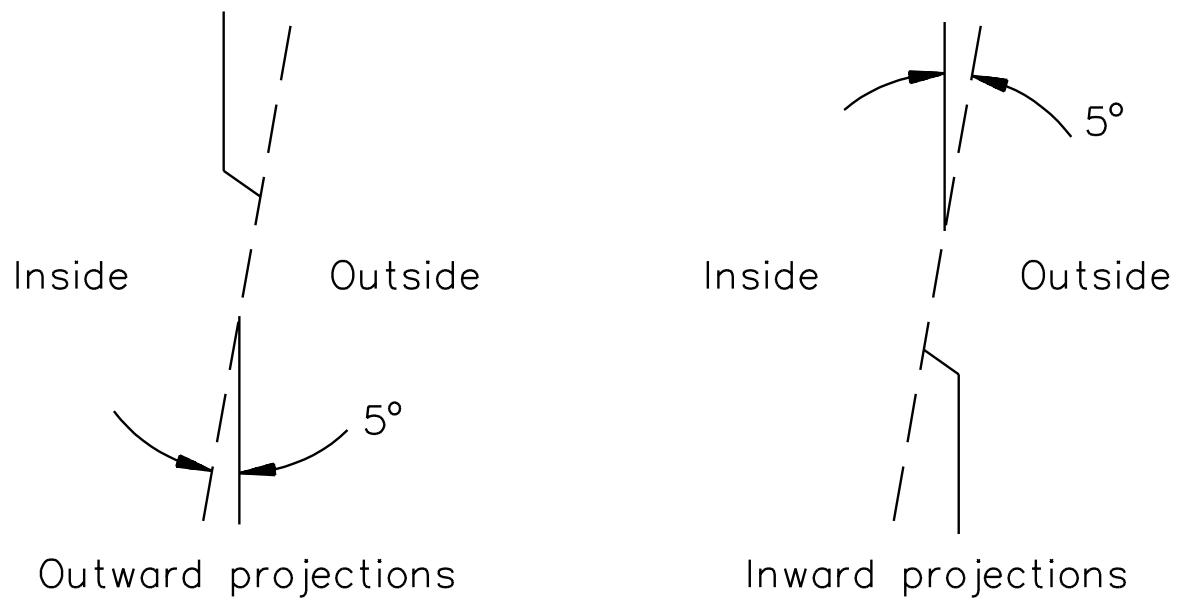
- a) Not exceed 5 mm (1/5 inch) in any dimension;
- b) Not exceed 1 mm (1/25 inch) in width regardless of length;
- c) Be provided with louvers that are shaped to deflect outwards an external vertically falling object (see Figure 8.1 for details); or
- d) Be so located that an object, upon entering the enclosure, is unlikely to fall on bare parts which are not considered low-voltage, limited energy (see Figure 8.2 for details).

Where a portion of the side of a fire enclosure falls within the area traced out by the 5 degree angle in Figure 8.3, the limitation in 8.2.5 on sizes of openings in bottoms of fire enclosures also apply to this portion of the side openings.

