



UL 498B

STANDARD FOR SAFETY

Receptacles with Integral Switching Means

UL Standard for Safety for Receptacles with Integral Switching Means, UL 498B

First Edition, Dated August 19, 2022

SUMMARY OF TOPICS

This First Edition ANSI/UL 498B, Standard for Receptacles with Integral Switching Means, dated August 19, 2022 covers a receptacle with integral switching means rated 600 V or less, used in ordinary dry locations and intended for connection to a branch circuit in accordance with the National Electrical Code, NFPA 70.

The requirements are substantially in accordance with Proposal(s) on this subject dated March 11, 2022 and June 24, 2022.

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UL 498B

Standard for Receptacles with Integral Switching Means

First Edition

August 19, 2022

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The most recent designation of ANSI/UL 498B as an American National Standard (ANSI) occurred on August 19, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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INTRODUCTION

1 Scope

1.1 These requirements cover a receptacle with integral switching means rated 600 V or less, used in ordinary locations and intended for connection to a branch circuit in accordance with the National Electrical Code, NFPA 70. A receptacle with integral switching means that is intended for energy management and building automation, in accordance with Article 406 of the National Electrical Code, NFPA 70, shall also comply with Annex [A](#) of this standard.

1.2 This standard contains Annex [A](#) – (Normative) – Receptacles with Integral Switching Means Intended for Energy Management and Building Automation.

1.3 This standard contains Annex [B](#) – (Normative) – Weather-Resistant Receptacles with Integral Switching Means.

1.4 A receptacle with integral switching means covered by this standard shall meet the following requirements:

- a) No voltage greater than 600 V above ground will be present in the device;
- b) An isolation transformer, if provided, shall furnish power at a lower potential than the primary voltage;
- c) The output of the device shall not be located in a circuit operating at greater than 600 V above ground; and
- d) The switching device shall be integral to the receptacle.

1.5 This standard does not apply to the following devices and the associated standards:

- a) A receptacle that does not employ an integral switching means but are marked with the word "CONTROLLED" and the symbol shown in [Table A8.1](#) Reference No. 2 is covered by the Standard for Attachment Plugs and Receptacles, UL 498 and are intended for use in energy management and building automation.
- b) A health care facility outlet assembly is covered by the Outline of Investigation for Cord-and-Plug-Connected Health Care Facility Outlet Assemblies, UL 2930.

1.6 This standard does not directly apply to, but may supplement the following standards:

- a) Devices produced integrally with flexible cord or cable, covered by the Standard for Cord Sets and Power-Supply Cords, UL 817;
- b) Current taps and adapters covered by the Standard for Current Taps and Adapters, UL 498A;
- c) Devices employing male or female screwshells, covered by the Standard for Lampholders, UL 496;
- d) Single and multipole connectors intended for factory assembly to copper or copper alloy conductors or printed wiring boards for use in data, signal, control and power applications within and between electrical equipment, covered by the Standard for Component Connectors for Data, Signal, Control and Power Applications, UL 1977;

- e) Devices intended for installation and use in hazardous (classified) locations in accordance with the National Electrical Code, NFPA 70, covered by the Standard for Explosion-Proof and Dust-Ignition-Proof Equipment for Use in Hazardous (Classified) Locations, UL 1203;
- f) Devices intended for use with telecommunications networks, covered by the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, or the Standard for Communications Circuit Accessories, UL 1863;
- g) Devices incorporating ground-fault circuit interruption circuitry, covered by the Standard for Ground-Fault Circuit Interrupters, UL 943;
- h) Direct plug-in devices incorporating transient voltage surge suppression circuitry, covered by the Standard for Surge Protective Devices, UL 1449;
- i) Direct plug-in devices incorporating electromagnetic interference filter circuitry, covered by the Standard for Electromagnetic Interference Filters, UL 1283;
- j) Cord-connected, relocatable power taps intended only for indoor use as a temporary extension of a grounding alternating-current branch circuit for general use, covered by the Standard for Relocatable Power Taps, UL 1363;
- k) Energy management equipment covered by the Standard for Energy Management Equipment, UL 916.

