

Subject 2735C

October 2, 2017

SUMMARY OF TOPICS

The following is being proposed:

1. The Proposed First Edition of the Standard for Electric Utility Meters for Canada, UL 2735C

STP BALLOTS AND ALL COMMENTS DUE: November 16, 2017

1. The Proposed First Edition of the Standard for Electric Utility Meters for Canada, UL 2735C

RATIONALE

Proposal submitted by: Paul Barnhart, UL LLC, on behalf of the 2735C Task Group

In the wake of significant concerns related to smart meters that were linked to fires in Canadian provinces, Canadian regulators, utilities, and manufacturers expressed an urgent need for an expedient process to develop an electric utility meter standard for Canada based on the existing Standard for Electric Utility Meters, UL 2735. The STP for Electric Utility Meters was formed to serve as the consensus body for the development and maintenance of the new Standard for Electric Utility Meters for Canada, UL 2735C.

UL provided a draft standard for preliminary review using the existing Standard for Electric Utility Meters, UL 2735, with modifications for use in Canada. Preliminary comments were provided by STP members and a 2735C STP Meeting was held to review and discuss comments and suggested changes to the draft standard. The draft standard was then balloted but did not achieve consensus. A Task Group was formed to address outstanding concerns and update the draft standard. A second preliminary review of the updated standard was then conducted followed by additional comment resolution.

Throughout the document extensive edits were made to ensure defined terms and definitions were consistently and properly used. In addition, numerous substantial changes have been incorporated and while not presented with legislative text due to the amount of changes, they are described as follows:

- a) Section 6: Revised to state that the meter must generally comply with the requirements of ANSI C12.10, Physical Aspects of Watthour Meters – Safety Standard. However, if not an ANSI C12.10 compliant meter, a wiring diagram shall be affixed to the meter and it should be tested with an appropriate socket if applicable. The meter shall meet the polymeric requirements of Annex C to ensure protection against risk of fire.
- b) Section 7: Added requirements to the enclosure such that it shall meet a specified IP rating. The old Section 8 has been replaced with Sections 8-11 stating the requirements for different types of insulation to reduce the risk of electrical shock.
- c) Sections 8-11: Insulation requirements have been substantially changed and improved.

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- Concepts such as function insulation and safety insulation have been added.
 - Requirements for Creepage and Clearance distances have been refined and means to determine those distances have been improved.
 - The different categories of circuits within a meter are better defined and explained to determine the type of insulation.
- d) Section 9: The concept of solid insulation is introduced and requirements defined.
- e) Section 10: Components bridging insulation is address and requirements added.
- f) Section 11: Requirements for limiting impedance are detailed.
- g) Current Transformers, old Section 9, has been deleted.
- h) Section 12: Requirements for batteries have been refined.
- i) Section 13: Load Control Switches renamed a Service Switch to reflect that it is in the meter and not be confused with a demand side management device.
- j) Section 17: The Section was rewritten to be easier to read.
- ANSI C12.1 Tests 25, 26, and 27 were removed as being non-safety related.
 - ANSI C12.1 Tests 32 and 33 were added with acceptance criteria for safety.
 - Increased the number of classes for Table 17.1 Maximum temperatures for insulation material of windings to accommodate more classes of insulation.
 - Test 9 requirements were clarified for meters that could exist in ambient temperatures above 40°C.
 - Environmental and conditioning requirements were specified for Test 15.
 - The requirements for Test 20 were modified to note differences between the overcurrent test of ANSI C12.1 and UL 414.
 - Test 20 Overload current requirements for transformer rated meters was revised to match IEC requirements.
 - Sample size requirements, Service Switch position and acceptance criteria are refined.
- k) Section 18: Instead of specifying the parts to be tested; more generally all polymeric parts are to be tested. The option to use new samples in case of a failure is removed.
- l) Section 19: Extended Overvoltage Test, (already removed from UL 2735) has been replaced with the Temporary Overvoltage Test which is based off a draft standard titled Construction and Safety Requirements for Electricity Meters, which will revise the current ANSI C12.10 Standard titled Physical Aspects of Watt-hour Meters.
- m) Section 20: A new section stating that testing shall verify the IP rating stated in section 7. Conditions of this testing are explained.