8.2.4 effective January 27, 2007

**Figure 8.1**  
**Example of louver design**

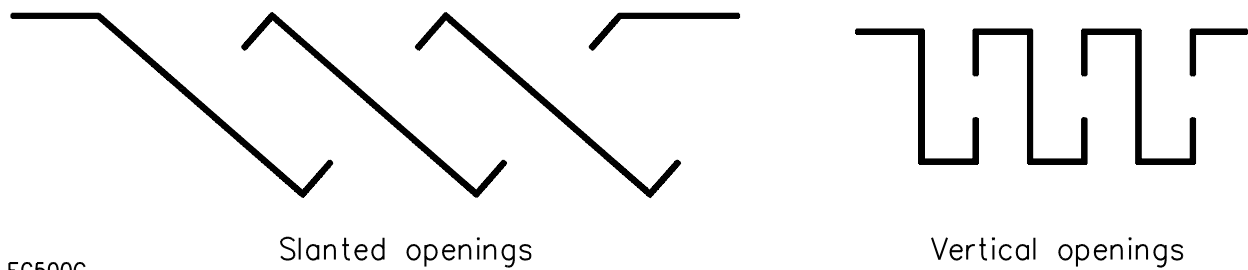
Figure 8.1 effective January 27, 2007



EC513A

**Figure 8.2**  
**Examples of enclosure side openings**

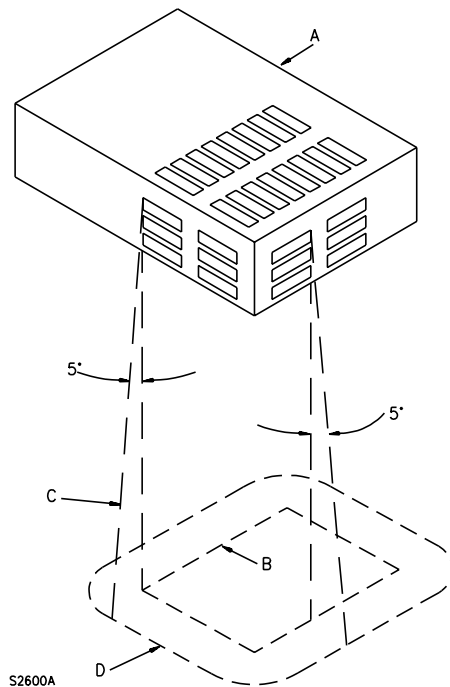
Figure 8.2 effective January 27, 2007



EC500C

**Figure 8.3**  
**Typical bottom of fire enclosure for partially enclosed components**

Figure 8.3 effective January 27, 2007



- A The portion of a component under which a FIRE ENCLOSURE is required, for example, under those openings in a component or assembly through which flaming particles might be emitted. If the component or assembly does not have its own FIRE ENCLOSURE, the area to be protected is the entire area occupied by the component or assembly.
- B The outline of the area A projected vertically downward onto the horizontal plane of the lowest point of the FIRE ENCLOSURE.
- C Inclined line that traces an outline D on the same plane as B. Moving around the perimeter of the outline B, this line projects at a 5° angle from the vertical at every point round the perimeter of the openings in A and is oriented to trace out the largest area.
- D Minimum outline of the bottom of the FIRE ENCLOSURE. A portion of the side of a FIRE ENCLOSURE which is within the area traced out by the 5° angle is also considered to be part of the bottom of the FIRE ENCLOSURE.

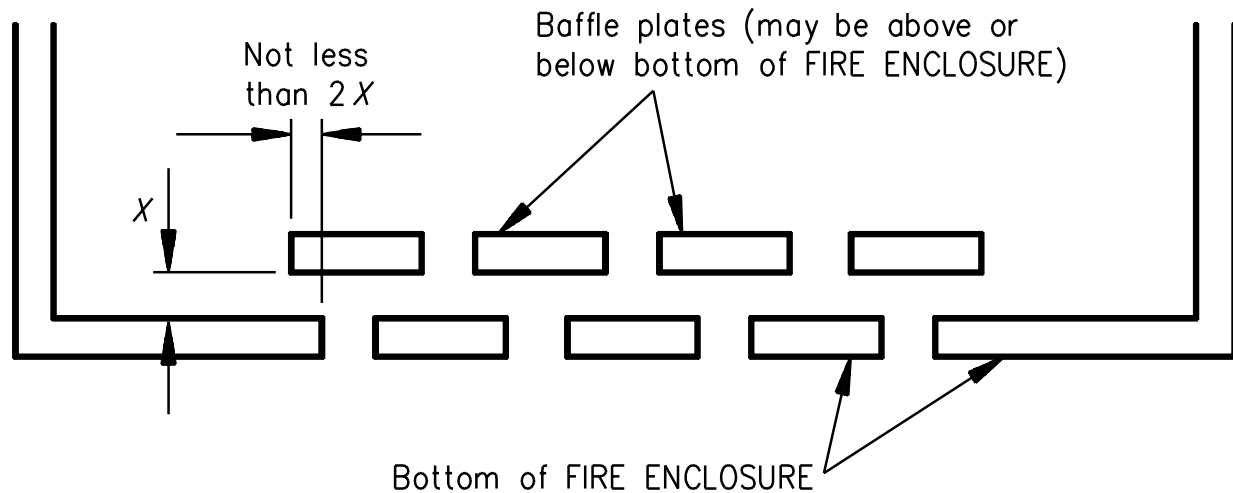
8.2.5 Openings in the bottom of a fire enclosure shall comply with one of the following:

