UL 2735

STANDARD FOR SAFETY

Electric Utility Meters

UL Standard for Safety for Electric Utility Meters, UL 2735

First Edition, Dated May 30, 2013

Summary of Topics

This revision of UL 2735 includes the update of minimum layer thickness for 300V.

Text that has been changed in any manner or impacted by UL's electronic publishing system 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 revised requirements are substantially in accordance with Proposal(s) on this subject dated January 27, 2014.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

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MAY 30, 2013
(Title Page Reprinted: October 6, 2014)

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UL 2735

Standard for Electric Utility Meters

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Electric Utility Meters, UL 2735.

First Edition

May 30, 2013

This UL Standard for Safety consists of the First Edition including revisions through October 6, 2014.

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 the electrical safety of electric utility (revenue) meters rated up to 600 V, which measure, monitor, record, transmit, or receive electrical energy generation or consumption information.

1.2 Meters covered by this standard may be provided with one or two-way communication capabilities, by means of carrier signals, telephone, cable, wireless communication, or other methods.

1.3 These meters may additionally provide signals, either by direct connection or wirelessly, for the control of electrical loads or electrical power generation equipment in response to signals received from the utility or local communication networks.

1.4 These requirements cover socket mounted plug-in (Type S) utility meters, and non-socket mounted, bottom connected (Type A) utility meters, intended for installation in ordinary (non-classified) locations. These may or may not be intended to be under the exclusive control of the serving utility.

1.5 These requirements also cover revenue meters that are not socket mounted (Type S) or bottom connected (Type A) meters, including those that are intended for factory installation as components within the enclosure of complete equipment.

1.6 These requirements do not cover equipment intended as test equipment or equipment intended to make measurements for analysis in a laboratory or industrial setting.

2 Glossary

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

2.2 ACCESS PANEL – A panel or door that may be opened or removed to provide access to a portion of the meter interior.

2.3 BOTTOM-CONNECTED METER (Type “A” Meter or “A-Base” Meter) – A non-detachable meter that is connected using wiring terminals on bottom of the meter.

2.4 CLEARANCE – The shortest distance in air between two conductive parts.

2.5 COVER – A portion of the meter that mates with the meter base to form a complete enclosure. The cover is typically transparent or has a transparent portion that allows the meter display to be viewed.

2.6 CREEPAGE DISTANCE – The shortest distance along the surface of a solid insulating material between two conductive parts.

2.7 DETACHABLE METER (Type “S” Meter) – A socket type meter, intended to plug into a meter socket or similar equipment.

2.8 ENCLOSURE – The exterior portion of a meter that prevents access to live parts when the meter is properly installed. For example, the enclosure of a typical Type S meter consists of the meter cover and the meter base.

2.9 ISOLATED SECONDARY CIRCUIT – A circuit having no direct connection to the mains circuit, that derives its power from a transformer, converter or equivalent isolation device, or from a battery.

2.10 LOAD CONTROL SWITCH – A device, normally external to the meter, that is intended to energize or de-energize an electrical appliance or other device based on a signal provided by the meter.

2.11 MAINS – An electricity supply system to which the equipment concerned is designed to be connected for the purpose of powering the equipment.

2.12 MAINS CIRCUIT – A circuit which is intended to be directly connected to the MAINS for the purpose of powering the equipment.

2.13 NORMAL USE – Operation, including stand-by, according to the instructions for use or for the obvious intended purpose.

2.14 REVENUE METER – A meter intended to measure energy usage for billing purposes. A revenue meter may be used as the main meter for an electrical service, or may be a submeter.

2.15 SERVICE SWITCH – A device internal to the meter that is intended to energize or de-energize the load terminals of the meter.

2.16 SINGLE FAULT CONDITION – A condition in which one means for protection against a risk of fire or shock is defective or one fault is present which could cause a risk of fire or shock.

2.17 SUBMETER – A meter intended for installation on the load side of the main utility meter for an electrical service. Submeters are intended to measure energy usage for a portion of the service to a premise. These devices include meters intended to measure electrical energy usage for subdivided billing, including energy consumption of individual loads and appliances.