2 Components

2.1 A component of a product covered by this standard shall:

- a) Comply with the requirements for that component as specified in this standard;
- b) Be used in accordance with its rating(s) established for the intended conditions of use; and
- c) Be used within its established use limitations or conditions of acceptability.

2.2 A component of a product covered by this standard is not required to comply with a specific component requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product;
- b) Is superseded by a requirement in this standard; or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

2.3 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.

2.4 A component that is also intended to perform other functions such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

3 Units of Measurement

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

4 Referenced Publications

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

4.2 The following publications are referenced in this standard:

ASTM 653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM A90, *Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings*

ASTM E230/E230M, *Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

ASTM G151, *Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources*

ASTM G153, *Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*

ASTM G155, *Standard Practice For Operating Xenon Arc Light Apparatus For Exposure Of Non-Metallic Materials*

NEMA WD6, *Wiring Devices – Dimensional Specifications*

NFPA 70, *National Electrical Code*

UL 13, *Power-Limited Circuit Cables*

UL 20, *General-Use Snap Switches*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 224, *Extruded Insulating Tubing*

UL 496, *Lampholders*

UL 498, *Attachment Plugs and Receptacles*

UL 498A, *Current Taps and Adapters*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 746E, *Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards*

UL 796, *Printed Wiring Boards*

UL 817, *Cord Sets and Power-Supply Cords*

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

UL 916, *Energy Management Equipment*

UL 943, *Ground-Fault Circuit-Interrupters*

UL 969, *Marking and Labeling Systems*

UL 1097, *Double Insulation Systems for Use in Electrical Equipment*

UL 1203, *Explosion Proof and Dust-Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations*

UL 1283, *Electromagnetic Interference Filters*

UL 1363, *Relocatable Power Taps*

UL 1449, *Surge Protective Devices*

UL 1557, *Electrically Isolated Semiconductor Devices*

UL 1863, *Communications-Circuit Accessories*

UL 1977, *Component Connectors for Data, Signal, Control and Power Applications*

UL 2930, *Outline of Investigation for Cord-and-Plug-Connected Health Care Facility Outlet Assemblies*

UL 5085-1, *Low Voltage Transformers – Part 1: General Requirements*

UL 5085-2, *Low Voltage Transformers – Part 2: General Purpose Transformers*

UL 5085-3, *Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

UL 60384-14, *Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains*

UL 60730-2-2, *Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors*

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

5 Glossary

5.1 For the purpose of this standard the following definitions apply:

5.2 CLASS 2 CIRCUIT – An isolated secondary circuit involving a potential of not more than 42.4 V peak supplied by:

- a) An inherently-limited Class 2 transformer;
- b) A combination of an isolated transformer secondary winding and a fixed impedance or regulating network that together comply with the performance requirements for an inherently-limited Class 2 transformer;
- c) A dry-cell battery having output characteristics not greater than those of an inherently-limited Class 2 transformer;
- d) Any combination of (a), (b), and (c) that together comply with the performance requirements for an inherently-limited Class 2 transformer; or
- e) One or more combinations of a Class 2 transformer and an overcurrent protective device that together comply with the performance requirements for a noninherently-limited Class 2 transformer.
- f) A circuit derived from a line-connected circuit by connecting impedance in series with the supply circuit as a means of limiting the voltage and current is not a Class 2 circuit. See Class 2 Circuits, Section [26](#).

5.3 CLASS 2 SEPARABLE LEAD ASSEMBLY – Consists of a factory-made, power-limited cable assembly provided with a connector, intended for Class 2 signaling between a device such as a sensor, timer or energy-management equipment and a wired controlled receptacle.

5.4 CONFORMAL COATING – An insulating coating which conforms to the configuration of the object coated and is used as a protective covering against environmental conditions or when electrical spacings are insufficient.