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- n) Section 21: Guidance is given to which surface to impact. Acceptance criteria is added.
- o) Section 22: Rating requirements are generalized to add flexibility to accommodate regulatory requirements.
- p) Section 23: Markings are generalized so as to meet regulatory requirements. An Indoor only meter must be marked as such. The meter must be traceable with a serial number.
- q) Section 24: Requirements added that the packaging state that only qualified people install the meters, that manufacturers documentation should be publicly available, and that the manufacturer have a warning in the documentation if the meters are rated to above 40°C. The requirement to include installation instructions has been removed.
- r) Annex C provides the requirements for polymeric materials to mitigate the risk of fire.

PROPOSAL

INTRODUCTION

1 Scope

- 1.1 These requirements cover the electrical safety of electricity METERS rated up to 600 VAC, 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 DETACHABLE METER (Type “S” Meter) UTILITY METERS, and BOTTOM-CONNECTED METER (Type “A” Meter or “A-Base” Meter) 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 do not cover equipment intended as test equipment or equipment intended to make measurements for analysis in a laboratory or industrial setting.

2 Definitions

- 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 ACCESSIBLE (part) – A METER part, conductive or non-conductive, which may be touched in NORMAL USE when the METER is installed as specified by the manufacturer, with the METER COVER in place.

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2.4 AUXILIARY (control) POWER SUPPLY – An electrical power supply of the METER, provided via dedicated terminal(s) in addition to the measurement terminals.

2.5 BASE – The back portion of a METER that mates with the METER COVER to form a complete ENCLOSURE, which supports the terminals, a hanger, and provides support for sealing to the COVER.

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

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

2.8 COVER – A lid or equipment covering used to protect the measurement components of a METER from external elements while allowing the viewing of the dials and nameplate information. A COVER may contain other components which may be required for resetting demand and electronically reading the METER[§].

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Note: The use of the term “dials” throughout this Standard also includes electronic displays.

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

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

2.11 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.

2.12 FUNCTIONAL INSULATION – Insulation needed for correct functioning of the meter and not intended to be used for protection against electric shock or fire or other safety purposes.

2.13 GROUND TERMINAL (Functional Earth Terminal) – An equipment terminal connecting to earth ground. The GROUND TERMINAL is not considered a MAINS terminal.

2.14 ISOLATED SECONDARY CIRCUIT – A circuit derived from an isolating source (such as a transformer, optical isolator, limiting impedance, electromechanical relay, or a battery) and having no other connection to the MAINS TERMINALS. A GROUND TERMINAL connection may be present.

2.15 MAINS – The electrical network supplying energy to the premises which consist of phase conductor(s) and neutral conductor(s). Neutral, if present, is normally connected to earth ground. Neutral is considered a MAINS conductor.

2.16 MAINS CIRCUIT – Any circuit directly connected to the MAINS TERMINALS. Circuitry having direct connection to a neutral terminal is considered a MAINS CIRCUIT.

2.17 MAINS TERMINALS – The equipment terminals used for connection to the MAINS which consist of potential (voltage) terminal(s), input current terminal(s), output current terminal(s) and neutral terminal(s). In some meter forms input current terminals also connect potential circuitry. Output current terminals may also connect to potential circuitry. Some meter forms do not have neutral terminals.

2.18 MATERIAL GROUPS – Related to the CTI performance level category values of insulating materials that are specified in Insulation coordination, CSA C22.2 No. 0.2-16, to be included in the group, as follows:

- a) I - $CTI \geq 600$ (PLC = 0)
- b) II - $400 \leq CTI < 600$ (PLC = 1)
- c) IIIa - $175 \leq CTI < 400$ (PLC = 2 or 3)
- d) IIIb - $100 \leq CTI < 175$ (PLC = 4)

Note: PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index.

2.19 METER – A device intended to measure electrical energy usage for billing. It may include energy consumption of individual loads and appliances.

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

2.21 POLLUTION DEGREES – Based on the presence of contaminants and possibility of condensation or moisture at the creepage distance and defined as follows:

- a) Pollution Degree 1 - No pollution or only dry, nonconductive pollution. The pollution has no influence.
- b) Pollution Degree 2 - Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected.
- c) Pollution Degree 3 - Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected.
- d) Pollution Degree 4 - Pollution that generates persistent conductivity through conductive dust or rain and snow.

