UL 355

STANDARD FOR SAFETY

Cord Reels

UL Standard for Safety for Cord Reels, UL 355

Tenth Edition, Dated June 25, 2004

Summary of Topics

This revision of ANSI/UL 355 dated June 10, 2021 is being issued to add requirements for Cord Reels with USB Outlets; 1.6, 2.2.1, 2.7.2, 2.11.1, 6.9, 16.20 – 16.22, Section 16A, Table 19.1, 52.6

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.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 23, 2021.

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Standard for Cord Reels

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This ANSI/UL Standard for Safety consists of the Tenth Edition including revisions through June 10, 2021.

The most recent designation of ANSI/UL 355 as an American National Standard (ANSI) occurred on June 10, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover cord reels for general use, as well as cord reels – herein referred to as special-use cord reels – intended to be mounted on or in electrical utilization equipment such as appliances, portable lamps, or similar equipment. These cord reels are intended for use in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements also cover reels for use in factories, household workshops, garages, commercial facilities and construction sites where an additional degree of protection against the risk of the entrance of water, dust or other contaminates might be needed.

1.3 These requirements also cover cord reels for use above but not in hazardous locations in commercial garages as defined in the National Electrical Code, NFPA 70.

1.4 A cord reel, as covered by these requirements, is a reel equipped with, or intended for use with, a length of flexible cord. The reel provides a means for the cord to be unwound by the user as desired. The reel is provided with a take-up mechanism, by which the cord is rewound on the reel. The mechanism by which the cord is extended or retracted to the desired length might or might not be driven by a motor. A latch is provided in some cases to restrain the action of a spring take-up mechanism while the cord reel is in use.

1.5 A cord reel shall be permitted to employ Ground-Fault Circuit-Interrupter(s) (GFCI) outlet(s) at the load connection. The Ground-Fault Circuit Interrupters shall be investigated under the applicable requirements in the Standard for Ground-Fault Circuit Interrupters, UL 943.

1.6 A cord reel shall be permitted to employ any of the following:

a) An integral Class 2, LIMITED POWER SOURCE (LPS), PS1, or PS2 power supply provided with an integral output connector(s); or

b) Specialty power units with integral Class 2 output connector(s); or

c) Receptacles employing integral power supplies provided with Class 2, LPS, PS1, or PS2 output connector(s).

2 Glossary

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

2.2 BRUSH – The part, which is mounted on the fixed part of the cord reel or the rotating hub, that conveys the current to the slip ring.

2.2.1 CLASS 2 SEPARABLE INTERFACE – A separable component containing Class 2, LPS, PS1, or PS2 low-voltage connector(s) only (such as Universal Serial Bus (USB) connector(s).

2.3 COMMERCIAL/INDUSTRIAL USE CORD REEL – A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service type cord.

2.4 CORD STORAGE DEVICE – A spool for storage of insulated flexible cord but does not enclose or support uninsulated live parts.

2.5 CORD REEL – A device used to store insulated flexible cord with allowance for variable lengths of cord to be extracted from the reel or spool.

2.6 GENERAL-USE INDOOR CORD REEL – A cord reel for use only in indoor, dry, residential type applications.

2.7 GENERAL-USE OUTDOOR CORD REEL – A cord reel that is acceptable for use outdoors as well as indoors in residential applications. The cord reel is intended to be stored indoors when not in use.

2.7.1 OPEN NEUTRAL PROTECTION – Consists of the opening of the line contacts of a protective device when either live contact loses power, whereby the output potential is interrupted to provide shock hazard protection. As an example, if the input neutral opens due to a broken conductor or loose plug connection, the protective device circuitry would not receive power, and therefore would not operate to provide protection. A current path from line to ground could exist, under these circumstances; a person in contact with the live conductor could receive a lethal shock. (A faulty appliance that has an internal insulation failure could allow the case to become energized.)

2.7.2 RECEPTACLE EMPLOYING INTEGRAL POWER SUPPLY PROVIDED WITH ONE OR MORE CLASS 2, LPS, or PS1 or PS2 OUTPUT CONNECTOR(S) – A receptacle employing an integral power supply having limited voltage and energy capacity that incorporates one or more one or more associated Class 2 output connectors accessible to the user after a cover plate is installed.

2.8 RETRACTION, AUTOMATIC – Retraction by inherent force, such as by spring tension, to position the cord back onto the spool of the cord reel.

2.9 RETRACTION, MANUAL – Retraction by the user, such as by hand cranking action, to position the cord back onto the spool of the cord reel.

2.10 SLIP RING – The part, which is mounted on the fixed part of the cord reel or the rotating hub, that is the circular conductor on which the brush rides.

2.11 SPOOL – The part that the cord is wrapped on when the cord is stored on the cord reel.

2.11.1 SPECIALTY POWER SUPPLY UNIT WITH ONE OR MORE CLASS 2, LPS, or PS1 or PS2 OUTPUT CONNECTOR (S) – A power supply unit having limited voltage and energy capacity that incorporates one or more associated Class 2, LPS, or PS1 or PS2 output connectors accessible to the user after a cover plate is installed.

2.12 SPECIAL-USE CORD REEL – A cord reel for use only permanently on or in electrical utilization equipment such as appliances, portable lamps, or similar equipment.

3 General

3.1 Components

3.1.1 Except as indicated in 3.1.2, a component of a product covered by this Standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

3.1.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

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

3.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.2 Units of measurement

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

3.3 Undated references

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

CONSTRUCTION

ALL CORD REELS

4 General

4.1 A cord reel shall be formed and assembled so that the cord reel has the strength and rigidity necessary to resist the abuses to which the cord reel is subjected in service, without increasing the 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.

4.2 The construction and the mechanical functioning of a cord reel shall be such that the cord will not be subjected to abrasion, kinking, pinching, jamming, or other treatment that might damage the cord conductors or insulation.

4.3 A cord reel that employs Ground-Fault Circuit Interrupter outlet(s) and is connected to the power supply by a means of flexible cord with an attachment plug shall be provided with open neutral protection, with the GFCI.

4.4 A cord reel construction that employs slip rings or an equivalent mechanism and also employs Ground-Fault Circuit Interrupter outlet(s) shall be provided with open neutral protection, with the GFCI.

5 Enclosure

5.1 Wiring terminals that will be inside an outlet box or the equivalent when the reel is installed need not be additionally enclosed.

5.2 The enclosure of a cord reel provided with a motor shall prevent molten metal, burning insulation, flaming particles, or similar objects from falling on flammable materials, including the surface upon which the product is supported.