5.5 CONTROLLED ENVIRONMENT – An environment:

- a) Relatively free of conductive contaminants, such as normal cooking vapors, carbon dust, and similar contaminants, which are a result of the end-use product in which a control will be installed or due to the location of the end-use product, and
- b) Not subject to humidity and the formation of condensation. A controlled environment is provided, for example, by means of a:
 - 1) Hermetically sealed enclosure;
 - 2) Encapsulation;
 - 3) A conformal coating; or
 - 4) A gasketed, tight-fitting enclosure or filter system preventing contamination in conjunction with a system preventing condensation – for example, the maintaining of the surrounding air at constant temperature and a suitably low relative humidity.

5.6 DEAD-CASE-MOUNTED SEMICONDUCTOR – A semiconductor, such as a triac or silicon-controlled rectifier, employing an integral metal tab or stud that is insulated from live parts.

5.7 ELECTRICAL STRESS FACTOR – For a circuit component, the ratio of operating electrical stress to rated electrical stress. Examples include the ratio of operating wattage to maximum rated wattage of a resistor and operating voltage to maximum rated voltage of a capacitor. A circuit component having no assigned maximum operating electrical rating is made the subject of an investigation.

5.8 ISOLATED SECONDARY CIRCUIT – A circuit derived from an isolated secondary winding of a transformer and that has no direct connection back to the line-connected circuit, other than through the

grounding means. A secondary circuit that has a direct connection back to the line-connected circuit is considered part of the line-connected circuit.

5.9 LIMITED-ENERGY CIRCUIT – A line-connected circuit in which the wattage from any point in the circuit to any return to the power supply is limited to 15 W; or an isolated secondary circuit in which the wattage from any point in the circuit to any return to the power supply is limited to 50 W.

5.10 LINE-CONNECTED CIRCUIT – A circuit in which the wiring and components are conductively connected to the branch circuit. It is also called a primary- or direct-connected circuit. See also [5.8](#).

5.11 OPPOSITE POLARITY – A difference in potential between two points, such that shorting of these two points results in a condition involving an overload; rupturing of printed wiring-board-tracks, components, or fuses; or similar condition.

5.12 OPTICAL ISOLATOR (PHOTON-COUPLED ISOLATOR) – A circuit-coupling device that provides circuit isolation by means of a light source and sensor integrated into a single package.

5.13 SAFETY CIRCUIT – A primary or secondary circuit that is relied upon to reduce the risk of fire, electric shock, injury to persons, or operation of controlled equipment that is capable of resulting in a risk of fire, electric shock, or injury to persons. Examples include an interlock circuit, a circuit which limits leakage current to accessible parts, a circuit which limits the wattage to a limited-energy circuit, or a phase control or other circuit designed to limit temperatures in the end-use product to acceptable levels.

5.14 THYRISTOR – A bistable semiconductor device comprised of three or more junctions that can be switched from the off state to the on state or vice versa, by means of the controlled conductivity of the semiconductor, with such switching occurring within at least one quadrant of the principal voltage-current characteristics. Such switching includes random switching in which conduction occurs at any phase angle of the alternating current load voltage cycle or regulated switching in which conduction occurs at some precise phase angle or load-voltage magnitude. A phase-controlled semiconductor device is one in which the semiconductor conducts for some portion of the load-voltage cycle.

a) **BIDIRECTIONAL TRIODE THYRISTOR (TRIAC)** – A three-terminal thyristor having substantially the same switching behavior in the first and third quadrants of the principal voltage-current characteristics.

b) **SILICON-CONTROLLED RECTIFIER (SCR)** – A reverse blocking triode thyristor. A three-terminal thyristor that conducts only for positive anode-to-cathode voltages and exhibits a reverse blocking state for negative anode-to-cathode voltages.