- a) No openings in the bottom of a fire enclosure;
- b) Openings in the bottom, each not larger than 40 mm<sup>2</sup> (.06 inch<sup>2</sup>) under components of flammability class V-1 or better, or parts made of material with flammability class V-1 better;
- c) Baffle plate construction as illustrated in Figure 8.4;
- d) Metal bottom screens having a mesh not greater than 2 mm by 2 mm (.08 inch by .08 inch) and a wire diameter of not less than 0.45 mm (.02 inch).

8.2.5 effective January 27, 2007

**Figure 8.4**  
**Baffle plate construction**

Figure 8.4 effective January 27, 2007



SB0855E

8.2.6 If part of the fire enclosure consists of a door or cover leading to an operator access area, one of the following requirements shall apply:

- a) The door or cover shall be interlocked to comply with the requirements in Interlocks, Section 26.
- b) A door or cover, intended to be routinely opened by the operator, shall not be removable from the fire enclosure by the operator, and it shall be provided with a means to keep it closed during normal operation; or
- c) A door or cover intended only for occasional use by the operator, such as for the installation of accessories, shall be permitted to be removable provided the equipment instructions include directions for correct removal and replacement for the door or cover.

8.2.6 effective January 27, 2007

### 8.3 Electrical enclosures

8.3.1 An electrical enclosure of equipment shall prevent the operator from contacting circuits other than low-voltage, limited-energy circuits. An electrical enclosure shall not provide access after being tested in accordance with Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 11.

8.3.1 effective January 27, 2007

8.3.2 Openings in the electric enclosure can be of any size provided the openings do not allow access to any hazardous circuits when tested in accordance with Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 11.

8.3.2 effective January 27, 2007

### 8.4 Mechanical enclosures

8.4.1 A mechanical enclosure shall prevent access to any hazardous moving part within the enclosure from operator contact. A mechanical enclosure shall not provide access after being tested in accordance with Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 11.

8.4.1 effective January 27, 2007

8.4.2 Openings in the mechanical enclosure can be of any size provided the openings do not allow access to any moving parts or pinch points when tested in accordance with Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 11.

8.4.2 effective January 27, 2007

### 8.5 Metallic enclosures

8.5.1 A metallic enclosure shall comply with the Strength of Enclosure Tests, Section 71.

8.5.1 effective January 27, 2007

8.5.2 For an unreinforced, flat surface in general, cast metal shall not be less than 3.2 mm (1/8 inch) thick, malleable iron shall not be less than 2.4 mm (3/32 inch) thick, and die-cast metal shall not be less than 2.0 mm (5/64 inch) thick.

*Exception: Metal of lesser thickness but not less than 2.4 mm (3/32 inch), 1.6 mm (1/16 inch) and 1.2 mm (3/64 inch), respectively for cast metal, malleable iron, and die-cast metal, is acceptable if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape and size, or both of the surface is such that its mechanical strength is equivalent to that of a metal of the specified minimum thickness.*

8.5.2 effective January 27, 2007

8.5.3 An enclosure of sheet metal shall be investigated with respect to its size, shape, thickness of metal, and its suitability for the particular application, considering the intended use of the complete equipment. Sheet steel having a thickness of less than 0.66 mm (0.026 inch) if uncoated or 0.74 mm (0.029 inch) if galvanized or of nonferrous sheet metal having a thickness of less than 0.91 mm (0.036 inch) shall not be used, except for relatively small areas or of surfaces that are curved or otherwise reinforced.