5.3 The requirement in 5.2 will necessitate the use of a barrier of nonflammable material under a motor unless:

a) The structural parts of the motor or of the product provide the equivalent of such a barrier;

b) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the product when the motor is energized under each of the following fault conditions:

1) Open main winding,

2) Open starting winding,

3) Starting switch short-circuited, and

4) Capacitor of permanent-split capacitor motor short circuited – the short-circuit is to be applied before the motor is energized, and the rotor is to be locked;

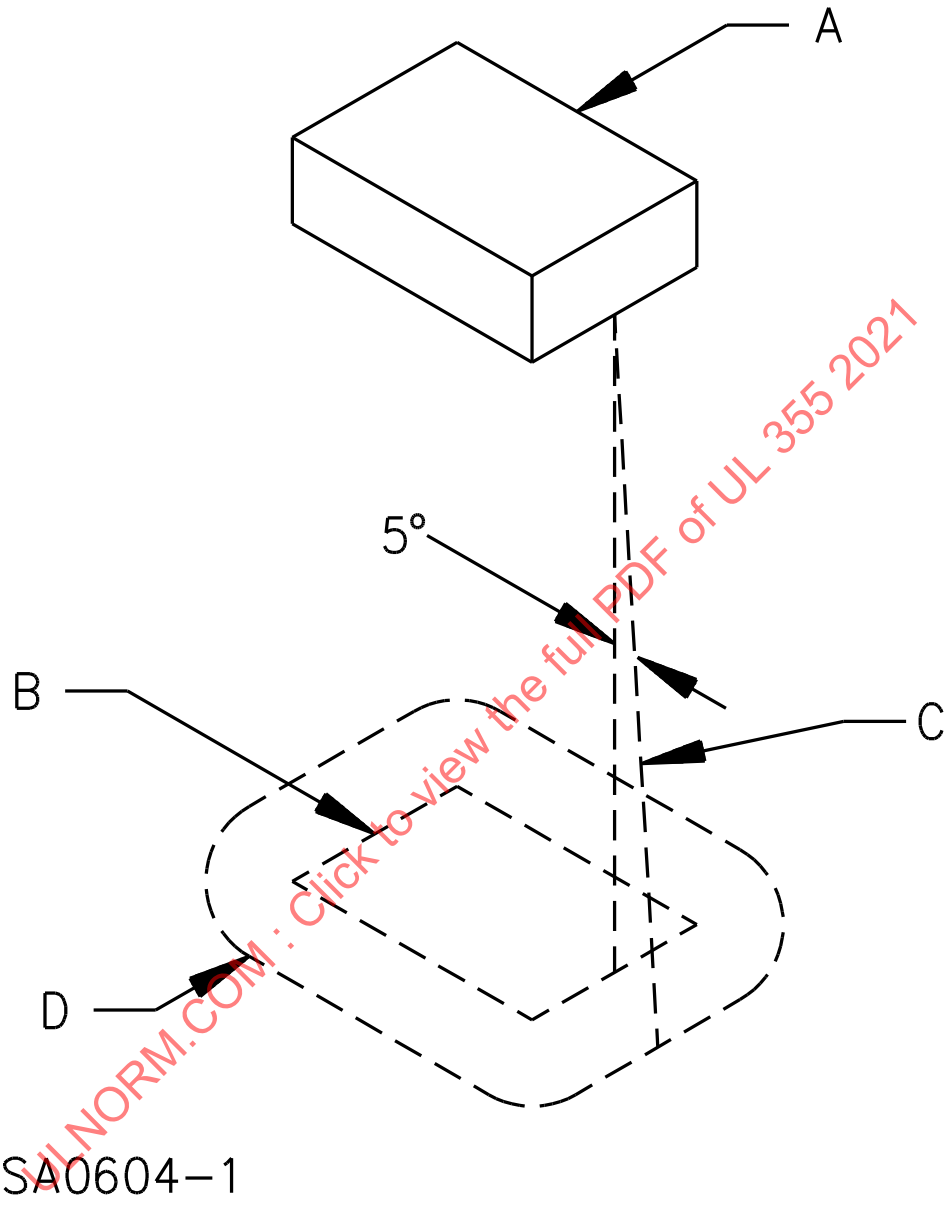
c) The motor is provided with a thermal motor protector – a protective device that is sensitive to temperature and current – that will prevents the temperature of the motor windings from exceeding 125° C (257° F) under the maximum load under which the motor will runs without causing the protector to cycle and from exceeding 150°C (302°F) with the rotor of the motor locked; or

d) The motor complies with the requirements for impedance-protected motors in the Standard for Overheating Protection for Motors, UL 2111, and the temperature of the motor winding does not exceed 150°C during the first 72 h of operation with the rotor of the motor locked.

5.4 The barrier specified in 5.3 shall be horizontal, shall be located as indicated in Figure 5.1, and shall not have an area less than that described in the illustration. Openings for drainage, ventilation, and similar functions in the barrier, are acceptable, provided such openings are located so that molten metal, burning insulation, or similar objects do not fall on flammable material.

Figure 5.1

Location and extent of barrier



NOTES –

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

1) Tangent to the component,

2) 5 degrees from the vertical, and

3) Oriented so that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

6 Accessibility of Uninsulated Live Parts and Film-Coated Wire

6.1 To reduce the risk of unintentional contact that involves a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with either (a) or (b).

a) For an opening that has a minor dimension (see 6.5) less than 1 in (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 6.1.

b) For an opening that has a minor dimension of 1 in or more, such a part or wire shall be spaced from the opening as specified in Table 6.1.

Exception: These requirements do not apply to a motor, other than one used in either a hand-held product or a hand-supported portion of a product, if the motor complies with the requirements in 6.2.

6.2 With respect to a part or wire as mentioned in 6.1 in an integral enclosure of a motor as mentioned in the Exception to 6.1:

a) An opening that has a minor dimension (see 6.5) less than 3/4 in (19.1 mm) is acceptable if:

1) Film-coated wire cannot be contacted by the probe illustrated in Figure 6.3;

2) In a directly accessible motor (see 6.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 6.1; and

3) In a indirectly accessible motor (see 6.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 6.2.

b) An opening that has a minor dimension of 3/4 in or more is acceptable if a part or wire is spaced from the opening as specified in Table 6.1.