2.22 PRINTED WIRING BOARD – Printed Circuit Board.

2.23 RISK OF ELECTRIC SHOCK – A risk of electric shock is considered to exist at any ACCESSIBLE part if:

- a) The potential between the part and earth ground or any other ACCESSIBLE part is more than 30 V rms (42.4 V peak) or 42.4 V dc; and
- b) The continuous current flow through a 2000Ω resistor connected across the potential exceeds 0.5 mA.

2.24 SELF CONTAINED METER (directly connected meter) – A METER in which the terminals are arranged for connection to the circuit being measured without using external instrument transformers[§].

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

2.26 SINGLE FAULT CONDITION – A condition in which one method for protection against a risk of fire or RISK OF ELECTRIC SHOCK is defective or one fault is present which could cause a risk of fire or RISK OF ELECTRIC SHOCK.

2.27 TRANSFORMER RATED METER – A METER in which the terminals are arranged for connection to the circuit being measured using external instrument transformers. Instrument transformers may be required for the connection of meter's voltage measurement terminals, or current measurement terminals, or both[§].

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2.28 UTILITY METER – A 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 Annex 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 Normative References

5.1 Where reference is made to any Standard, such reference shall be considered to refer to the latest editions and revisions, unless otherwise specified.

CSA Group Standards

C22.1-15,
Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0-10,
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.2-16,
Insulation Coordination

CAN/CSA-C22.2 No. 0.17-00 (R2013),
Evaluation of Properties of Polymeric Materials

C22.2 No. 14-13,
Industrial Control Equipment

C22.2 No. 94.1-15,
Enclosures for Electrical Equipment, Non-Environmental Considerations

C22.2 No. 94.2-15,
Enclosures for Electrical Equipment, Environmental Considerations

C22.2 No. 115-14,
Meter-Mounting Devices

CAN/CSA-E60384-14-14,
Fixed Capacitors for Use in Electronic Equipment - Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

CAN/CSA C22.2 No. 60950-1,
Information Technology Equipment – Safety – Part 1: General Requirements

UL Standards

UL 414
Meter Sockets

UL 840
Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 1449
Surge Protective Devices

UL 1577
Optical Isolators

ANSI¹ Standards

ANSI C12.1,
Electric Meters Code for Electricity Metering

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ANSI C12.10,
Physical Aspects of Watthour Meters – Safety Standard

ASTM² Standards

ASTM D3195,
Standard Practice of Rotameter Calibration

ASTM D5025,
Standard Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

ASTM D5207,
Standard Practice for Confirmation of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials

IEC³ Standards

IEC 60529,
Degrees of Protection Provided by Enclosures (IP Code)

¹ American National Standards Institute.

² American Society for Testing and Materials.

³ International Electrotechnical Commission.

CONSTRUCTION

6 General

6.1 Other than as noted in 6.2, a DETACHABLE METER OR BOTTOM-CONNECTED METER shall be of one of the form designations and current classes described in the Physical Aspects of Watthour Meters - Safety Standard, 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 form designations and current classes not listed in ANSI C12.10 are allowed. When special forms are utilized the METER shall:

- a) Be provided with a wiring diagram on a label affixed to the product;
- b) Be evaluated in combination with an appropriately rated mounting socket (if socket mounted); and
- c) Comply with all other requirements of ANSI C12.10.

6.3 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 or terminals of a METER having a standard configuration as described in ANSI C12.10 are considered to meet this requirement.

6.4 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 DISTANCE and CLEARANCE requirements between MAINS and ISOLATED SECONDARY CIRCUITS are maintained.

6.5 METERS provided with wiring leads for connection of ISOLATED SECONDARY CIRCUITS during installation shall comply with the following:

- 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 DISTANCE and CLEARANCE requirements between MAINS and ISOLATED 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 RISK OF ELECTRIC SHOCK.

6.6 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.

6.7 Polymeric materials in contact with uninsulated live parts shall comply with ANNEX C.

7 Enclosure

7.1 METERS shall comply with the performance requirements of Degrees of Protection Provided by Enclosures (IP Code), IEC 60529, for the IP Codes designated in Table 7.1 as demonstrated by the tests in Enclosure tests, Section 20.

Table 7.1
IP code requirements

	Indoor only ^a	Outdoors ^b
IP Code	51	55
^a Protected against dust infiltration and dripping water.		
^b Protected against moderate volume hose directed water and dust infiltration.		