8.5.3 effective January 27, 2007

8.5.4 A metallic fire enclosure shall be considered to comply with flammability requirements without test.

8.5.4 effective January 27, 2007

## 8.6 Non-metallic enclosures

8.6.1 A polymeric enclosure shall comply with the mechanical strength tests in Strength of Enclosure Tests, Section 71.

8.6.1 effective January 27, 2007

8.6.2 The minimum thickness for the polymeric material used shall be determined by its component recognition or by test.

8.6.2 effective January 27, 2007

8.6.3 The flammability of a nonmetallic enclosure shall comply with the appropriate requirement below:

a) For equipment with a total mass not exceeding 18 kg (40 lbs), the fire enclosure material shall have a flammability rating of V-1 minimum at the smallest thickness used: or

b) For equipment with a total mass exceeding 18 kg (40 lbs), the fire enclosure material shall have a flammability rating of 5-V at the smallest thickness used.

8.6.3 effective January 27, 2007

8.6.4 Enclosures of molded or formed thermoplastic material shall be constructed so that any shrinkage or distortion of the material over time will not allow for the user to be exposed to hazardous parts.

8.6.4 effective January 27, 2007

8.6.5 Non-metallic enclosures shall be subjected to the Stress Relief Test, Section 70.

8.6.5 effective January 27, 2007

## 9 Flammability of Materials and Components

### 9.1 General

9.1.1 Components and parts inside a fire enclosure shall be so constructed, or shall make use of such materials, that the propagation of fire is minimized.

9.1.1 effective January 27, 2007

9.1.2 In considering how to minimize the propagation of fire, and what are "small parts", account shall be taken of the cumulative effect of small parts when they are adjacent to each other, and also of the possible effect of propagating fire from one part to another.

9.1.2 effective January 27, 2007

## 9.2 Flammability

9.2.1 Except as specified elsewhere in this standard, all materials shall comply with one of the following:

- a) They shall have a flammability rating of V-2 or better; or
- b) They shall have a flammability rating of HF-2 or better.

*Exception: This requirement does not apply to:*

- a) Components meeting the flammability requirements of a relevant component standard which includes such requirements;*
- b) Meter cases, meter faces, and indicator lamps that are part of a separate and distinct accessory;*
- c) Gears, cams, belts, bearings, and other small parts which would contribute negligible fuel to a fire provided they are separated from electrical parts, that under a fault condition would be likely to produce temperatures that could cause ignition, by 13 mm (1/2 inch) of air;*
- d) Tubing for air or fluid systems provided they are of flammability class HB or HBF or better;*
- e) Integrated circuit packages, transistor packages, optocoupler packages, capacitors, and other small parts mounted on a material of flammability class V-1 or better; and*
- f) Inflatable air bags used in dynamometers for raising and lowering the automobile onto the dynamometer, provided they are of flammability class HB or HBF or better and they are separated from electrical parts, that under a fault condition would be likely to produce temperatures that could cause ignition, by 13 mm (1/2 inch) of air.*

9.2.1 revised January 18, 2008

9.2.2 Printed wiring board material for use in garage equipment shall have a flammability rating of V-1 minimum.

9.2.2 revised January 18, 2008

9.2.3 Air filter assemblies shall be constructed of materials of flammability class V-2 or better, or of HF-2 or better, except that the following constructions need not comply with this requirement:

- a) Air filter assemblies in air circulating systems that are not intended to be vented outside the fire enclosure; or
- b) Air filter assemblies located externally to the fire enclosure, constructed of materials of flammability class HB or HBF or better.

9.2.3 effective January 27, 2007

9.2.4 Parts of the equipment which are located external to the fire enclosure shall be constructed of materials of flammability class HB or better. This requirement also applies to mechanical and electrical enclosures provided they are located external to the fire enclosure.