Figure 6.1

Articulate probe with web stop

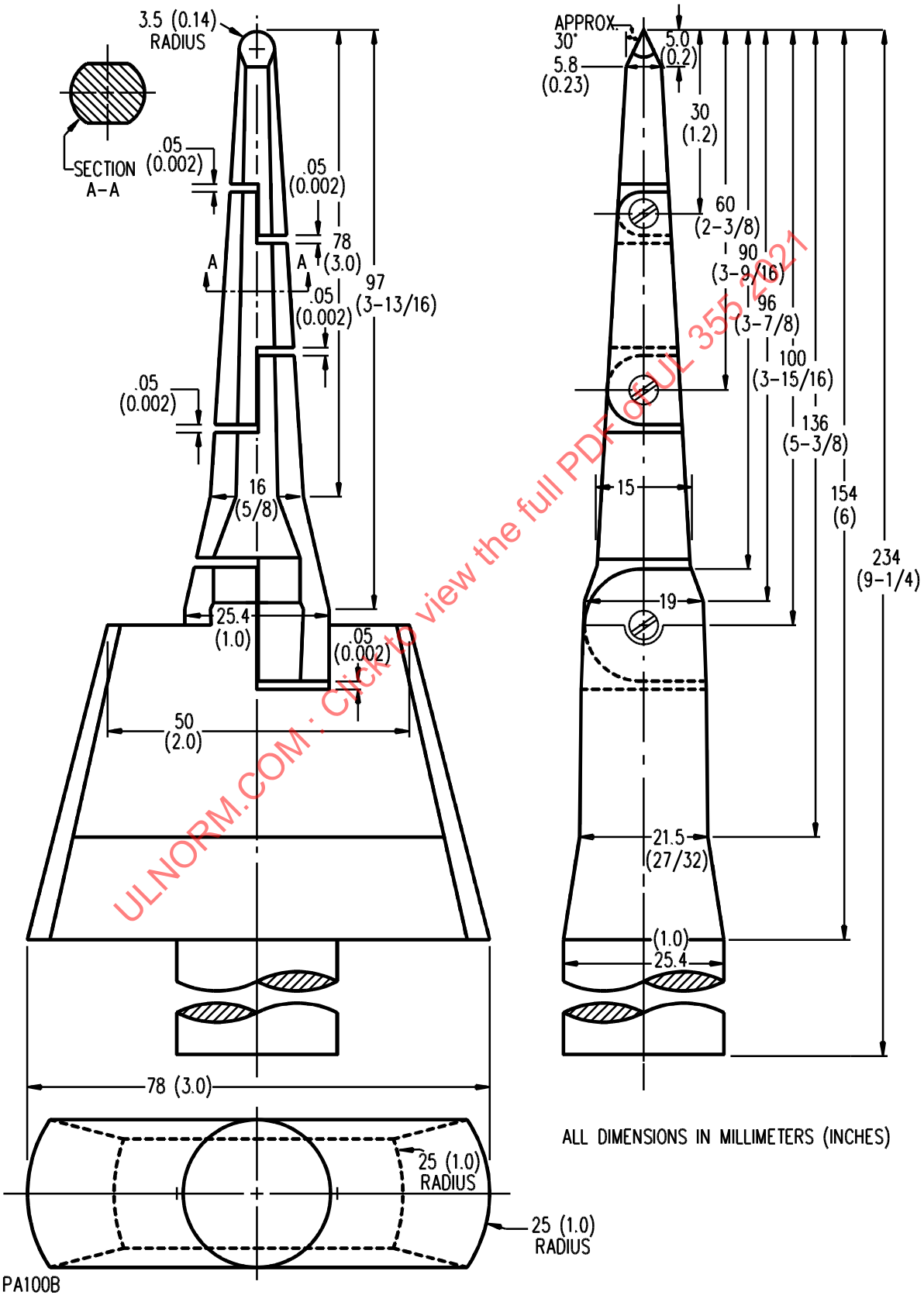


Table 6.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension[a] of opening, in (mm)[b]	Minimum distance from opening to part, in (mm)[b]
3/4[c] (19.1)	4-1/2 (114.0)
1[c] (25.4)	6-1/2 (165.0)
1-1/4 (31.8)	7-1/2 (190.0)
1-1/2 (38.1)	12-1/2 (318.0)
1-7/8 (47.6)	15-1/2 (394.0)
2-1/8 (54.0)	17-1/2 (444.0)
d	30 (762.0)

[a] See 6.5.
[b] Between 3/4 in and 2-1/8 in, interpolation is to be used to determine a value between values specified in the table.
[c] A dimension less than 1 in applies to a motor only.
[d] More than 2-1/8 in, but not more than 6 in (152.0 mm).