7.2 METER ENCLOSURES incorporating polymeric materials shall comply with the requirements for polymeric materials in the Standard Enclosures for Electrical Equipment, Non-Environmental Considerations, CAN/CSA-C22.2 No. 94.1. Additionally, if the METER is intended for outdoor use, polymeric materials used for the ENCLOSURE shall comply with the Weatherometer Test of CAN/CSA C22.2 No. 0.17.

7.3 A METER marked with additional ENCLOSURE type designations that are in addition to those in Table 7.1 shall also comply with the performance requirements for those ENCLOSURE type designations.

7.4 If an ENCLOSURE has a door or ACCESS PANEL, a means for firmly securing it in place shall be provided.

7.5 If a protective GROUND TERMINAL is needed, it shall comply with the requirements for grounding terminals in ANSI C12.10.

8 Clearance and Creepage Distances

8.1 A RISK OF ELECTRIC SHOCK shall not exist on any ACCESSIBLE parts of the METER both in NORMAL USE and in SINGLE FAULT CONDITIONS.

8.2 ACCESSIBLE parts include data communication terminals and KYZ terminals.

8.3 The product shall be designed with CLEARANCE and CREEPAGE DISTANCE as specified in 8.4 – 8.13.

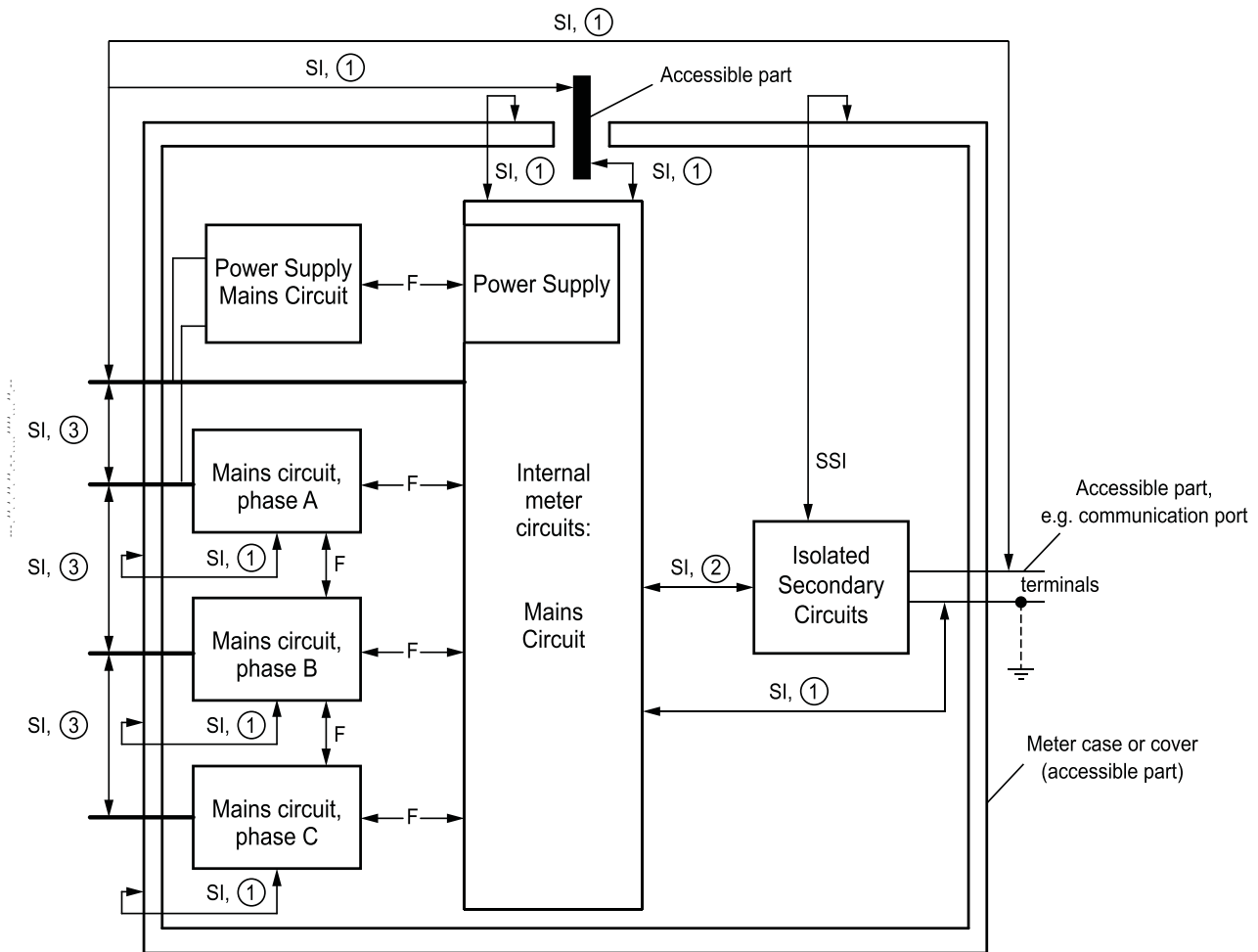
CLEARANCE and CREEPAGE DISTANCES may be made up of composite spacings that add up to meet the required dimensions. Conformity is checked by inspection and measurement or, in the case of CLEARANCE DISTANCES, by the requirements of Clause 5.1 of Insulation Coordination - General Instruction No.1, CSA C22.2 No. 0.2-16, or Clause 7 of Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