9.2.4 effective January 27, 2007

## 10 Mechanical Assembly

10.1 Garage equipment shall be so assembled that it will not be affected adversely by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise designed to prevent loosening.

10.1 effective January 27, 2007

10.2 A switch, a lampholder, an attachment plug receptacle, a motor-attachment plug, or similar component shall be mounted securely and shall be prevented from turning. See 10.3.

*Exception: A lampholder for a non-replaceable lamp, such as a neon pilot or indicator light in which the lamp is sealed in a non-removable enclosure, need not be prevented from turning if rotation can not reduce spacings below the minimum required values.*

10.2 effective January 27, 2007

10.3 A means for preventing the turning mentioned in 10.2 shall consist of more than friction between surfaces – for example, a properly applied lock washer is acceptable as the means for preventing turning of a small stem mounted switch or other device having a single hole mounting means.

10.3 effective January 27, 2007

10.4 An uninsulated live part shall be secured so that it will be prevented from turning or shifting in position, if such motion would result in a reduction of spacings below the minimum acceptable values.

10.4 effective January 27, 2007

## 11 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

11.1 To reduce the likelihood of unintentional contact with an uninsulated live part, a film-coated wire, or a moving part, an opening in an electrical or mechanical enclosure shall comply with either of the following:

a) For an opening that has a minor dimension less than 25 mm (1 inch), such a part or wire shall not be contacted by the probe illustrated in Figure 11.1;

b) For an opening that has a minor dimension greater than 25 mm (1 inch), such a part or wire shall be spaced from the opening as specified in Table 11.1.

*Exception No. 1: A motor other than one used in either a hand-held or hand-supported equipment, need not comply with these requirements if it complies with 11.2.*

*Exception No. 2: Insulated brush caps on motors are not required to be additionally enclosed.*

*Exception No. 3: A moving part or portion of a part that is necessarily exposed to perform the intended work function need not comply with this requirement.*

11.1 effective January 27, 2007



**Table 11.1**  
**Minimum acceptable distance from an opening to a part that may involve a risk of electric shock**

Table 11.1 effective January 27, 2007

| Minimum dimension <sup>a</sup> of opening,<br>mm<br>(inches) <sup>b</sup> |         | Minimum distance from opening to part,<br>mm<br>(inches) <sup>b</sup> |          |
|---------------------------------------------------------------------------|---------|-----------------------------------------------------------------------|----------|
| 19 <sup>c</sup>                                                           | (3/4)   | 110                                                                   | (4-1/2)  |
| 25 <sup>c</sup>                                                           | (1)     | 165                                                                   | (6-1/2)  |
| 32                                                                        | (1-1/4) | 190                                                                   | (7-1/2)  |
| 38                                                                        | (1-1/2) | 320                                                                   | (12-1/2) |
| 48                                                                        | (1-7/8) | 400                                                                   | (15-1/2) |
| 54                                                                        | (2-1/8) | 440                                                                   | (17-1/2) |
| d                                                                         |         | 760                                                                   | (30)     |

<sup>a</sup> See 11.5.  
<sup>b</sup> Between 19 and 54 mm, interpolation is to be used to determine a value between values specified in the table.  
<sup>c</sup> Any dimension less than 25 mm applies to a motor only.  
<sup>d</sup> More than 54 mm, but not more than 152.0 mm (6 inches).

11.2 For a part or wire specified in 11.1 that is an integral enclosure of a motor specified in Exception No. 1 to 11.1:

a) An opening that has a minor dimension less than 19 mm (3/4 inch) is acceptable if:

- 1) A moving part can not be contacted by the probe illustrated in Figure 11.4;
- 2) Film-coated wire can not be contacted by the probe illustrated in Figure 11.2;
- 3) In a directly accessible motor (see 11.5), an uninsulated live part can not be contacted by the probe illustrated in Figure 11.3; and
- 4) In an indirectly accessible motor (see 11.5), an uninsulated live part can not be contacted by the probe illustrated in Figure 11.4.

b) An opening that has a minor dimension of 19 mm (3/4 inch) or more is acceptable if a part or wire is spaced from the opening as specified in Table 11.1.