2.18 UTILITY METER – A revenue meter intended for installation by an electric utility.

3 Units of Measurement

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

4 Components

4.1 Other than as indicated in 4.2, 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 typical components used in the products covered by this Standard.

4.2 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.

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

4.4 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.

5 Undated References

5.1 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.

CONSTRUCTION

6 General

6.1 Other than as noted in 6.2, a type A or type S meter shall be of one of the form designations and current classes described in the Standard for Electric Meters – Code for Electricity Metering, ANSI C12.10, and shall comply with all the requirements of ANSI C12.10.

6.2 When intended for installation by a specific utility and when agreeable to all parties concerned, special forms and current classes are not prohibited. When special forms are utilized the meter shall:

a) Be provided with a wiring diagram on a label affixed adjacent to the wiring compartment;

b) Be evaluated in combination with the intended mounting socket (if socket mounted); and

c) Be marked to indicate the socket with which it is intended to be used.

6.3 A meter intended for factory installation as a component of complete equipment need not comply with the form designations in ANSI C12.10, but shall comply with all other requirements of ANSI C12.10 when installed in the complete equipment.

6.4 Detachable meters shall be provided with connecting blades having dimensions as described in ANSI C12.10.

6.5 Terminals shall be arranged to reduce the possibility of short circuits during meter connection, adjustment of the meter, or removal or replacement of the cover. The blades of a meter having a standard configuration as described in ANSI C12.10 are considered to meet this requirement.

6.6 Terminals for connection to isolated secondary circuits during installation shall be located such that the wiring connected to these terminals may be reliably routed away from live parts of the mains circuit, such that the creepage and clearance requirements between mains and secondary circuits are maintained.

6.7 Meters provided with wiring leads for connection of secondary circuits during installation shall comply with 6.7(a) through (c):

a) Wiring leads shall be insulated for the highest rated voltage of the meter, or shall be routed and secured away from live parts of the mains circuit, such that the creepage and clearance requirements between mains and secondary circuits are maintained;

b) Wiring leads shall be protected against abrasion and sharp bends at the point where the conductors enter the equipment, by an inlet or bushing with a smoothly rounded opening; and

c) Wiring leads shall be secured to relieve the conductors from strain, including twisting, where they are connected within the meter. Knots in conductors shall not be used as strain relief. It shall not be possible to push the cord into the equipment to an extent which could damage the conductor or cause a risk of fire or shock.

6.8 A meter may have provision for adjustments during service. Such adjustments shall be accessible without disassembly of the meter other than removal of the cover.

7 Enclosure

7.1 General

7.1.1 The enclosure of a meter shall completely enclose all live parts, other than parts that are enclosed by the meter base when the meter is properly installed.

7.1.2 Meter enclosures incorporating polymeric materials shall comply with the requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C as applied to permanently installed equipment.

7.1.3 The enclosure of a utility meter intended for use indoors shall comply with the performance requirements of the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, for Type 2 enclosures. A meter marked with additional enclosure type designations shall also comply with the performance requirements for those enclosure type designations in accordance with UL 50E.

7.1.4 The enclosure of equipment intended for use outdoors shall comply with the performance requirements of the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, for Type 3R enclosures. A meter marked with additional enclosure type designations shall also comply with the performance requirements for those enclosure type designations in accordance with UL 50E.

7.1.5 If a meter is provided with a glass dome enclosure, the glass portion shall comply with the Crush Resistance Test described in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50 and the Resistance to Impact Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.2 Access panels

7.2.1 A part of an enclosure such as a door or access panel shall be provided with means for firmly securing it in place.

7.2.2 Other than as noted in 7.2.3, an access panel shall be hinged if it gives access to a fuse or other overcurrent device, the functioning of which requires renewal, or if it is necessary to open the cover in connection with normal operation of the device.

7.2.3 A hinged access panel is not required if the only overload-protective devices enclosed are:

a) Supplementary fuses in control circuits, provided the devices and circuit loads are within the same enclosure;

b) Extractor fuses having an integral enclosure; or

c) Located within a detachable meter and accessible only after detaching the meter from the meter base.