8.4 CLEARANCE and CREEPAGE DISTANCES in Table 8.1 shall apply between (reference Safety Insulation 'SI' in Figures 8.1 – 8.4):

- a) MAINS CIRCUITS and ACCESSIBLE parts – For non-conductive ACCESSIBLE parts, the CLEARANCE and CREEPAGE distances shall apply to any ACCESSIBLE surface of the part;
- b) MAINS CIRCUITS and ISOLATED SECONDARY CIRCUITS;
- c) MAINS TERMINALS;
- d) Voltage and current terminals of the same phase for meters where current terminals and voltage terminals are isolated, such as for TRANSFORMER RATED METERS.

NOTE: Internal METER circuits may be either MAINS CIRCUITS or ISOLATED SECONDARY CIRCUITS as described in the meter construction examples illustrated in Figures 8.1 – 8.4.

Figure 8.1
Meter Construction Example, Non-isolated Neutral



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NOTES:

1. See Clause 8.4 a)
2. See Clause 8.4 b)
3. See Clause 8.4 c)

SI – Safety Insulation (for protection against electric shock, or protection against spread of fire) - distances from Table 8.1 shall be used.

SSI – Safety Insulation in Secondary circuits (for protection against electric shock, or protection against spread of fire) - distances from Table 8.3 and Table 8.4 shall be used.