Figure 6.2
Probe for uninsulated live parts

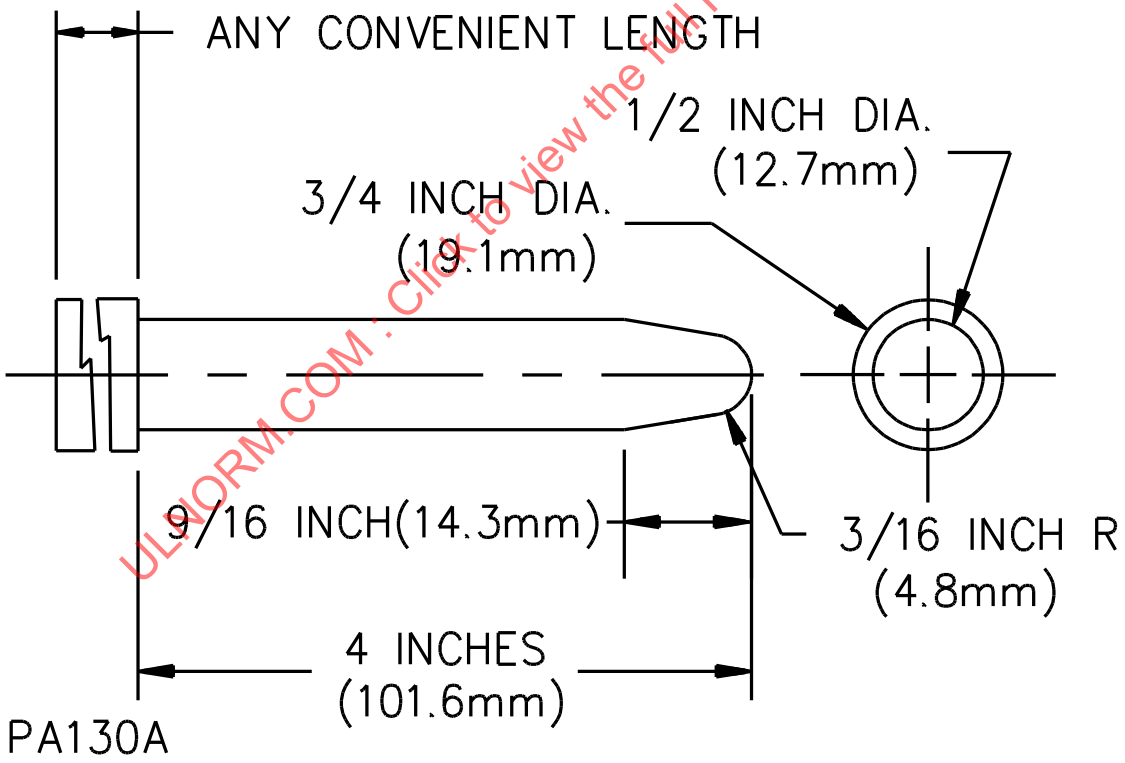
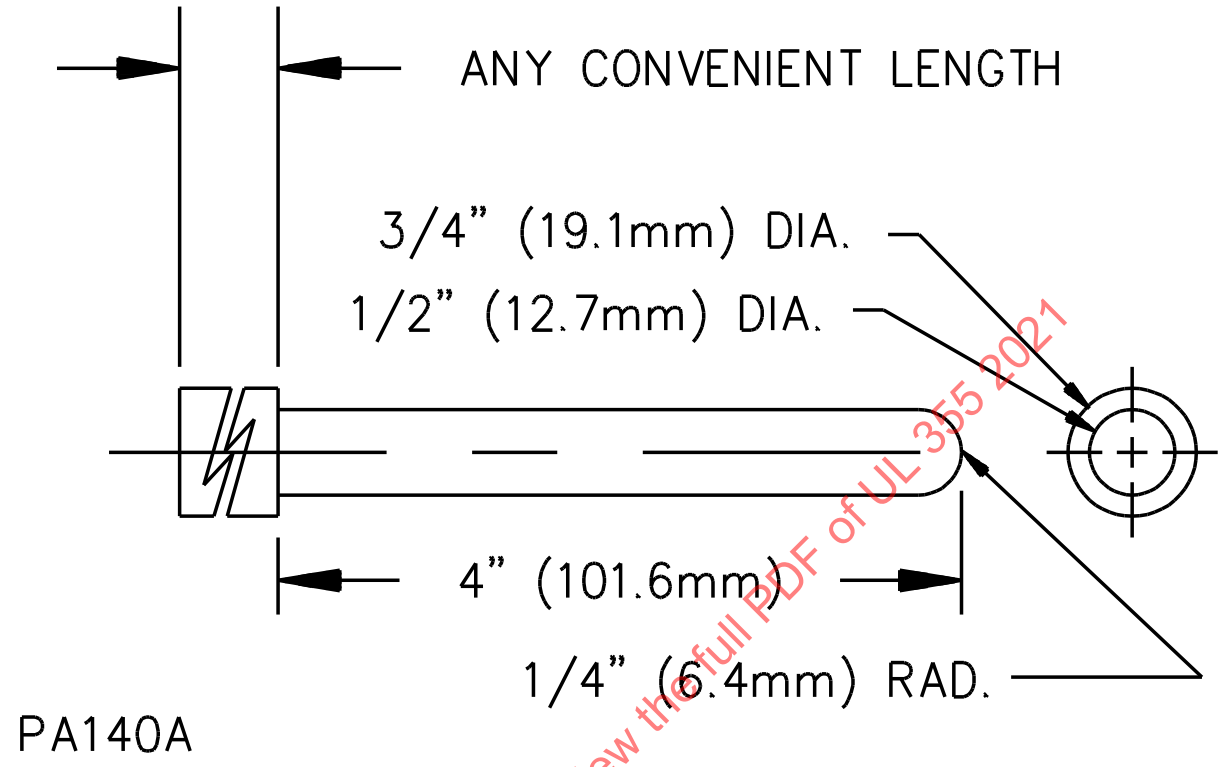


Figure 6.3

Probe for film-coated wire



6.3 The probes mentioned in 6.1 and 6.2 and illustrated in Figure 6.1 – Figure 6.3 shall be applied to any depth that the opening will accommodate, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probe illustrated in Figure 6.1 shall be applied in any possible configuration; and if necessary, the configuration shall be changed after insertion through the opening.

6.4 The probes mentioned in 6.1 – 6.3 shall be used as measuring instruments to determine the accessibility provided by an opening, and not as instruments to determine the strength of a material. The probes are to be applied with the minimum force necessary to determine accessibility.

6.5 With reference to 6.1 and 6.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

6.6 With reference to 6.2,

a) An indirectly accessible motor is a motor:

1) Accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or

2) Located at such a height or otherwise guarded or enclosed so that the motor is unlikely to be contacted.

b) A directly accessible motor is a motor:

1) That can be contacted without opening or removing any part, or

2) Located so as to be accessible to contact.

6.7 During the examination of a product to determine compliance with 6.1 or 6.2, a part of the enclosure that can be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

6.8 With reference to 6.1 and 6.2, insulated brush caps are not required to be additionally enclosed.

6.9 With reference to 6.1 and 6.2, connectors and contacts supplied by an isolated secondary circuit complying with 16.20 – 16.22 may be accessible to the user.

7 Means for Mounting

7.1 A cord reel shall not be provided with means for permanent mounting if the reel is intended to be connected to the power supply by a means of flexible cord with an attachment plug. For this type of construction, the source of supply is connected at the hub of the cord reel. See 16.3.

Exception: A general-use cord reel provided with a flexible cord and attachment plug provided with a means for permanent mounting is acceptable if the flexible cord complies with 13.4.

7.2 The requirement in 7.1 does not preclude the permanent mounting of a special-use cord reel connected to the power supply by means of the retractable flexible cord. A cord terminated with an attachment plug is acceptable if the reel is also provided with means for permanent connection to the load, for example, a cord reel mounted on a mobile appliance. For this type of construction, the source of supply is connected at the unspooled cord.

7.3 With reference to 7.1, a keyhole slot, a notch, a hanger hole, or a hanger ring 1/2 in (12.7 mm) or larger in diameter is not considered to be a means for permanent mounting. If a hanger ring is employed, the hanger ring shall form a complete loop after the cord reel is mounted as intended. A separate bracket intended for permanent attachment to a wall or other surface, to which the cord reel might be attached by a removable swivel pin or similar device, is not considered to be a means for permanent attachment.

7.4 A cord reel that is intended for permanent connection to the power supply shall be provided with means for permanent mounting.

8 Bonding

8.1 All exposed dead-metal parts of a cord reel:

a) Intended for permanent connection to the power supply shall be bonded to the point on the reel to which the supply system will be connected, and to the equipment-grounding terminal or lead if such is provided on the reel.

Exception: This requirement does not apply to a dead-metal part of a load-end fitting of a reel employing a 2-wire cord.

b) Intended to be connected to the power supply by a cord employing an equipment-grounding conductor shall be bonded to the equipment-grounding conductor, or to the terminal to which the equipment-grounding conductor will be connected if the cord is to be field installed.