8 Clearance and Creepage Distances

8.1 Type A and Type S meters shall comply with the dimensional requirements of ANSI/NEMA C12.10.

8.2 Clearance and creepage distances in the mains circuit shall comply with Table 8.1. Clearance and creepage distances between the mains circuit and isolated secondary circuits shall also comply with Table 8.1.

Table 8.1
CLEARANCES and CREEPAGE DISTANCES for MAINS CIRCUITS

Voltage line-to-neutral a.c. r.m.s. or d.c.	Values for CLEARANCE	Values for CREEPAGE DISTANCE	
V	mm	mm	
		Printed wiring boards (see note)	Other materials
≤150	3.0	3	3.0
>150 ≤ 300	5.5	5.5	5.5
>300 ≤ 600	8.0	8.0	9.4

Note: Creepages on printed wiring board apply only between coated or uncoated parts and traces of the printed wiring board that are covered with a coating. Creepages between two live parts on a printed wiring board that are not covered with coating shall comply with the creepages shown under “other materials”.

8.3 Clearances in secondary circuits that are isolated from the mains circuit by a transformer, optical isolator, or similar device shall comply with Table 8.2.

Table 8.2
CLEARANCES and test voltages for secondary circuits derived from MAINS CIRCUITS

Secondary		MAINS voltage	MAINS voltage	MAINS voltage
Working voltage		≤150 V	>150≤ 300 V	>300 ≤ 600 V
		a.c. rms	a.c. rms	a.c. rms
a.c. rms	d.c. or a.c. peak	CLEARANCE	CLEARANCE	CLEARANCE
V	V	mm	mm	mm
16	22.6	1.5	2.9	5.4
33	46.7	1.5	3.0	5.4
50	70	1.5	3.0	5.5
100	140	1.6	3.1	5.6
150	210	1.6	3.2	5.7
300	420	1.8	3.4	6.0
600	840	2.4	3.9	6.6

Linear interpolation is allowed.

8.4 Creepages in secondary circuits that are isolated from the mains circuit by a transformer, optical isolator, or similar device shall comply with Table 8.3.

Table 8.3
CREEPAGE DISTANCES for secondary circuits

Secondary working voltage a.c. r.m.s. or d.c.	CREEPAGE DISTANCE	
V	mm	
	Printed Wiring Boards (see note)	Other Insulating Materials
10	0.04	1.0
12,5	0.04	1.05
16	0.04	1.1
20	0.04	1.2
25	0.04	1.25
32	0.04	1.3
40	0.04	1.8
50	0.04	1.9
63	0.063	2.0
80	0.1	2.1
100	0.16	2.2
125	0.25	2.4
160	0.4	2.5
200	0.63	3.2
250	1.0	4.0
320	1.6	5.0
400	2.0	6.3
500	2.5	8.0
630	3.2	10.0

Note: Creepages on printed wiring board apply only between coated or uncoated parts and traces of the printed wiring board that are covered with a coating. Creepages between two live parts on a printed wiring board that are not covered with coating shall comply with the creepages shown under ″other materials.″

8.5 Conductors located between the same two layers of a multilayer printed wiring board shall be separated by at least the applicable minimum distance of Table 8.4.

Table 8.4
Minimum values for distances between same two layers of a multilayer printed wiring board

Table 8.4 revised October 6, 2014 |

Line-to-neutral voltage	Minimum thickness of each layer	Minimum distance
V r.m.s. or d.c.	mm	mm
≤300	0.3	0.4
≥300 ≤ 600	0.6	0.6
>600 ≤ 1000	1.0	1.0

8.6 For glass and ceramics, there are no requirements for CREEPAGE DISTANCES.

9 Current Transformers

9.1 Other than as described in 9.2, a meter with measurement circuitry intended for connection to current transformers shall be provided with the current transformers integral to the meter.

9.2 A meter intended for connection to current transformers which are not provided with the meter shall be provided with instructions to indicate ratings of the current transformers to be used with the meter.

9.3 The output of current transformers shall be reliably isolated from other isolated secondary circuits that are not contained wholly within the equipment.