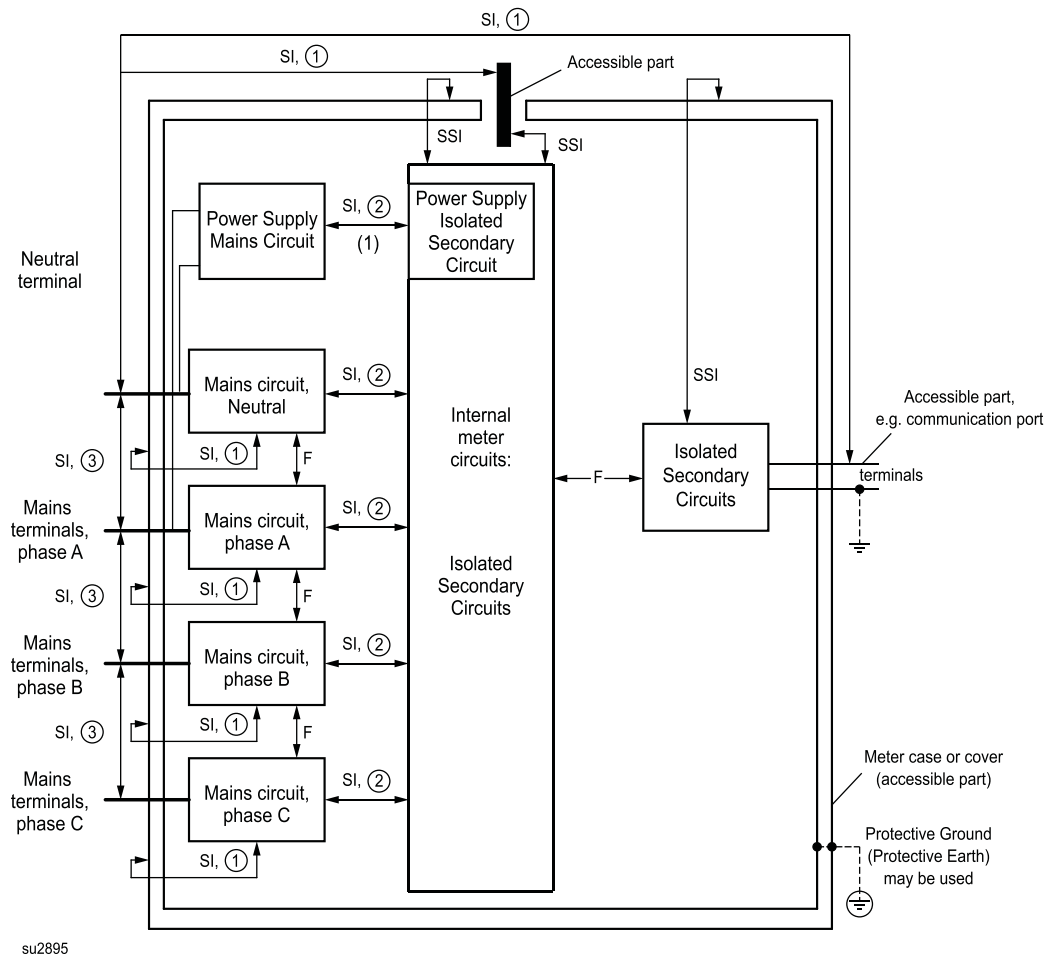
F – Functional Insulation

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Figure 8.2
Meter Construction Example, Isolated Neutral



NOTES:

1. See Clause 8.4 a)
2. See Clause 8.4 b)
3. See Clause 8.4 c)

SI – Safety Insulation (for protection against electric shock, or protection against spread of fire) - distances from Table 8.1 shall be used.