11.2 effective January 27, 2007

**Figure 11.2**  
**Probe for film-coated wire**

Figure 11.2 effective January 27, 2007

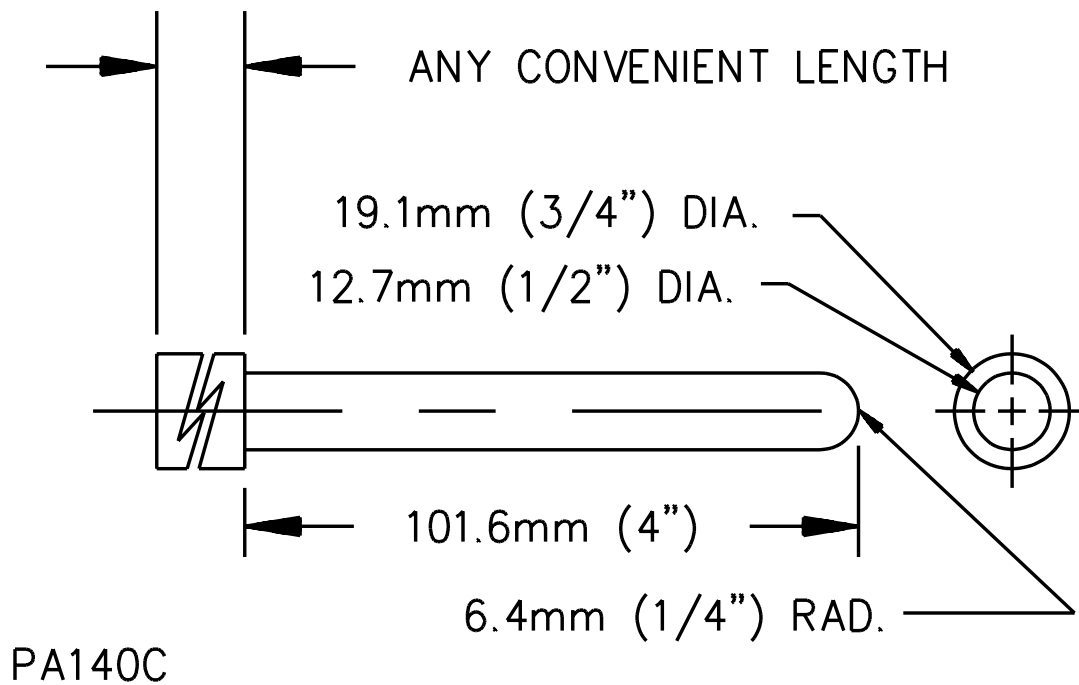
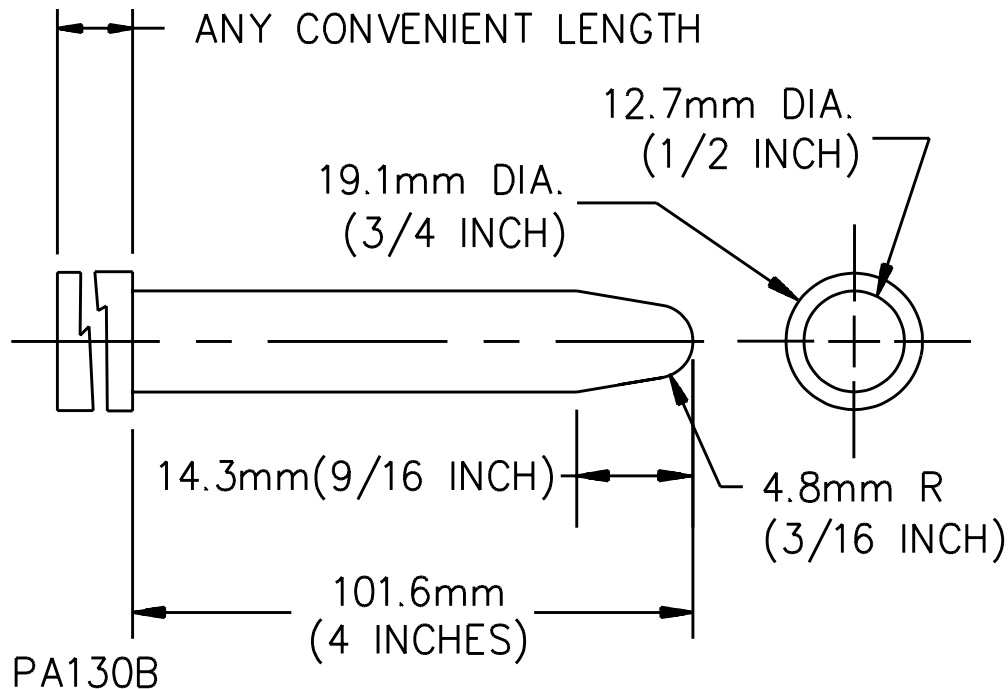