5.15 TRANSFORMER – The term includes a motor-transformer or an autotransformer. For the purpose of these requirements, the types of transformers typically encountered in or supplying power to controls are:

a) **CLASS 2** – An isolation type transformer as specified in UL 5085-1 and UL 5085-3.

b) **POWER** – A transformer other than Class 2 that is intended to transmit power. Included are isolation and non-isolation (such as an autotransformer) types.

c) **PULSE** – An isolation-type transformer designed to pass pulse waveforms as distinguished from sine waves. It is not considered to be a power transformer.

d) **CURRENT SENSING** – An isolation-type transformer designed to have the primary winding connected in series with a circuit carrying current to be measured or controlled. In window type current transformers, the primary winding is provided by a separate conductor and is not an integral part of the transformer.

e) ISOLATING – A transformer in which one or more secondary windings are electrically separated by insulation, spacings, or both, from the primary windings. Secondary windings are not required to be electrically separated from other secondary windings.

5.16 WIRED CONTROLLED RECEPTACLE – A receptacle that employs an integral switching means where a Class 2 signaling device such as a sensor, timer or energy-management equipment is connected to the device by a Class 2 separably lead assembly.

5.17 WIRELESS CONTROLLED RECEPTACLE – A receptacle that employs an integral switching means where the signaling device such as a sensor, timer or energy-management equipment is wirelessly connected to the controlled receptacle by radio-signal.

CONSTRUCTION

6 General

6.1 In addition to the construction requirements contained in this standard, a receptacle with integral switching means shall also comply with the applicable construction requirements of UL 498.

6.2 A receptacle with integral switching means shall employ materials that are rated for the particular use, and shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

6.3 A receptacle with integral switching means shall be formed and assembled so that the device has the strength and rigidity necessary to resist the foreseeable abuse to which the device is subjected, without resulting in a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6.4 A risk of electric shock exists at any conductive part of a control if the open circuit voltage between the part and other conductive parts or between the part and earth ground exceeds the values specified in [8.2](#).

6.5 For a controlled environment, the means used to prevent contamination and condensation shall be rated for the purpose. The controlled environment in a non-production indoor area in an ordinary location free of conductive contaminants shall be evaluated for the means used to prevent condensation only.

6.6 A Class 2 separable conductor lead assembly, provided with or intended for use with a wired control receptacle, shall only be located behind the plane of the wired control receptacle mounting yoke and not be accessible when a cover plate is installed.

7 Configurations

7.1 A receptacle with integral switching means referenced in this standard are in accordance with NEMA WD6.

8 Accessibility of Live Parts

8.1 The method of determining the accessibility of an uninsulated live part that involves a risk of electric shock and other electrical parts shall be in accordance with UL 498.

8.2 A live part of a receptacle with integral switching means is considered to involve a risk of electric shock unless it is in one of the following circuits:

a) A circuit supplied by one or more isolated secondary windings of a transformer in which the maximum open circuit voltage at the transformer is less than:

- 1) 30 V (42.4 V peak) where wet contact is not likely to occur; and
- 2) 15 V (21.2 V peak) where wet contact is likely to occur.

b) A circuit derived from a primary or isolated secondary circuit in which the maximum open circuit voltage, including voltage to earth ground, is less than the values specified in (a) by virtue of circuit impedance, regardless of the polarity.

c) A circuit derived from a primary or isolated secondary circuit in which the maximum open circuit voltage, including voltage to earth ground, is greater than the values specified in (a), but the available current measured through an impedance, equivalent to that in the end-use product, is limited by virtue of the circuit impedance to the value specified in the end-product standard for normal operation.

d) Each line in a circuit that employs such impedance shall satisfy the following equation:

$$Z \geq \frac{V}{I}$$

in which:

Z is the minimum impedance, including tolerances;

V is the open-circuit voltage; and

I is the current limitation of the end-product standard.