9 Protection Against Corrosion

9.1 Iron or steel parts, other than stainless steel, shall be protected against corrosion by plating, galvanizing, enameling, or the equivalent.

10 Live Parts

10.1 Current-carrying parts shall be of copper, copper alloy, silver alloy, carbon composition, or other material rated for the purpose. Iron or steel shall not be used for current-carrying parts.

10.2 Uninsulated live parts shall be mounted and shall be prevented from turning by means other than friction between surfaces.

11 Overcurrent Protection

11.1 A cord reel employing or intended to be used with flexible cord having conductor sizes smaller than 16 AWG shall be provided with overcurrent protection (short-circuit and overload protection) unless:

a) The cord reel is provided with a permanently attached accessory with a fixed load, such as a hand lamp, or

b) The cord reel is a special use cord reel.

The overcurrent protection shall be rated equal to or less than the current rating of the flexible cord.

11.2 The overcurrent protective device shall have a minimum short-circuit rating of 1000 A. A replaceable or manual resettable type is acceptable. The device shall not be of the automatic resetting type.

11.3 The overcurrent protective device shall be an integral part of the attachment plug, or shall be located in series with the cord not more than 6 in (152 mm) from the face of the plug to the rear of the fuse holder, or in the cord reel enclosure.

11.4 Supplementary overcurrent protection is an acceptable method of providing the protection required in 11.1. However, thermal cutouts, thermal relays, and other devices not intended to open a short-circuit shall not be used.

11.5 The overcurrent protective device shall provide protection for each ungrounded circuit conductor but not for any grounded circuit or grounding conductor unless the overcurrent protective device:

a) Opens all circuit conductors simultaneously – including the grounded circuit conductor, and

b) Cannot open the grounded circuit conductors without opening all of the ungrounded circuit conductors.

12 Thermal Protection

12.1 A thermal protector provided for abnormal operating conditions is optional. If provided, the protector shall be a type that permanently opens the circuit when the protector functions, or the protector shall be a manual-reset type. The protector shall not be an automatic-reset type. The protector shall comply with the Standard for Overheating Protection for Motors, UL 2111, or the Standard for Thermal-Links – Requirements and Application Guide, UL 60691. The protector shall comply with the abnormal and limited short-circuit tests in Thermal Protector Tests, Section 41.2.

Exception No. 1: The abnormal test, the short-circuit test, or both are not required If the protector has previously been tested and rated for the application.

Exception No. 2: An automatic-reset device in line with the load is acceptable only if the cord reel has a known load, and automatic resetting of the device does not result in a risk of fire, electric shock, or injury to persons.

13 Flexible Cord

13.1 The construction shall be such that all connections will be enclosed under all conditions of use.

13.2 Strain relief shall be provided so that stress on a flexible cord will not be transmitted to connections inside a reel or inside line or load fittings. This requirement applies where the cord terminates on the spool and, if provided, at the point where a supply cord enters the cord-reel enclosure. See Strain-Relief Test, Section 40.

13.3 With reference to 13.2, if flexible cord is not provided, strain-relief means shall be incorporated in the reel for the types and sizes of cord recommended by the manufacturer.

13.4 A flexible cord for connection to the power supply provided with a cord reel intended for permanent mounting shall be Type SJ or harder service cord. The length of the power supply cord shall not be less than 18 in (475 mm) or greater than 6 ft (1.83 m). The conductor size shall not be less than 16 AWG (1.34 mm^2).

14 Fittings

14.1 A line fitting, such as an attachment plug, and a load fitting such as a cord-connector body, portable hand lamp, or similar device, provided as a part of the cord reel shall have an electrical rating not less than the voltage and current or wattage ratings of the cord reel.

15 Motors

15.1 A motor provided as part of a cord reel shall be protected from overheating due to any condition of load, up to and including locked rotor.

15.2 A product as mentioned in 15.1 shall have motor-overload protection consisting of one of the following:

a) Thermal protection complying with the applicable requirements in the Standard for Overheating Protection for Motors, UL 2111.

b) Impedance protection complying with the applicable requirements in the Standard for Overheating Protection for Motors, UL 2111, when the motor is tested as used in the product under locked rotor conditions.

c) Other protection that is shown by test to be equivalent to the protection mentioned in (a) or (b).

16 Line and Load Connections

16.1 A cord reel intended for permanent mounting shall be provided with leads or wiring terminals for the connection of power-supply conductors or a flexible cord complying with 13.4 provided with a grounding-type attachment plug. See 7.1 and 13.4.

16.2 Leads for power-supply connection shall be rated for the purpose, and shall not have a current rating less than the maximum current rating of the reel.

16.3 A cord reel not intended for permanent mounting shall be provided with an attachment plug assembled to the power-supply cord.

16.4 A cord reel not provided with a flexible cord for connection of the load shall be provided with wiring terminals for cord connection. The wiring terminals shall be capable of accommodating conductors of the size recommended by the manufacturer for use with the reel, and the wiring terminals shall comply with the requirements in 16.9 and 16.11 – 16.16.

16.5 A terminal intended for the connection of a grounded supply conductor shall be:

a) Identified by a plating substantially white in color (such as nickel),

b) Of a metal that is substantially white in color, or

c) Otherwise be colored white, marked "WH," or proper identification of the terminal shall be clearly shown in some other manner, such as on an attached wiring diagram.

16.6 The field wiring lead, or the conductor of a jacketed cord, intended for the connection of the grounded supply conductor shall be identified by:

a) White or gray colored conductor insulation or

b) Light blue colored conductor insulation with the insulation of the other conductors having colors other than white or gray.

16.7 The conductor of a parallel cord intended for the connection of the grounded supply conductor shall be identified by:

a) A continuous rib or ribs running the length of the cord or

b) Tinned or white metal on all strands of the conductor.

16.8 If a cord reel is intended for mounting on an outlet box, wiring terminals that will be inside the box after the reel is installed shall be located or recessed so that contact will not occur between the terminals and the wires inside the box after the reel is installed.

16.9 A wiring terminal shall be mounted so that the terminal will not turn or shift in position. Friction between surfaces is not acceptable as the sole means to prevent the turning of a wiring terminal.

16.10 A wiring terminal shall be capable of securing a conductor having an ampacity not less than the maximum current rating of the reel, but not smaller than 14 AWG (2.1 mm^2).

16.11 A wiring terminal shall be provided with a soldering lug or pressure wire connector, bolted or held by a screw.

Exception: A wire-binding screw employed at a terminal intended for the connection of a 10 AWG (5.3 mm^2) or smaller conductor is acceptable if upturned lugs or the equivalent are provided to retain the conductor under the head of the screw.

16.12 Upturned lugs or a cupped washer, if employed, shall be capable of retaining a supply conductor corresponding in size to that mentioned in 16.10 under the head of the screw or washer.