10 Batteries and Battery Charging

10.1 Batteries shall not cause explosion or produce a risk of fire as a result of excessive charge or discharge, or if a battery is installed with incorrect polarity. If necessary, protection shall be incorporated in the equipment, unless the manufacturer's instructions specify that it is for use only with batteries which have built-in protection.

10.2 If an explosion or risk of fire could occur through installing a battery of the wrong type (for example, if a battery with built-in protection is specified) there shall be a warning marking on or near the battery compartment or mounting, and a warning in the manufacturer's instructions.

10.3 If equipment has means for charging rechargeable batteries, and if non-rechargeable cells could be installed and connected in the battery compartment, there shall be a warning marking in or near the compartment. The marking shall warn against the charging of non-rechargeable batteries and indicate the type of rechargeable battery that can be used with the recharging circuit.

10.4 The battery compartment shall be designed so that there is no possibility of explosion or fire caused by build-up of flammable gases.

10.5 Batteries shall be mounted so that any leakage of their electrolyte will not be directed toward energized primary circuit parts.

10.6 Under normal operating conditions, a failure of a single component shall not lead to an explosion of the battery or risk of fire.

11 Load Control Switches

11.1 If provided with a switching device that controls a load (including a service switch), the switching device shall comply with the overload and endurance test requirements of UL 508. Service switches that control the entire load of the meter may be investigated for a lesser number of endurance operations than required by UL 508, but not less than 1000 operations at the maximum rated voltage and current of the meter, with a power factor not greater than 0.80.

12 Printed Wiring Boards

12.1 Printed wiring boards shall be made of material with a flammability classification of V-1 or better of UL 94.

12.2 Coatings used on printed wiring boards shall comply with Polymeric Materials - Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards, UL 746E and Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The combination of coating and printed wiring shall have a flammability classification of V-1 or better of UL 94.

PERFORMANCE

13 General

13.1 Meters shall comply with the test requirements in Sections 14 through 18.

13.2 When conducting electrical tests on a detachable meter, the meter shall be placed in a properly rated meter socket complying with the Standard for Meter Sockets, UL 414.

13.3 When conducting electrical tests on a bottom connected meter, the meter shall be installed in a metal enclosure having dimensions of 150% of the meter, unless the installation instructions specify the use of a specific enclosure or an enclosure with different dimensions, in which case the tests are to be conducted with the meter mounted in the enclosure specified in the instructions.

13.4 When conducting electrical tests, connections shall be made with wire sized per the National Electrical Code requirements for service entrance conductors. The wire used for the test shall be copper wire, not less than 4 ft (48 in.) per terminal (8 ft (96 in.) jumper between terminals). The length of wire shall not exceed 9 feet (108 in.) per pole during the Effects of Temporary Overload Test.

14 Testing in SINGLE FAULT CONDITION

14.1 General

14.1.1 SINGLE FAULT CONDITION tests shall be conducted, unless it can be demonstrated that no risk of fire or shock could arise from a particular fault condition. Circuit analysis may be used to determine if a specific single fault condition could result in a risk of fire or shock, and single fault conditions that will not result in a risk of fie or shock need not be conducted.

14.1.2 The equipment shall be operated under the least favorable test conditions These conditions may be different for different faults and they shall be recorded for each test.

14.1.3 For these tests, the complete meter, and socket as applicable, shall be covered with a double layer of cheesecloth, and a softwood surface, covered with a double layer of white tissue paper, shall be placed beneath the meter.

14.1.4 A previously untested sample may be used for each separate SINGLE FAULT CONDITION.

14.2 Application of fault conditions

14.2.1 Fault conditions shall include those specified in 14.2.2 to 14.2.4. The conditions shall be applied only one at a time and shall be applied in turn in any convenient order. Multiple simultaneous faults shall not be applied unless they are a consequence of an applied fault. During and after each application of a fault condition, the equipment or part shall meet the requirements of 14.4.

14.2.2 Discrete components, such as capacitors, diodes, resistors, and the like, shall be shorted and opened, one at a time. Where a circuit analysis shows that failure of a particular component will not result in overloading of other components or circuits, the component need not be subjected to this test.