**Figure 11.4**  
**Straight probe**

Figure 11.4 effective January 27, 2007



11.3 The probes specified in 11.1 and 11.2 and illustrated in Figures 11.1 – 11.4, shall be applied to any depth that the opening will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figure 11.1 and 11.3 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

11.3 effective January 27, 2007

11.4 The probed specified in 11.1 and 11.2 shall be used as measuring instruments to determine the accessibility provided by an opening, and not as instruments to determine the strength of material; they shall be applied with the minimum force necessary to determine accessibility.

11.4 effective January 27, 2007

11.5 With reference to 11.2:

- a) An indirectly accessible motor is a motor that is accessible only by opening or removing a part of the enclosure, such as a guard or panel that can be removed without the use of a tool, or that is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted; and
- b) A directly accessible motor is a motor that can be contacted without opening or removing any part or is so located as to be accessible to contact.

11.5 effective January 27, 2007

11.6 During the examination of equipment to determine compliance with 11.1 or 11.2, a part of the enclosure that can be opened or removed by the operator – either without the use of a tool or with instructions given to the user to open or remove the part of the enclosure – is to be opened or removed.

11.6 effective January 27, 2007

## 12 Protection Against Corrosion

12.1 An iron or steel part shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if the deterioration or breakage of the part is likely to result in a risk of fire, electric shock, or injury to persons.

*Exception No. 1: For constructions where the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable – thickness of metal and temperature also being factors – surfaces of sheet steel and cast iron parts within an enclosure need not be protected against corrosion*

*Exception No. 2: This requirement does not apply to bearings, laminations, or to minor parts of iron or steel, such as washers, screws, and the like.*

12.1 effective January 27, 2007

12.2 If the failure of a gasket, seal, or liquid container provided as a part of the equipment is likely to result in a risk of fire, electric shock, or injury to persons; the gasket, seal or container shall be of a material that is resistant to corrosion by the liquid intended to be used therein.

12.2 effective January 27, 2007

## 13 Supply Connections

### 13.1 Cord connected equipment

13.1.1 Cord connected equipment shall be provided with a flexible cord and a grounding type attachment plug for connection to the supply circuit.

*Exception: Equipment intended to be used with a detachable power supply cord is acceptable without provision of the detachable supply cord if the equipment is marked in accordance with 78.4, and the instruction manual contains instructions as described in 81.5 concerning the proper selection of the power supply cord.*

13.1.1 effective January 27, 2007

13.1.2 A flexible cord shall be rated for a voltage not less than the rated voltage of the equipment, and shall have a current rating not less than the current rating of the equipment.

13.1.2 effective January 27, 2007

13.1.3 A flexible cord for use on movable or stationary floor supported equipment, where the cord is in contact with the floor and could be subjected to abuse, shall be Type G, SO, STO, or W.