16.13 A wire-binding screw shall thread into metal.

16.14 A wire-binding screw employed at a field-wiring terminal shall not be smaller than No. 10, and shall not have more than 32 threads per in.

Exception: A No. 8 wire-binding screw is acceptable at a terminal intended only for the connection of one 14 AWG (2.1 mm^2) conductor.

16.15 A terminal plate for a wire-binding screw of a wiring terminal shall not be of metal less than 0.050 in (1.27 mm) thick, and shall not have less than two full threads in the metal. Extruding the metal at the tapped hole for the binding screw to provide two full threads is acceptable.

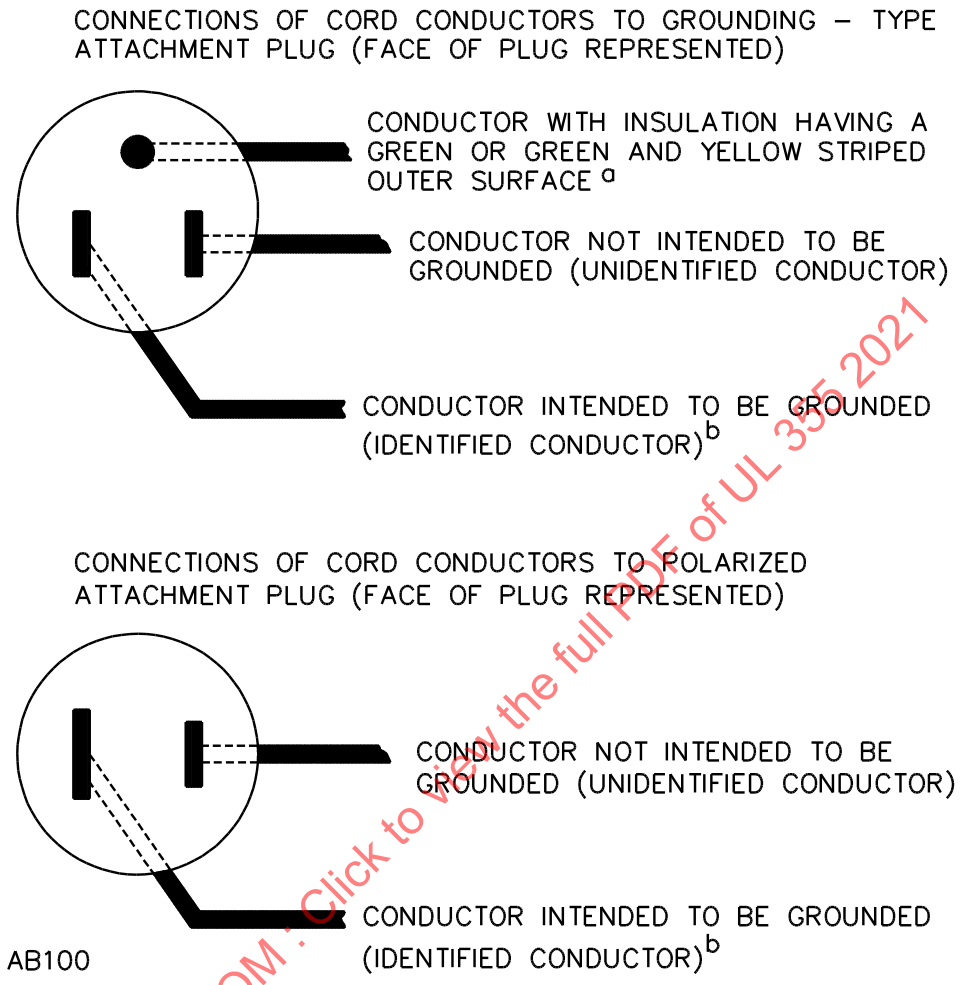
16.16 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal-shaped, slotted, or both. A pressure wire connector intended for connection of an equipment-grounding conductor shall be marked in accordance with 53.5. The wire-binding screw or pressure wire connector shall be located so that removal is not required during normal servicing of the product.

16.17 The power-supply cord of a cord reel having a portable hand lamp shall terminate in a 2-pole, 3-wire, 15-A, 125-V grounding attachment plug or in a 2-pole, 2-wire, 15-A, 125-V polarized attachment plug. The power-supply cord of a cord reel provided with a receptacle as a load fitting shall terminate in a grounding attachment plug having a voltage and current rating equal to that of the receptacle.

16.18 If connection to the source of supply is by means of a 2-conductor flexible cord, the conductors shall be connected to a parallel-blade attachment plug as illustrated in Figure 16.1.

Figure 16.1

Connections to attachment plug



[a] The blade to which the green or green and yellow conductor is connected may have a u-shaped cross section instead of the circular cross section shown.

[b] The conductor intended to be grounded signifies a conductor identified in accordance with 16.6 and 16.7.

16.19 If the flexible cord includes an equipment-grounding conductor, that conductor shall be green in color with or without one or more yellow stripes. The conductors of the flexible cord shall be connected to a parallel-blade, 3-wire grounding attachment plug as illustrated in Figure 16.1.

16.20 An integral Class 2, LPS, or PS1 or PS2 power supply provided with an integral output connector (s) provided in a cord reel shall comply with applicable construction and performance requirements of one of the following:

a) As a Class 2 device as described in the Standard for Class 2 Power Units, UL 1310; or

b) As an LPS or PS1 or PS2 energy source as described in the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

16.21 Specialty power supply units with integral Class 2 output connectors employed in a cord reel shall comply with the construction and performance requirements as described in the Standard for Class 2 Power Units, UL 1310, for permanently-connected specialty (Class 2) power supply units intended for installation in outlet boxes.

Exception: A cover plate incorporating a specialty power supply unit with integral Class 2 output connector (s) that has terminations relying solely upon friction or spring pre-loaded contact to external surfaces of wire-binding screwheads shall not be employed in a cord reel.

16.22 Receptacles with integral power supplies with Class 2 output connector(s) employed in a cord reel shall comply with the construction and performance requirements for Receptacles with Integral Power Supplies with Class 2 Output Connectors as described in the Standard for Attachment Plugs and Receptacles, UL 498.

16A Separation of Circuits

16A.1 A cord reel employing isolated secondary circuits, such as Class 2, LPS, or PS1 or PS2 circuits, shall be provided with a barrier, physically secured by means other than friction, that separates the AC power circuit conductors from the conductors of the other circuits. Bonding of the equipment grounding conductor and the referenced conductors of isolated secondary circuits is permissible.

Exception No. 1: A barrier is not required between conductors that are separated by a minimum spacing of 2 inches (50.8 mm), including lead dress.