14.2.3 Transformers connected to the MAINS CIRCUIT shall be subjected to short circuit tests on each winding that is loaded in NORMAL USE. Each winding shall be tested separately.

14.2.4 Transformers connected to the MAINS CIRCUIT shall be subjected to overload tests on each winding that is loaded in NORMAL USE. Each winding shall be tested separately by connecting a variable resistor across the winding, and adjusting the resistor as quickly as possible and readjusting, if necessary, after 1 min to maintain the applicable overload. No further readjustments shall be made. For each winding, the overload test current shall be one of the following:

a) If a current interrupting device provides overcurrent protection, the overload test current is the maximum current which the overcurrent protection device will carry for 1 h. Before the test, the device is replaced by a link with negligible impedance. If the maximum current cannot be determined from the device specifications, it shall be determined by test.

b) If the winding output voltage is designed to collapse when a specified overload current is reached, the test current is to be slowly increased to the point just before the output voltage collapses.

c) In all other cases, the test current shall be the maximum power output that can be obtained from the transformer.

14.3 Duration of tests

14.3.1 The meter shall be operated until further change as a result of the applied fault is unlikely. Each test is normally limited to 1 h since a secondary fault arising from a SINGLE FAULT CONDITION will usually occur within that time. If there is an indication that a risk of electric shock, spread of fire or injury to persons may eventually occur, the test shall be continued for 4 h unless one of these risks arises before then.

14.4 Conformity

14.4.1 During and at the conclusion of each single fault test, there shall be:

a) No exposure of live parts,

b) No molten metal, burning insulation, or flaming particles expelled from the meter, and

c) No charring, glowing, or flaming of the tissue paper or cheesecloth.

14.4.2 For meters having isolated secondary circuits that are intended for external connection, there shall be no breakdown when the Insulation Resistance test is conducted between the mains and secondary circuits.

15 Tests based on ANSI C12.1

15.1 Meters shall be subjected to the tests specified in 15.2. Compliance with the test requirements shall be determined in accordance with 15.6 of this document.

15.2 The tests from ANSI C12.1 shown below are required. Test sequence and conditions shall be as described in 15.3 through 15.5:

a) Test No. 9: Temperature Rise (as modified by 15.7 of this standard);

b) Test No. 15: Insulation Resistance;

c) Test No. 17: Effect of High Voltage Line Surges;

d) Test No. 20: Effect of Temporary Overloads (as modified by 15.8 of this document);

e) Test No. 25: Effect of Electrical Fast Transient/Burst Test

f) Test No. 26: Effect of radio frequency interference;

g) Test No. 27: Radio frequency conducted and radiated emissions test; and

h) Test No. 28: Effect of electrostatic discharge (ESD) (as modified by 15.9 of this document).

15.3 Test numbers 17, 25, 26, and 28 shall be conducted on the same sample, followed by Test 27. Test number 20 may be conducted on a separate sample, and shall be followed by Test number 15. All other tests may be conducted on separate sample groups, and need not be followed by Test 27.

15.4 If a meter contains a service switch or a load control switch, they shall be set to the open state for all testing, with the exception of the Temperature Rise Test (Test No. 9) and the Effects of Temporary Overloads Test (Test No. 20).

15.5 The selection of representative samples shall be as described in the test method specified ANSI C12.1, except only one sample is required per test.

15.6 When tested in accordance with the requirements specified in 15.1 and 15.2, conformity with the test requirements is to be determined as detailed below:

a) No test shall cause a service switch or load control switch to move from the open to the closed position;

b) There shall be no exposed live parts at the conclusion of any test;

c) The meter shall meet the requirements of the Insulation Resistance Test (Test 15 of ANSI C12.1) at the conclusion of all tests other than the Radiated and Conducted Emissions Test.

15.7 When conducting the Temperature Rise Test, measured temperatures shall not exceed the temperature ratings of any components or insulating material, and shall not exceed the limits specified in Tables 15.1 and 15.2. Maximum temperature is determined by measuring the temperature rise under reference test conditions and adding this rise to 40°C, or to the maximum rated ambient temperature if higher.

