



UL 1238

STANDARD FOR SAFETY

Control Equipment for Use with Flammable Liquid
Dispensing Devices

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UL Standard for Safety for Control Equipment for Use with Flammable Liquid Dispensing Devices, UL 1238

Sixth Edition, Dated July 10, 2015

Summary of Topics

This new edition of ANSI/UL 1238 is being issued to update references to motor standards, update and clarify the Flammability Test, revise user replaceable fuse marking and to address the editorial maintenance of UL Standards for Safety.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated May 29, 2015.

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1



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UL 1238

Standard for Control Equipment for Use with Flammable Liquid

Dispensing Devices

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Sixth Edition

July 10, 2015

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The most recent designation of ANSI/UL 1238 as an American National Standard (ANSI) occurred on July 10, 2015. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

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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CONTENTS

INTRODUCTION

1 Scope	6
2 General	7
2.1 Components	7
2.2 Units of measurement	7
2.3 Undated references	7
3 Glossary	8
4 Instructions	9

CONSTRUCTION

5 Frame and Enclosure	10
5.1 General	10
5.2 Covers	10
5.3 Cast metal	11
5.4 Sheet metal	12
5.5 Nonmetallic	12
5.6 Glass panels	15
5.7 Openings	15
5.8 Ventilating openings	16
5.9 Other openings	16
5.10 Wiring openings	18
5.11 Speaker openings	19
6 Raintight and Rainproof Enclosures	20
7 Operating Mechanism	21
8 Corrosion Protection	21
9 Protection of User and Service Personnel	22
10 Field Wiring Connections	22
10.1 Permanently connected devices	22
10.2 Terminal compartments	23
10.3 Wiring terminals and leads	23
10.4 Cord- and plug-connected devices	24
11 Internal Wiring	26
11.1 General	26
11.2 Wires	26
11.3 Splices and connections	27
11.4 Interconnecting cords and cables	27
12 Grounding	28
13 Bonding of Internal Parts	29
13.1 General	29
13.2 Construction and connections	29

ELECTRICAL COMPONENTS

14 Switching Devices	30
15 Capacitors	31
16 Transformers	31
17 Motors	31
18 Heaters	32

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19 Insulating Material	33
20 Insulating Barriers	35
21 Secondary Circuits	36
22 Separation of Circuits	37
23 Low-Voltage Class-2 Circuits	38
24 Limited Current Circuits	39
25 Barriers	39
26 Printed-Wiring Boards	39

SPACINGS

27 General	40
------------------	----

PERFORMANCE

28 General	43
28.1 Test voltage	43
28.2 Additional tests	44
29 Input Measurement Test	44
30 Output Measurement Test	44
31 Maximum Voltage Output Measurement Test	45
32 Normal Temperature Test	45
33 Operation	48
34 Overload and Endurance Test	48
34.1 General	48
34.2 Overload	49
34.3 Endurance	49
35 Dielectric Voltage-Withstand Test	49
36 Aging Test	50
37 Low-Voltage Class-2 Transformer Test	50
37.1 General	50
37.2 Open-circuit secondary voltage	51
37.3 Current output	51
37.4 Volt-ampere capacity	51
37.5 Burnout	52
37.6 Dielectric withstand	52
38 Limited Current Test	52
39 Nonmetallic Enclosures	53
39.1 General	53
39.2 Thermal aging conditioning	54
39.3 Flammability test	54
39.4 Elevated temperature test	55
39.5 Impact test	55
40 Snap-On Covers	56
40.1 General	56
40.2 Squeezing force test	56
40.3 Pull force test	56
40.4 Impact test of snap-on covers	56
41 Rain Test	57
42 Water Penetration Test	60
43 Component Faults	60
44 Heater Maximum Temperature Test	60

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MANUFACTURING AND PRODUCTION LINE TESTS

45 General	.61
45.1 Details	.61
45.2 Production line dielectric voltage-withstand test	.61

RATING

46 General	.62
------------------	-----

MARKING

47 General	.62
------------------	-----

APPENDIX A

Standards for Components.....	A1
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INTRODUCTION

1 Scope

1.1 These requirements cover electrical equipment used for the control and monitoring of flammable liquid and LP-Gas dispensing devices rated 600 volts or less. Such control equipment is intended to be installed in ordinary locations in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements also cover electrical control equipment that is capable of being installed in or over a hazardous area as defined by the Flammable and Combustible Liquids Code, NFPA 30. Electrical control equipment for installation in a Class I, Division 1 or Division 2 hazardous area shall comply with the applicable requirements for the Hazardous Location protection method employed. See Appendix A for a list of appropriate standards.