Exception No. 2: Conductors that are suitably insulated for the maximum AC power circuit voltage involved are not required to be separated from the AC power circuit conductors, when breakage or loosening of a conductor at a terminal in either circuit cannot result in contact between uninsulated parts of one circuit and uninsulated or inadequately insulated parts of the other circuit.

Exception No. 3: For conductors other than AWM (traces on a printed-wiring board, terminals mounted on insulating blocks, and the like), the minimum separation between communication circuits and the AC.

17 Insulating Material

17.1 A material for the mounting of uninsulated live parts shall be porcelain, phenolic, or cold-molded composition, or other material that has been investigated and found to be acceptable for the application. A thermoplastic or thermosetting material for a general-use cord reel shall comply with the applicable requirements in Polymeric Materials, Section 20. A commercial/industrial use cord reel shall comply with the applicable requirements for Enclosures, Section 27.

18 Bushings

18.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that is secured in place, and that has a smooth, rounded surface for the cord. If the cord is lighter service than Type SJ, if the wall or barrier is of metal, and if the construction is such that the cord is subjected to stress or motion, an insulating bushing shall be provided. See 18.2.

18.2 If the cord hole is in porcelain, phenolic composition, or other nonconductive material, a smooth, rounded surface is equivalent to a bushing.

18.3 Ceramic materials and some molded compositions are acceptable for insulating bushings; but separate bushings of hot-molded shellac-and-tar compositions, rubber materials, or certain thermoplastic materials are not acceptable.

18.4 Fiber is acceptable if the bushing is not less than 3/64 in (1.2 mm) thick, and if the bushing is formed and secured in place so that the bushing is not adversely affected by conditions of ordinary moisture.

18.5 An insulated grommet is acceptable in place of an insulating bushing, if the insulating material used is not less than 1/32 in (0.8 mm) thick and completely fills the space between the grommet and the metal in which the grommet is mounted.

19 Spacings

19.1 The spacing between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead-metal part, shall not be less than that specified in Table 19.1.

Table 19.1
Minimum spacings, in (mm)

Maximum voltage rating of reel, V	General-use reel				Special-use reel	
	Through air		Over surface		Through air or over surface	
0 – 50	1/16	(1.6)	1/16	(1.6)	1/16	(1.6)
51 – 250	3/32	(2.4)	3/32	(2.4)	1/16	(1.6)
251 – 600	3/8	(9.5)	1/2	(12.7)	1/4	(6.4)

19.2 The spacings between uninsulated live parts of opposite polarity and between uninsulated live parts and dead-metal parts at the point of the connection of field-wiring terminals, if provided, shall not be less than that specified in Table 19.2.

Table 19.2
Spacings at field-wiring terminals

Maximum rating, V	Minimum spacings, in (mm)					
	Between wiring terminals through air or over surface[a]		Between terminals and other uninsulated metal parts not always of the same polarity[a]			
			Over surface		Through air	
250 or less	1/4	(6.4)	1/4	(6.4)	1/4	(6.4)
More than 250	1/2	(12.7)	1/2[b]	(12.7)	3/8	(9.5)

[a] Applied to the sum of the spacings involved where an isolated dead metal part is interposed.

[b] A spacing of not less than 3/8 in, through air and over surface, is acceptable in a wiring compartment or terminal box if the compartment or box is integral with a motor.

20 Polymeric Materials

20.1 A polymeric material, thermoplastic or thermosetting, used to provide all or part of the enclosure for electrical parts as specified in 22.1 or used to provide structural support of live parts as specified in 17.1 in the cord reel, shall comply with 20.2 – 20.8.

20.2 A material shall comply with the requirements specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and with the requirements in 20.3 – 20.8.

20.3 With respect to the requirements for thermal endurance in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, a normal-temperature test shall be conducted. If enclosure temperatures exceed 65°C (150°F), the material shall have a mechanical temperature index, with impact, as a result of long-term aging, of at least the measured temperature and have an electrical temperature index, as a result of long-term aging of at least the measured temperature if the part is involved in the direct or indirect support of a live part.

Exception: A material is acceptable for temperatures over 65°C without long-term thermal aging, if the material has been accepted for higher temperatures as a generic material class in accordance with the table for relative thermal indices based upon past field-test performance and chemical structure in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

20.4 The evaluation to the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, shall include the ball-impact test. The drop test shall be included if the cord reel does not have a mounting means provided.

20.5 The mold stress-relief distortion evaluation in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, shall be conducted only by the air-oven method, not by the test-cell method.

20.6 The severe-conditions evaluation and abnormal operation in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, are not to be performed.

20.7 All metal parts in a polymeric enclosure that are required to be grounded shall be bonded in accordance with Bonding, Section 8.

20.8 A material used for the direct contact or support of live parts shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: Materials that may not have acceptable properties as tabulated in UL 746C may be tested in the application in accordance with tests in UL 746C.

GENERAL-USE CORD REELS

21 General

21.1 A general-use cord reel shall comply with the applicable construction requirements in Sections 4 – 20 as well as those described below.

21.2 A control device in line with the load provided as part of a cord reel shall not be of the automatic-reset type.

Exception: An automatic-reset device in line with the load is acceptable only if the cord reel has a known load, and automatic resetting of the device does not result in a risk of fire, electric shock, or injury to persons.

22 Enclosure

22.1 A general-use cord reel shall be provided with an enclosure. The enclosure shall be constructed of metal, or polymeric material complying with Polymeric Materials, Section 20. The enclosure shall house all uninsulated live parts.

Exception: Wiring terminals that will be inside an outlet box or the equivalent when the reel is installed are not required to be additionally enclosed.

22.2 For unreinforced, flat surfaces of an enclosure of a general-use cord reel, cast metal shall not be less than 1/8 in (3.2 mm) thick, malleable iron shall be not less than 3/32 in (2.4 mm) thick, and die-cast metal shall not be less than 5/64 in (2.0 mm) thick. Corresponding thicknesses of not less than 3/32, 1/16 (1.6 mm), and 3/64 in (1.2 mm), respectively, are acceptable if the surface is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that equivalent mechanical strength is provided.

22.3 A sheet-steel enclosure of a general-use cord reel shall not be less than 0.029 in (0.74 mm) thick.

23 Flexible Cord

23.1 A flexible cord provided with a general-use cord reel rated up to 300 V shall be Type HPN, SP-2, SPT-2, or SPE-2 or equivalent. Flexible cord provided with a general-use cord reel rated more than 300 V up to 600 V shall be Types S, SO, STO, or SE or equivalent.

Exception: A special-use cord reel that is intended for use as a component of other equipment is acceptable with other cord types complying with the requirement for the end-use application.