Table 15.1
Surface temperature limits in normal condition

		Part	Limit
			°C
1		Outer surface of enclosure (unintentional contact)	
	a)	metal, uncoated or anodized	65
	b)	metal, coated (paint, non metallic)	80
	c)	plastics	85
	d)	glass and ceramics	80
	e)	small areas (<2 cm^2) that are not likely to be touched in NORMAL USE	100
2		Knobs and handles (NORMAL USE contact)	
	a)	metal	55
	b)	plastics	70
	c)	glass and ceramics	65
	d)	non-metallic parts that in NORMAL USE are held only for short periods (1 s - 4 s)	70

Table 15.2
Maximum temperatures for insulation material of windings

Class of insulation	Normal condition	SINGLE FAULT CONDITION
	°C	°C
Class A	105	150
Class B	130	175
Class E	120	165
Class F	155	190
Class H	180	210

15.8 When conducting the Effects of Temporary Overload test specified in 15.2 (ANSI C12.1, Test Number 20) the following additional requirements apply:

a) The current level for Current Class 200A or 320A shall not be less than 12,000 amperes rms symmetrical. The current level for Current Class 100A meters shall not be less than 10,000 amperes rms symmetrical. For meters with a short-circuit current rating exceeding these minimum levels, the test current shall be equal to the short-circuit current rating;

b) For meters with a short circuit rating exceeding 10,000 amperes, the unit may be tested as described in the Standard for Meter Sockets, UL 414, or the unit shall be subjected to the Effects of Temporary Overload test with the test current equal to the short-circuit current rating. The minimum peak current for either test method shall be 30,000 amperes;

c) The Temporary Overload test is applicable to both self contained and current transformer rated meters. For current transformer type meters, the test shall be conducted with the current transformers provided or specified by the manufacturer, with the overload current passed through the primary of the current transformer; and

d) When conducting the Temporary Overload test, all grounded metal is to be connected through a 30-ampere, non-time delay type cartridge fuse to the line side of the pole least likely to arc to the enclosure by a 10 AWG (5.3 mm) copper wire 4 – 6 feet (1.2 – 1.8 m) long. The fuse shall not open during the test.

15.9 When conducting the Effect of Electrostatic Discharge (ESD) test specified in 15.2 (ANSI C12.1, Test Number 28). The effects of electrostatic discharge (ESD) shall be evaluated in accordance with ANSI C12.1, using the laboratory environmental conditions, the polarity of the discharge, the verification of the waveforms and the satisfaction of lower level discharges requirements in accordance with Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test, IEC 61000-4-2.

16 Flammability – 127 mm (5 inch) Flame

16.1 General

16.1.1 This test is not required to be conducted on parts that are molded from materials that are classed as 5VA by the five inch burning test described in UL 94. All other polymeric enclosure parts are to be subjected to this test.

16.2 Test specimens and conditioning

16.2.1 Three samples of the complete equipment or three test specimens of the part(s) thereof shall be subjected to this test. Consideration is to be given to leaving in place components and other parts that might influence the performance, including installation within the intended meter mounting equipment.

16.2.2 Other than as noted in 16.2.3, the test samples are to be conditioned in a full draft circulating air oven for 7 days at 10°C greater than the maximum use temperature but not less than 70°C in any case.

16.2.3 The conditioning of the test samples specified in 16.2.2 is not required if both of the following conditions are met:

a) The material used does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging.