SSI – Safety Insulation in Secondary circuits (for protection against electric shock, or protection against spread of fire) - distances from Table 8.3 and Table 8.4 shall be used.

F – Functional Insulation

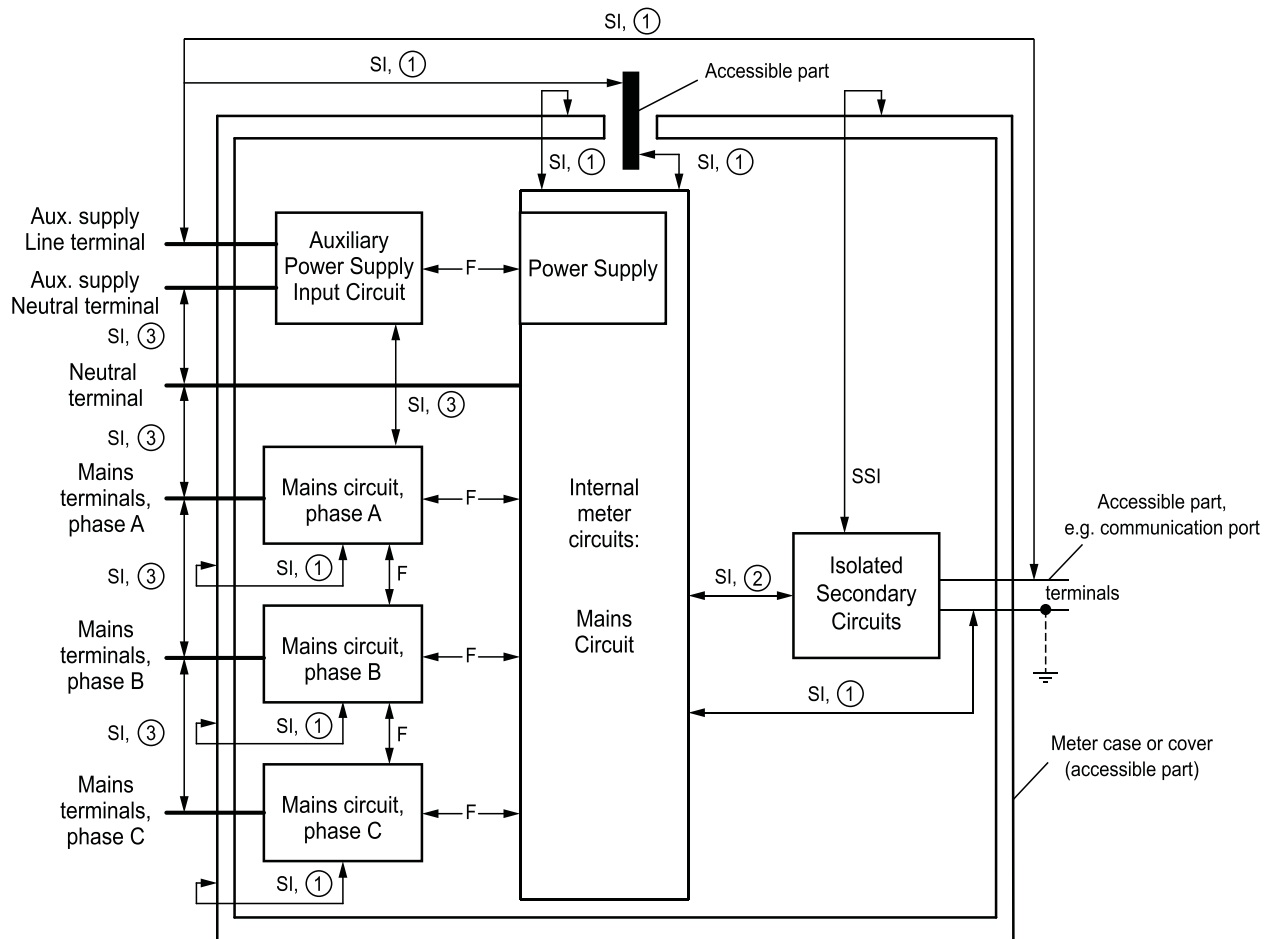
- (1) Distances larger than the minimum values specified in Table 8.1 may be needed in case of switching power supplies.