1.3 These requirements cover general-use field-installed equipment. They also cover controls intended to be factory installed on or in certain devices as operating controls. Typical devices covered by these requirements include:

- a) Communication Units – Visual, pulse, or audio devices which complies with the transmittal of data or information. Such devices include audio or visual systems between the service station attendant and the customer, and data processing systems between the service station and a remote data processing terminal.
- b) Control Consoles – Prepay, post-pay, remote totalizing, or remote actuating and monitoring devices located indoors or within a structure some distance from the dispensing device.
- c) Credit Acceptance Units – Dollar bill, coin, token, pulse, or credit card activated devices which are capable of being installed on, adjacent to, or away from the dispensing device.
- d) Electric Computer Resets – Electrically authorized or electrically operated devices which reset a mechanical computer.

1.4 These requirements do not cover safety or emergency controls which automatically or manually interrupt the operation of a dispensing device.

1.5 The term "device" refers to any equipment covered by this standard.

1.6 These requirements do not cover purely mechanical systems such as hose nozzle attachments and pneumatic or hydraulic actuators.

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.

2.1.2 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.

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

2.1.4 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.

2.1.5 Except for portable equipment, provision shall be made for securely mounting control equipment in position. Bolts, screws, or other parts used for mounting equipment shall be independent of those used for securing components of the equipment to the frame, base, or panel.

2.2 Units of measurement

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

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 terms apply.

3.2 ABBREVIATIONS – For the purpose of this standard, the following definitions apply:

AC – Alternating Current

AWG – American Wire Gage

DC – Direct Current

GSG – Galvanized Sheet Gage

Hz – hertz

MSG – Manufacturers Standard Gage

NEC – National Electrical Code, NFPA 70

psig – Pounds per square inch gauge

rms – Root-mean-square

3.3 BRANCH CIRCUIT – That portion of the building wiring system beyond the final overcurrent device on the power-distribution panel protecting the circuit to the field-wiring terminals in a permanently connected device or to the receptacle outlet for cord-connected devices.

3.4 CIRCUITS, ELECTRICAL –

a) Class 2 (Low-Voltage) – A circuit involving a potential of not more than 42.4 volts peak supplied by:

- 1) An energy-limiting Class 2 transformer;
- 2) A nonenergy-limiting Class 2 transformer and an overcurrent protective device that has been evaluated for limiting energy to Class 2 levels;
- 3) The combination of an isolated transformer secondary winding and a fixed impedance or reliable regulating network which complies with the applicable performance requirements for an energy-limiting Class 2 transformer;
- 4) A dry cell battery having output characteristics no greater than those of an energy-limiting Class 2 transformer; or

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5) The combination of a rechargeable battery and a fixed impedance or reliable regulating network which complies with the applicable performance requirements for an energy-limiting Class 2 transformer.

b) Line-Voltage – Any field connected source of supply other than battery power, nominally 50 – 60 Hz, 115, 208, or 230 volts, is classified as a line-voltage circuit.

c) Secondary – Those circuits supplied from transformer output windings which are electrically isolated, i.e., insulated from ground.

3.5 CORD- AND PLUG-CONNECTED DEVICE – A device intended for connection to the branch-circuit power line by means of a supply cord. Such a device is intended to be moved for reasons of interchange or servicing.

3.6 GENERAL PURPOSE ENCLOSURE – A metallic or nonmetallic enclosure that is not required to be explosion proof.

3.7 LIMITED CURRENT CIRCUIT – A circuit which is so designed and protected that, under both normal conditions and a likely fault condition, the current which can be drawn is not at levels that are considered hazardous. See Limited Current Test, Section 38, for limits.