b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

16.3 Test equipment

16.3.1 The test equipment shall comply with 16.3.2 through 16.3.6.

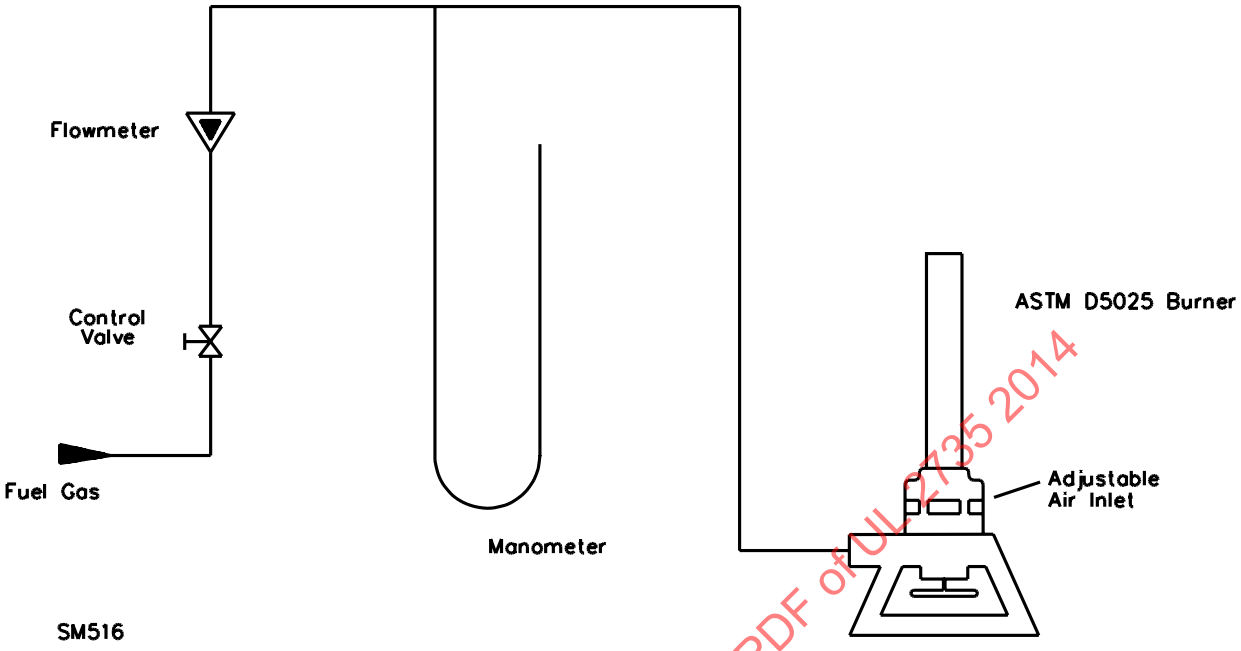
16.3.2 A laboratory type burner having a tube with a length of 100 ±10 mm (3.94 ±0.39 inch) and an inside diameter of 9.5 ±0.3 mm (0.374 ±0.012 inch) is to be used. The barrel is not to be equipped with an end attachment, such as a stabilizer. The burner shall be in compliance with ASTM D5025, Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials.

16.3.3 The burner shall be adjusted to produce a blue flame 125 ±10 mm high (5 inch nominal). The flame is obtained by adjusting the gas supply and air ports of the burner until a 40 ±2 mm (1.5 inch nominal) yellow-tipped blue flame is produced. The air supply shall be increased until the yellow tip just disappears. The height of the flame shall be measured again and readjusted it if necessary.

16.3.4 The test flame shall be calibrated in accordance with ASTM D5207, Standard Practice for Calibration of 20 mm and 125 mm Test Flames for Small-Scale Burning Tests on Plastic Materials at least once a month and when the gas supply is changed, test equipment is replaced, or when data is questioned.

16.3.5 Other than as noted in 16.3.6, a supply of technical-grade methane gas (minimum 98 percent pure) is to be used with a regulator and meter for uniform gas flow. The methane gas supply to the burner shall be arranged as in Figure 16.1 and adjusted to produce a gas flow rate of 965 ±30 ml/min with a back pressure of 125 ±25 mm of water. See ASTM D 5207. The flow meter shall be a rotameter calibrated in accordance with ASTM D3195, Practice of Rotameter Calibration with correlation curves appropriate for the gas, or a mass flow meter with ±2 percent accuracy.

Figure 16.1
Burner supply arrangement



16.3.6 Natural gas having a heat content of approximately 37 MJ/m^3 (1000 Btu/ft^3) at 23°C has been found to provide similar results, and may be used in lieu of technical-grade methane gas.

16.4 Test method

16.4.1 Prior to application of the flame, the samples are to be maintained for a minimum of 4 hours at 23.0 ±2.0°C and 50 ±5 percent relative humidity.