13.1.3 effective January 27, 2007

13.1.4 A flexible cord for use on equipment other than specified in 13.1.3 shall be Type G, SO, SJO, SJEO, SJOO, SJTO, SJTOO, SO, STO, or W, or a type at least equally serviceable for the particular application.

13.1.4 effective January 27, 2007

13.1.5 A flexible cord shall be attached permanently to the equipment or shall be in the form of a separate cord set with means for connection to the equipment, such as an attachment plug.

13.1.5 effective January 27, 2007

13.1.6 The length of an attached flexible cord, including the attachment plug, shall not be less than 1.8 m (6 feet).

13.1.6 effective January 27, 2007

13.1.7 The length of an attached flexible cord, including the attachment plug, shall not be less than 1.8 m (6 feet).

13.1.7 effective January 27, 2007

13.1.8 An attachment plug, provided with equipment with provision for use on two or more different values of voltage, either by field alteration of internal connections or by a voltage selector switch, shall be rated for the highest voltage rating on the equipment.

13.1.8 effective January 27, 2007

## 13.2 Strain relief

13.2.1 Strain relief shall be provided on a non-detachable flexible cord to reduce the risk of mechanical stress being transmitted to terminals, splices, or interior wiring. See Strain Relief Test, Section 60. A knot in the flexible cord is not considered an acceptable form of strain relief.

13.2.1 effective January 27, 2007

13.2.2 A metal strain relief clamp or band provided in accordance with 13.2.1 shall be provided with auxiliary insulation over the cord if damage to the cord insulation results when the strain relief test is conducted without auxiliary insulation.

13.2.2 effective January 27, 2007

13.2.3 Means shall be provided to prevent a flexible cord from being pushed into the equipment through the cord entry hole if such displacement would:

- a) Result in mechanical damage to the cord;
- b) Expose the cord to a temperature higher than that for which it is rated; or
- c) Reduce spacings, such as to a metal strain relief clamp, below the acceptable minimum values.

To determine compliance, the supply cord or lead shall be tested in accordance with Section 61, Push-Back Relief Test.

13.2.3 effective January 27, 2007

### 13.3 Bushings

13.3.1 At the point where a non-detachable flexible cord passes through an opening in a wall, barrier, or the enclosure, there shall be a bushing or the equivalent that is secured in place, and that has a smooth, well rounded surface against which the cord may bear. An insulating bushing shall be provided, if the wall or barrier is of metal, or if the construction is such that the cord may be subjected to strain or motion.

13.3.1 effective January 27, 2007

13.3.2 A hole in porcelain, phenolic composition, or other non-conducting material, having a smooth, rounded surface, is considered to be equivalent to a bushing

13.3.2 effective January 27, 2007

13.3.3 In the frame of a motor or in the enclosure of a capacitor attached to a motor (but not elsewhere in the equipment), a separate soft-rubber, neoprene, or polyvinyl chloride bushing is acceptable if:

- a) The bushing is not less than 1.2 mm (3/64 inch) thick; and
- b) The bushing is located that it will not be exposed to oil, grease, oily vapor, or other substances having a deleterious effect on the compound employed.

13.3.3 effective January 27, 2007

13.3.4 A bushing of the same material as, and molded integrally with, a supply cord is acceptable if the built-up section is not less than 1.6 mm (1/16 inch) thick at the point where the cord passes through the enclosure.

13.3.4 effective January 27, 2007

13.3.5 At a point of flexure, no additional flexible cords or wires shall be routed through a bushing or opening with the power supply cord.

13.3.5 effective January 27, 2007

### 13.4 Permanently connected equipment

13.4.1 Permanently connected equipment shall have provision for connection to a wiring system for the supply circuit.

13.4.1 effective January 27, 2007

13.4.2 Sheet metal to which a supply circuit wiring system is to be connected shall not have a thickness less than 0.81 mm (0.032 inch) if uncoated steel, not less than 0.86 mm (0.034 inch) if galvanized steel, and not less than 1.14 mm (0.045 inch) if nonferrous.

13.4.2 effective January 27, 2007