4 Instructions

4.1 A copy of the operating and installation instructions intended to accompany each device, or equivalent information, is to be used as a reference in the examination and test of the device. For this purpose, a printed edition is not required.

4.2 The instructions shall include such directions and information as deemed by the manufacturer to be adequate for the proper installation, maintenance, and use of the device.

4.3 For products marked in accordance with 47.1(f)(4), the following statements shall be included in the installation instructions.

a) A statement to the effect that the equipment is to be installed and used in accordance with the National Electrical Code, NFPA 70, and the Flammable and Combustible Liquids Code, NFPA 30.

b) Detailed information showing hook-up and/or ratings associated with each terminal, lead, or connector in the interconnection box or other device to which field connections are to be made.

c) Information necessary to determine that the junction box in the dispenser has sufficient volume for the application. See 20.13 and 20.14 and Table 20.2 in the Standard for Power-Operated Dispensing Devices for Petroleum Products, UL 87.

d) Wiring diagrams showing typical dispenser-control system connections.

CONSTRUCTION

5 Frame and Enclosure

5.1 General

5.1.1 Control equipment shall be so fabricated and assembled that it has the strength and rigidity required to resist the abuses to which it is capable of being subjected, without increasing the risk of fire, explosion, electric shock, or injury to persons due to total or partial collapse resulting in reduction of spacings, loosening or displacement or parts, or other serious defects.

5.1.2 The equipment shall be provided with an enclosure of material evaluated for use in this application which shall house all electrical parts that are capable of presenting a risk of fire, electric shock, or injury to persons under any condition of use.

5.1.3 A portion of an overall enclosure can be omitted when the equipment is intended to be installed in conjunction with other equipment where the latter completes the enclosure, and installation instructions are provided.

5.1.4 For equipment with electrical circuits that will be located over a classified area such as field island terminals that extend to grade, a metal plate shall be provided as a secondary bottom enclosure. The plate shall comply with all of the following:

- a) The plate shall comply with all other enclosure requirements in this standard, such as material requirements and thickness requirements;
- b) The plate shall have no openings following installation, such that any flaming particles or drops that fall downward will be contained by the plate with no particles or drops falling below the plate; and
- c) The plate shall be located at a height of 18 inches minimum from the base of the product, such that the plate is located over the Classified area as well.

5.2 Covers

5.2.1 An enclosure and a part of an enclosure such as a door, cover, or similar parts shall be provided with means for firmly securing it in place.

5.2.2 Sheet-metal screws threading directly into metal shall not be used to attach a cover, door, or other part removed to install field wiring or for operation of the equipment. Sheet-metal screws can thread into sheet-metal nuts that are permanently mounted and suitably protected against corrosion. Machine screws and self-tapping machine screws can thread directly into sheet-metal walls.

5.2.3 Sheet-metal screws mounting internal components that are not removed for installation or operation can thread directly into metal.

5.2.4 A snap-on cover that gives access to exposed live parts and that does not require a tool for removal shall comply with the tests in Snap-On Covers, Section 40.

5.2.5 The continuity of the bonding means for a snap-on or fastener-attached cover shall comply with the requirements in 13.1.1 – 13.1.4, 13.2.1, and 13.2.2.

5.2.6 An enclosure cover shall be hinged when it gives access to a fuse, thermal cutout, or any other overload-protective device, the normal functioning of which requires renewal, or when it is required to open the cover in connection with the normal operation of the device.

5.2.7 A door or cover giving access to a fuse or thermal cutout in other than a low-voltage circuit shall shut closely against a 1/4 inch (6.4 mm) rabbet or strips that have been determined to be equivalent, or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the walls of the box proper and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). An appropriate construction that affords protection that has been determined to be equivalent or a combination of flange and rabbet is permissible.

5.2.8 Strips used to provide rabbets, or angle strips fastened to the edges of a door shall be secured at not less than two points, not more than 1-1/2 inches (38 mm) from each end of each strip and at points between these end fastenings not more than 6 inches (152 mm) apart.

5.2.9 A hinged cover shall be provided with a spring latch or catch, and not depend solely upon screws or other similar means requiring the use of a tool to hold it closed. For a hinged cover that is provided, although not required, a hasp, sliding latch, or other means for holding the cover closed can be employed.