16.4.2 Each sample is to be mounted or positioned as intended in service, in a draft-free test chamber, enclosure, or laboratory hood. A layer of absorbent 100 percent cotton is to be located 305 mm (12 inch) below the point of application of the test flame.

16.4.3 The 127 mm (5 inch) flame is to be applied to any portion of the interior of the part judged as likely to be ignited (by its proximity to live or arcing parts, coils, wiring, and the like).

16.4.4 When testing complete assemblies, it may be necessary to modify the assembly to provide an opening through which the burner may be inserted to apply the flame to the interior of the part under test. The size of this opening shall be such as to allow insertion of the burner, while minimizing the impact on the enclosure integrity. The flame may be applied to the outside of an enclosure if the equipment is of the encapsulated type or of such size that the flame cannot be applied inside.

16.4.5 The flame is to be applied at an angle of approximately 20 degrees in so far as possible from the vertical so that the tip of the blue cone touches the specimen.

16.4.6 The test flame is to be applied to three different locations (one on each of the three samples tested).

16.4.7 For detachable meters (such as Type S meters), that may be installed through an opening in the meter mounting equipment enclosure, the base of the meter shall be subjected to applications of the flame on both the inside and outside surfaces of the base.

16.4.8 The flame is to be applied for 5 seconds and removed for 5 seconds. The operation is to be repeated until the specimen has been subjected to five applications of the test flame.

16.4.9 When testing complete assemblies, if the flame extinguishes due to oxygen starvation during one or more of the 5 second applications, the burner is to be withdrawn, re-ignited, and testing shall be continued until five applications of the test flame (including any application that self-extinguishes) are conducted.

16.5 Assessment of test results

16.5.1 When tested as described in 16.4, all of the following results shall be obtained:

a) The material shall not continue to burn for more than 1 minute after the fifth 5-second application of the test flame, with an interval of 5 seconds between the applications of the flame,

b) Flaming drops or flaming or glowing particles that ignite surgical cotton 205 mm (12 inch) below the test specimen shall not be emitted by the test sample at any time during the test, and

c) No visible flame shall be observed on the surface of the enclosure opposite to the surface that the test flame is applied during the test. In addition, no opening greater than 3 mm shall appear after the test and the sample has cooled for 30 seconds.

16.5.2 The three test samples are to exhibit the acceptable performance described in 16.5.1. If one sample does not comply, the test is to be repeated on a set of three new samples with the flame applied under the same conditions as the unsuccessful sample. If all the new specimens comply with 16.5.1 the material is acceptable.

17 Extended Overvoltage Test

17.1 Deleted January 9, 2014

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18 Mechanical Tests

18.1 Static test

18.1.1 The equipment shall be held firmly against a rigid support and subjected to a force of 30 N (6.7 lbf) applied by the hemispherical end of a hard rod of 12 mm diameter. The rod shall be applied to each part of the enclosure which could easily be touched when the equipment is ready for use, and which could cause a risk of fire or shock if distorted.

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18.2 Impact test

18.2.1 An impact shall be applied to any point on surfaces which are easily touched in NORMAL USE and which would be likely to cause a risk of fire or shock if damaged.

18.2.2 Non-metallic enclosures shall be cooled to the -35°C ±2°C temperature, maintained at this temperature for 3 hours, and then tested within 10 min of removal from the chamber.

18.2.3 Impacts may be applied to empty enclosures if it is clear that the equipment would have passed the test if it had been tested in complete condition.

18.2.4 If an enclosure is damaged by an impact but meets the conformance criteria of 18.4, a new enclosure may be used for the next impact.

18.2.5 Equipment shall be mounted as specified in the installation instructions and each test point is subjected to one impact by a smooth steel sphere with a mass 500 g ±25 g (1.1 lb ± .05 lb) and with a diameter of approximately 50 mm (2 in.). The impact energy level shall be 5 J (3.7 ft-lbs).

18.2.6 The impact test can be performed with the equipment mounted at 90° to its normal position to allow both the method of Figure 18.1(a) and Figure 18.1(b).