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Figure 8.3
Meter Construction Example, Non-isolated Neutral and AUXILIARY POWER SUPPLY



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NOTES:

1. See Clause 8.4 a)
2. See Clause 8.4 b)
3. See Clause 8.4 c)

SI – Safety Insulation (for protection against electric shock, or protection against spread of fire) - distances from Table 8.1 shall be used.

SSI – Safety Insulation in Secondary circuits (for protection against electric shock, or protection against spread of fire) - distances from Table 8.3 and Table 8.4 shall be used.

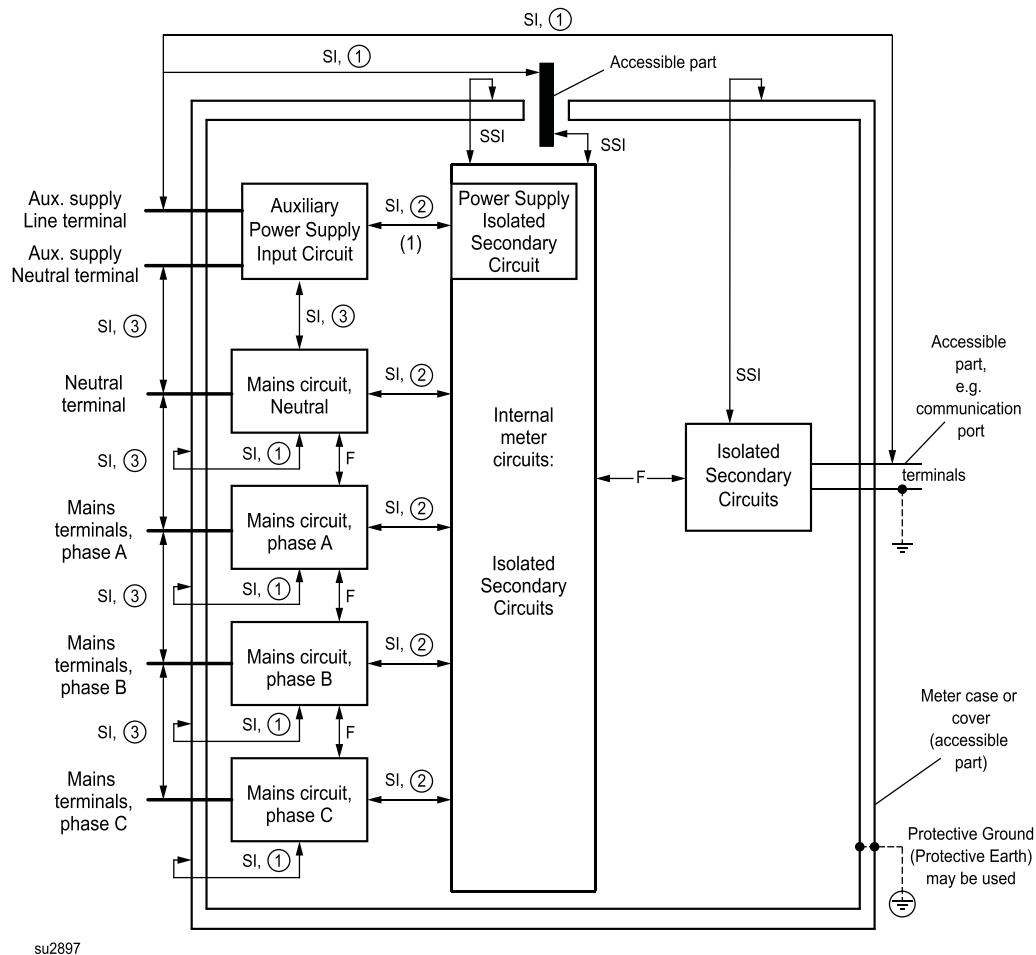
F – Functional Insulation

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Figure 8.4
Meter Construction Example, Isolated Neutral and AUXILIARY POWER SUPPLY



NOTES:

1. See Clause 8.4 a)
2. See Clause 8.4 b)
3. See Clause 8.4 c)

SI – Safety Insulation (for protection against electric shock, or protection against spread of fire) - distances from Table 8.1 shall be used.

SSI – Safety Insulation in Secondary circuits (for protection against electric shock, or protection against spread of fire) - distances from Table 8.3 and Table 8.4 shall be used.

F – Functional Insulation

(1) Distances larger than the minimum values specified in Table 8.1 may be needed in case of switching power supplies.

Table 8.1
CLEARANCES and CREEPAGE DISTANCES for MAINS CIRCUITS

Phase to ground ^a a.c. r.m.s. or d.c.	Values for CLEARANCE mm	Values for CREEPAGE DISTANCE		
		mm		
		Printed wiring board ^b	Other materials	
V			Pollution degree 2	Pollution degree 3
≤150	3.0	2.5	3.0	3.0
>150 ≤ 300	5.5	5.5	5.5	5.5
>300 ≤ 600	8.0 ^c	8.0	8.0	9.4

^a For ungrounded systems or systems with one phase grounded, the phase-to-ground voltage is considered to be the same as the phase-to-phase voltage for the purposes of using this table.

^b 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”. Solder mask shall not be considered to be a coating unless the coating meets the requirements of 8.9 g).

^c CLEARANCE DISTANCE for >300 ≤600 volts is for protection against the RISK OF ELECTRICAL SHOCK with accessible surfaces and accessible circuitry. FUNCTIONAL INSULATION for non-accessible surfaces and non-accessible circuitry may use 5.5mm CLEARANCE.

NOTE: Linear interpolation is not allowed.

8.5 CLEARANCE DISTANCES of equipment rated to operate at altitudes above 2000m above sea level shall be multiplied by the correction factors given in Table 8.2; the CREEPAGE DISTANCE does not require an altitude correction, however it shall not be smaller than the associated CLEARANCE DISTANCE.

Table 8.2
Multiplication factors for CLEARANCE DISTANCES

Rated operating altitude M	Multiplication factor
≤ 2000	1.0
2001 to 3000	1.14
3001 to 4000	1.29
4001 to 5000	1.48

8.6 CLEARANCE and CREEPAGE DISTANCES within MAINS CIRCUIT are considered FUNCTIONAL INSULATION. (Reference FUNCTIONAL INSULATION ‘F’ in Figures 8.1 – 8.4). CLEARANCE and CREEPAGE DISTANCES between a MAINS TERMINAL and a location within a MAINS CIRCUIT are considered FUNCTIONAL INSULATION.

8.7 CLEARANCE for FUNCTIONAL INSULATION within MAINS CIRCUIT and for Safety Insulation in Secondary Circuits (Reference “SSI” in Figures 8.1 – 8.4) is defined by the repetitive peak working voltage and the maximum transient overvoltage. The maximum transient overvoltage may be determined by measuring the peak