8.3 With reference to [8.2](#) (a) and (b), if the circuit incorporates a voltage-multiplier or other circuit which increases the steady state potential, the maximum steady state potential shall not exceed the values specified.

8.4 Circuit elements, such as resistors, capacitors, rectifiers, and similar elements, which constitute the circuit impedance referred to in [8.2](#) (b) and (c), shall be of the fixed type and shall be evaluated as a unit for acceptability with respect to end-use conditions.

8.5 An electronic circuit element relied upon to limit the voltage, current, or both to the values specified in [8.2](#) shall not experience an electrical stress factor:

- a) Greater than 0.5 during all conditions of normal operation; or
- b) Greater than 1.0 after single component failure.

8.6 For supplies of circuits of the types specified in [8.2](#) (b) and (c):

- a) Minimum electrical spacings shall be in accordance with Spacings, Section [23](#), up to the point at which the voltage, current, or both is limited, regardless of the maximum available power involved.
- b) A risk of fire, electric shock, or injury to persons shall not result when the circuit is subjected to the 7-hour short-circuit test specified in [38.1](#).

9 Current-Carrying Parts

9.1 A current-carrying part shall be of silver, copper, a copper-base alloy, or other material rated for the application. Iron or steel shall not be used as a current-carrying part.

10 Internal Wiring

10.1 Internal wiring shall be routed and secured so that the wiring and related electrical connections are not subjected to stress or mechanical damage, especially wiring smaller than 24 AWG (0.21 mm²) or having insulation less than 1/32 inch (0.79 mm) thick.

INTERNAL SPLICES AND CONNECTIONS

11 General

11.1 Internal splices and connections shall be mechanically secure and shall provide electrical continuity without strain on connections and terminals. Vibration, flexing, motion, and similar conditions shall be taken into account when determining compliance of the mechanical security of an electrical connection.

11.2 A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection results in a risk of fire, electric shock, or injury to persons.

11.3 A lead is considered to be mechanically secure when one or more of the following is provided prior to soldering:

- a) A minimum of one full wrap is provided around a terminal;
- b) A lead not integral with a component on a printed wiring board is passed through an eyelet or opening and if hand-soldered is bent 90 degrees to the board;
- c) A lead integral with a component is inserted through an opening of a printed wiring board;
- d) A lead is twisted with other conductors; or
- e) A lead is inserted into a U- or V-shaped slot in the terminal.

11.4 Placement of a lead along a flat surface and tack soldering is not acceptable unless the construction is such that a risk of fire, electric shock, or injury to persons does not result when the lead is detached.

11.5 A printed-wiring board connector intended to facilitate interconnection within a receptacle with integral switching means shall be:

- a) Rated for the current, voltage, and temperature involved; and
- b) Provided with mechanical locking or securing means other than friction for providing electrical continuity, maintenance of spacings, and separation of circuits.

Exception: This requirement is not applicable if loosening or removal of the connector does not result in a risk of fire, electric shock, or injury to persons.

12 Wire-Wrapped Connections

12.1 Solderless wrapped connections are not acceptable if subject to movement or flexure on the wires during normal operation or user servicing.

12.2 The wire for a wire-wrapped connection shall be solid, copper wire and shall be a wire size of 24, 22, or 20 AWG (0.511, 0.643, or 0.813 mm). Other sizes and types of wires shall be subjected to evaluation.

12.3 A terminal shall be made of copper or brass and have at least two sharp edges.

12.4 The wrap shall:

- a) Have a minimum of 20 points on the corners of the terminal in contact with the wire; and
- b) Have a minimum of 16 points closely wrapped with no overlapping.
- c) See [Table 12.1](#). A smaller number of wraps shall be subjected to evaluation. Contact points shall produce compression or flow of the conductor rather than a nick that weakens the mechanical strength of the conductor such that fracture is able to occur.