5.3 Cast metal

5.3.1 Cast metal for a general purpose enclosure shall be at least 1/8 inch (3.2 mm) thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4 inch (6.4 mm) thick at tapped holes for conduit; except that, other than at plain or threaded conduit holes, die-cast metal shall not be less than 3/32 inch (2.4 mm) thick for an area greater than 24 square inches (155 cm²) or having any dimension greater than 6 inches (152 mm), and shall not be less than 1/16 inch (1.6 mm) thick for an area of 24 square inches (155 cm²) or less and not having dimensions greater than 6 inches. The area limitation for metal 1/16 inch thick complying with the provision of reinforcing ribs subdividing a larger area. Die-cast metal of 0.035 inch (0.9 mm) minimum thickness can be employed in lieu of 1/16 inch thick die-cast metal when the enclosure will not be used as a splice box and when the voltage rating of the complete control is such that the voltage between any two conductors does not exceed 250 volts ac or dc; and die-cast metal of 0.028 inch (0.71 mm) minimum thickness can be employed in lieu of 1/16 inch thick die-cast metal for an enclosure housing only low-voltage circuits.

5.4 Sheet metal

5.4.1 The thickness of a sheet-metal enclosure shall be as indicated in Tables 5.1 and 5.2, except that steel shall be not less than 0.032 inch (0.81 mm) (No. 20 MSG) thick [0.034 inch (0.86 mm) (No. 20 GSG) thick when zinc coated] and nonferrous metal shall be not less than 0.045 inch (1.14 mm) (No. 18 GSG) thick at points where a wiring system is to be connected.

5.5 Nonmetallic

5.5.1 A nonmetallic material can be used for part or all of a general purpose enclosure when it complies with the requirements in 5.5.2 – 5.5.5.

5.5.2 A nonmetallic enclosure or enclosure part shall have mechanical strength and durability and be so formed that operating parts are protected against damage, and shall resist the abuses that will be encountered during installation and normal use and service. The enclosure or enclosure part shall protect persons from shock hazard, and the material shall not create or contribute to a hazardous condition.

5.5.3 A nonmetallic enclosure shall comply with the following:

- a) Flammability test, 39.3;

Exception: Parts that are molded from materials that are classed as 5VA, 5VB, V-0, V-1, or V-2 by the vertical burning test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, need not be subjected to the flammability test described in 39.3.

- b) Elevated temperature test, 39.4; and

- c) Impact test, 39.5.

The material is not to display a loss of these properties beyond its minimum intended level as a result of aging.

5.5.4 Temperatures shall be monitored on the enclosure during the Normal Temperature Test, Section 32. If any part of the enclosure is subjected to a temperature rise greater than 40°C, the enclosure shall be conditioned in accordance with 39.2, prior to the tests outlined in 5.5.3.

5.5.5 A metallized coating provided on a nonmetallic part, shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and shall be suitable for the application to the appropriate surface material.

Table 5.1
Minimum thickness of sheet metal for enclosures carbon steel or stainless steel

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness uncoated,		Minimum thickness metal coated,	
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	inch (mm) [MSG]		inch (mm) [GSG]	
4.0 (10.2)	Not limited	6.25 (15.9)	Not limited	0.020 ^d (0.51)		0.023 ^d (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 ^d (0.66)		0.029 ^d (0.74)	
7.0 (17.8)	8.75 (22.2)	10.0 (25.4)	12.5 (31.8)	[22]		[22]	
8.0 (20.4)	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 (1.34)		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 (1.53)		0.063 (1.61)	
25.0 (63.5)	31.0 (78.7)	35.0 (89.0)	43.0 (109.2)	[15]		[15]	
25.0 (63.4)	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]	

^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 the same outside dimensions as the enclosure surface and which has torsional rigidity to resist the bending moments which is capable of being applied via the enclosure surface when it is deflected. Construction that is determined to have equivalent reinforcing can be accomplished by constructions that produce a structure which is as rigid as one built with a frame of angles or channels. Construction determined 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 can 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.

^d Sheet metal for an enclosure intended for outdoor use shall comply with 6.6 and 6.7.