Table 12.1
Typical Number of Wraps

Number of sharp corners on the terminal	Number of closely wrapped turns	Total number of turns
4	4	5
2	8	10

12.5 The term "closely wrapped" in [12.4\(b\)](#) means:

- a) There shall not be gaps between adjacent turns greater than one half of the diameter of the wire exclusive of gaps on the first and last turns; and
- b) The sum of all gaps on any side of a connection shall not exceed the diameter of the wire exclusive of gaps on the first and last turns.

12.6 The requirements in [12.5](#) applies only to the actual number of wraps that are required. Gaps between any additional wraps that have been added at the manufacturer's option are not included when determining compliance with [12.5](#).

13 Wiring Terminals and Leads

13.1 A receptacle with integral switching means shall comply with the terminal and leads requirements of UL 498.

14 Separation of Circuits

14.1 Separation of circuits between insulated conductors or other insulated live parts of different circuits, and between insulated conductors or other insulated live parts of one circuit and uninsulated live parts of a different circuit, shall be accomplished by one or more of the means indicated in [Table 14.1](#).

Table 14.1
Separation of Circuits

Part ^a			Separation requirement ^b
Insulation			
Rated for highest voltage involved	Not rated for highest voltage involved	Uninsulated	
Footnote a and Footnote b			None
Footnote a	Footnote b		Footnote b(A)(1), (B), (C), (D)
Footnote a		Footnote b	Footnote b(A)(1), (B), (C), (D)(2), (D)(3)
	Footnote a and Footnote b		Footnote b(A)(1), (A)(2), (D)(2), (D)(3)
	Footnote a	Footnote b	Footnote b(A)(1), (A)(2), (D)(2), (D)(3)

^a The letters a and b refer to separation (See [14.1](#)) as follows:

a Separation between insulated conductors or other insulated live parts of different circuits; and

b Separation between insulated conductors or other insulated live parts of one circuit and uninsulated live parts of a different circuit.

^b Acceptable means of separation are:

A) Spacings – The through air spacings as indicated in [Table 23.1](#), based on the highest voltage involved, shall be used to determine compliance of separation. See [23.3](#).

1) Required spacing.

2) Twice required spacing.

B) Double Insulation – Two separate and distinct insulations with each rated for the highest voltage involved, see [23.3](#), and complying with the requirements in UL 1097.

C) Reinforced Insulation – Improved basic insulation rated for the highest voltage involved with such mechanical and electrical qualities that, in itself, (1) provides the same degree of protection against risk of electric shock as two single insulations and (2) complies with UL 1097.

D) Barriers – A barrier shall have mechanical strength for the conditions of use, be secured in place, and if there are openings in the barrier, the barrier shall be located between the parts in question so that spacings between the parts are maintained.

1) Metal – A metal barrier shall be located and connected so that an electrical breakdown of one or two insulations will not result in the voltage of one circuit appearing in the other circuit.

2) Insulating Material – Vulcanized fiber, polyethylene terephthalate (PETP) film, and resin-bonded mica shall have thicknesses not less than 0.028 inch (0.71 mm), 0.007 inch (0.18 mm), and 0.006 inch (0.15 mm), respectively. Other materials shall comply with the requirements applicable to internal barriers in UL 746C.

3) Insulating Material (Sole Separation) – Insulating material shall comply with the requirements in [23.5](#) and [23.7](#).

14.2 Segregation of insulated conductors accomplished by clamping, routing, or an equivalent means that provides permanent separation from insulated or uninsulated live parts of a different circuit is acceptable.

14.3 With reference to [14.1](#), a limited energy circuit derived from a circuit by limiting impedance shall be treated as one circuit.

14.4 Wires and cables that are part of an isolated secondary circuit shall be provided with strain relief means if stresses on the wire or cable cause noncompliance with [14.1](#). The strain relief means shall comply with the requirements for the end-use product.

14.5 When determining the required separation of the circuits in accordance with [14.1](#), such effects as deterioration of insulation resulting in abnormal operation involving overload, short-circuit, component failure conditions and similar effects shall be taken into account.