Table 5.2
Minimum thickness of sheet metal for enclosures aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness, inches (mm) [AWG]
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	Maximum width, ^b inches (cm)	Maximum length, inches (cm)	
3.0 (7.6)	Not limited	7.0 (17.8)	Not limited	0.023 ^d (0.58)
3.5 (8.9)	4.0 (10.2)	8.5 (21.7)	9.5 (24.1)	[22]
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 (34.2)	[20]
6.0 (15.2)	Not limited	14.0 (35.6)	Not limited	0.036 (0.91)
6.5 (16.5)	8.0 (20.4)	15.0 (38.1)	18.0 (45.7)	[18]
8.0 (20.4)	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)	[16]
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)	[14]
18.0 (45.7)	Not limited	42.0 (106.7)	Not limited	0.075 (1.91)
20.0 (50.8)	25.0 (63.4)	45.0 (114.3)	55.0 (139.7)	[12]
25.0 (63.4)	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)	[10]

^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 the same outside dimensions as the enclosure surface and which has torsional rigidity to resist the bending moments which are capable of being applied via the enclosure surface when it is deflected. Construction that is determined to have equivalent reinforcing can be accomplished by constructions that produce a structure which is as rigid as one built with a frame of angles or channels. Construction determined 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 can 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.

^d Sheet metal for an enclosure intended for outdoor use shall comply with 6.6 and 6.7.

5.6 Glass panels

5.6.1 Glass covering an observation opening shall be secured in place so that it cannot be readily displaced in service, and shall provide the required mechanical protection for the enclosed parts. Glass for an opening not more than 4 inches (102 mm) in any dimension shall not be less than 1/16 inch (1.6 mm) thick. Glass for a larger opening not more than 144 square inches (929 cm²) in area and not having a dimension greater than 12 inches (305 mm), shall not be less than 1/8 inch (3.2 mm) thick. Glass used to cover a still larger area shall not be less than 1/8 inch thick and shall comply with one of the following:

- a) The glass shall be of a nonshattering or tempered type that, when broken, shall comply to the performance specifications noted in the Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1-1972; or
- b) Shall withstand a 2-1/2 foot-pound (3.39 J) impact from a 2 inch (50.8 mm) diameter, 1.18 pound (0.54 kg) steel sphere without cracking or breaking to the extent that a piece is released or dropped from its normal position.

5.6.2 If an adhesive is used to hold a gasket or glass cover in place, and failure of the adhesive would allow rain to enter the enclosure or allow access to hazardous circuits or parts, the combination shall be subjected to the Adhesion Test in the Standard for Gaskets and Seals, UL 157.

5.7 Openings

5.7.1 The electrical enclosure shall be constructed to prevent the risk of emission of flame, sparks, molten metal, flaming or glowing particles, or flaming drops. The size of openings permitted for drainage, ventilation, etc., shall be reduced or shall be baffled or screened where required to comply with this requirement. See 5.9.1 and 5.9.2.

5.7.2 When the failure of any part that contains, conducts, or otherwise contacts a liquid or vapor results in a hazardous condition, the part shall be resistant to the liquid or vapor involved under any conditions of use.

5.7.3 When a liquid, powder, or other material that must be replenished, removed, or replaced is present in the equipment, spilled material shall be prevented from contacting live parts, and any other hazardous condition that results from filling, emptying, storage, normal movement of the equipment, or similar activities, shall be prevented from occurring.

5.8 Ventilating openings

5.8.1 For ventilating openings the following requirements shall apply:

- a) A compartment or that part of an enclosure that contains field-wiring splices in the line-voltage circuit shall not be provided with ventilating openings.
- b) The nearest portion of a ventilating opening shall be above the bottom of the enclosure and away from any wall mounting surface by a distance equal to one-quarter of the enclosure height and depth, respectively, or 1 inch (25.4 mm) whichever is the least.
- c) There shall not be emission of flame or molten material, or manifestation of fire hazard, during the normal tests, as well as during abnormal tests such as transformer burnout and burnout of relays with blocked armature, on the control.
- d) Unless the construction of a device provided with forced ventilation is such that there is not direct path between live parts and the outlet opening, burnout tests, in addition to those specified in (c) shall be conducted to determine that there is not emission of flame or molten material through that opening.
- e) Air from a ventilating opening, either forced or otherwise, shall not be directed into a duct or into a concealed space in a building, shall not be directed against the mounting surface, and shall not be directed so that a disturbance is propagated to other equipment.

5.9 Other openings

5.9.1 The smaller dimension (width) of an opening in an enclosure around a dial, adjusting knob, lever, handle, pointer, and similar parts shall not be more than 1/8 inch (3.2 mm) for any setting or position of the dial, knob, or similar part.

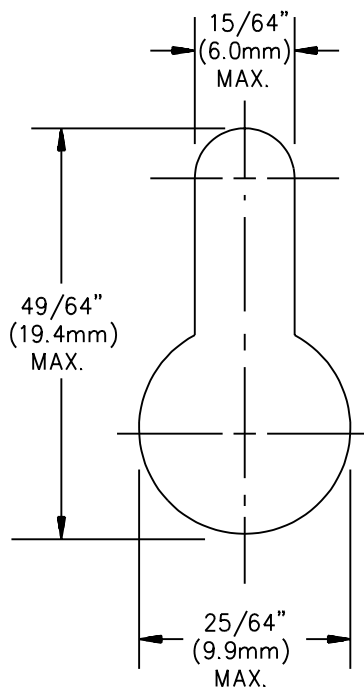
5.9.2 Except as permitted for ventilating openings or in 5.9.1, the enclosure shall not have open holes other than:

- a) Not more than four unused holes intended for mounting various components inside the enclosure. The largest dimension of each such opening shall not be more than 3/16 inch (4.8 mm).
- b) Not more than four holes 1/8 inch (3.2 mm) or less in diameter for the escape of air or drainage of paint during the painting process if they are located as close to the corners of the enclosure as possible, preferably at the rear of the enclosure.
- c) The drainage opening in a rainproof enclosure shall not exceed 1/4 by 1/4 inch (6.4 by 6.4 mm).
- d) Not more than four enclosure mounting holes shall be provided for an enclosure having a maximum dimension of 18 inches (457 mm). Six holes can be provided for an enclosure with a maximum dimension more than 18 inches, and less than 48 inches (122 cm). Eight holes can be provided for an enclosure with a maximum dimension of 48 inches or more. Four of the holes for an enclosure with a maximum dimension of 12 inches (305 mm) can be keyhole slots having the configuration illustrated in Figure 5.1. The dimensions shown in Figure 5.1 can vary when the area is determined to be equivalent. Four of the holes for a larger enclosure can be keyhole slots, the dimensions of which are not specified and shall be judged with respect to the enclosure dimensions and configuration.

- e) An opening for passage of a tube, pipe, or other required mechanism shall result in an unclosed portion of the opening not larger than 1/16 inch (1.6 mm).

5.9.3 A plate or plug for an unused conduit opening shall have a thickness not less than 0.014 inch (0.36 mm) for steel or 0.019 inch (0.48 mm) for nonferrous metal for a hole having a 1/4 inch (6.4 mm) maximum dimension, and 0.027 inch (0.69 mm) steel or 0.032 inch (0.81 mm) nonferrous metal for a hole having a 1-3/8 inch (34.9 mm) maximum dimension. A closure for a larger hole shall have a thickness equal to that required for the enclosure of the device or a standard knockout seal shall be used. Such plates or plugs shall be securely mounted.

Figure 5.1
Keyhole Slot



EC600

5.9.4 In a small device where the indentation of a guard or enclosure will not alter the clearance between uninsulated, movable, live parts and grounded metal, so as to adversely affect performance or reduce spacings below the minimum values given in Table 27.1, 0.020 inch (0.51 mm) expanded metal mesh [0.023 inch (0.58 mm) when zinc coated] can be employed, as long as:

- a) The exposed mesh on any one side or surface of the device so protected has an area of not more than 72 square inches (465 cm²) and has no dimension greater than 12 inches (305 mm) or
- b) The width of an opening so protected is not greater than 3-1/2 inches (88.9 mm).