24 Switches

24.1 A switch used in a cord reel to control an outlet shall comply with the Standard for General-Use Snap Switches, UL 20.

24.2 A switch used in a cord reel having a fixed load, such as an incandescent hand lamp without a receptacle, shall comply with the Standard for General-Use Snap Switches, UL 20, the Standard for Special-Use Switches, UL 1054 or the Standard for Switches for Appliances – Part 1: General Requirements – UL 61058-1. A switch used in a cord reel having a fixed inductive or motor load shall comply with the Standard for General-Use Snap Switches, UL 20.

24.3 A through-cord or pendant switch shall have voltage and current ratings equal to or greater than the cord-reel voltage current and current ratings.

24.4 A switch shall simultaneously open all of the supply conductors of a cord reel that does not use polarized fittings.

24.5 A switch in a cord reel that does use polarized fittings shall simultaneously open all supply conductors, or the switch shall open only the unidentified conductor.

24.6 A switch shall not open the equipment-grounding conductor of a cord reel.

GENERAL-USE OUTDOOR CORD REELS

25 General

25.1 A general-use outdoor cord reel shall comply with the applicable construction requirements in Sections 4 – 20 as well 25.2 – 25.6.

25.2 A general-use outdoor cord reel shall be provided with cord types marked "W" on the outer cord jacket.

25.3 A general-use outdoor cord reel molded of a polymeric material, thermoplastic or thermosetting, used to provide all or part of the enclosure for electrical parts shall:

a) Be resistant to thermal aging, ozone, and sunlight in accordance with Exposure to High Temperature, Ozone Resistance, and Exposure to Ultraviolet and Water Tests, Sections 44 – 46, respectively; and

b) Comply with the Resistance to Impact Test at minus 25° F (minus 32° C) as described in the Standard for Polymeric Materials – Use in Electrical Evaluations, UL 746C.

25.4 A general-use outdoor cord reel shall be constructed to prevent water or other contaminants from wetting or coming in contact with uninsulated live parts (including, but not limited to, fuseholder contacts, receptacle contacts, fittings, and wiring) or other electrical parts that are not inherently waterproof. To determine compliance, the cord reel shall comply with Rain Test, Section 42.

Exception: This requirement does not apply to a cord storage device intended for use outdoors.

25.5 A general-use outdoor cord reel enclosure that permits the entry of water shall be provided with an open drain hole so that accumulation of water does not result in the wetting of an electrical part. The hole shall be as specified in Table 25.1.

Table 25.1
Size of drain holes

Opening shape	Minimum dimension in (mm)	Minimum area in^2 (mm^2)	Minimum dimension in (mm)	Maximum area in^2 (cm^2)
Slot	1/8 (3.2) (width)	0.012 (7.74)	3/8 (9.6) (width)	1-1/2 (9.68)
Square	1/8 (3.2) (side)	–	1/2 (12.7) (side)	–
Round	1/8 (3.2) (diameter)	–	1/2 (12.7) (diameter)	–
Irregular	–	0.012 (7.74)	–	1-1/2 (9.68)

25.6 Each receptacle outlet of a general-use outdoor cord reel shall comply with Low Temperature Insertion Test, Section 43.

Exception: Receptacles molded of phenolic or urea need not be subjected to Temperature Test, Section 35.

COMMERCIAL/INDUSTRIAL USE CORD REELS

26 General

26.1 A commercial/industrial use cord reel shall comply with the requirements in Sections 4 – 19 as well as Sections 27 – 32.

27 Enclosure

27.1 A commercial/industrial use cord reel shall comply with the Standard for Enclosures for Electrical Equipment, UL 50. Consideration shall be given to the following items:

a) Type ratings and associated tests,

b) Polymeric enclosures and enclosure parts,

c) Openings, windows, notches, covers, doors, and similar features,

d) Thickness of metal enclosures,

e) Gaskets,

f) Connection to wiring systems, and

g) Type and cautionary markings.

27.2 The brush and slip-ring contacts of a cord reel that is intended for use above a hazardous location of a commercial garage shall be totally enclosed, or the enclosure of the reel shall be constructed to prevent the escape of sparks or hot metal particles. Consideration is to be given to the intended method of mounting the reel.

Exception: This requirement does not apply to a cord reel that is marked in accordance with 54.6.

28 Means for mounting

28.1 A cord reel that is intended for use above a hazardous location in a commercial garage shall be provided with means for permanent mounting or with a separate mounting bracket. A separate bracket shall not be readily interchangeable with other brackets. See 7.3.

29 Bonding

29.1 If a portable hand lamp is provided on a reel not marked in accordance with 54.5 and 54.6, a metallic lamp guard or reflector with or without an insulating coating shall be bonded to the equipment-grounding means. A reel marked in accordance with 54.5 and 54.6 shall comply with the requirements in 31.3.

30 Flexible cord

30.1 A flexible cord provided on or intended for use with a commercial/industrial use cord reel shall be Type SJ or equivalent. In addition, cord reels intended for use in wet locations shall be provided with cord types marked "W" on the outer cord jacket.

30.2 Flexible cord provided on a commercial/industrial use cord reel intended for use above a hazardous location in a commercial garage and in oily conditions or in oily conditions only shall be provided with cord types "O" or "OO."

31 Fittings

31.1 An electrical load fitting provided on a commercial/industrial use cord reel shall comply with the construction requirements in the applicable standard for that product and shall also comply with the performance requirements in the Standard for Enclosures for Electrical Equipment, UL 50.

31.2 A portable hand lamp provided as part of a cord reel intended for use above a hazardous location shall comply with applicable requirements in the Standard for Portable Electric Luminaires, UL 153, and with 31.3.

31.3 A portable hand lamp provided as part of a cord reel intended for use above a hazardous location in a commercial garage shall consist of a handle, lampholder, hook, and lamp guard attached to the lampholder or handle, and shall comply with the following:

a) All exterior surfaces shall be of nonconductive material, or shall be effectively protected by insulation that is not affected by petrochemicals.

b) A switch or receptacle for an attachment plug shall not be provided.

c) The outer shell of the lampholder shall be of an insulating material.

d) A metal cap and shell lampholder with cardboard liner shall not be used.

e) The lamp shall comply with requirements in the Standard for Portable Electric Luminaires , UL 153.

32 Motors

32.1 A motor provided as part of a cord reel intended for use above hazardous locations shall be totally enclosed and comply with 5.2.

PERFORMANCE

33 General

33.1 The endurance, temperature, and dielectric voltage-withstand tests shall be performed, in that order.

34 Endurance Test

34.1 A cord reel shall be mounted as intended, and the cord shall be pulled from the cord reel in a manner that simulates, the most adverse operation and use. The cord reel shall withstand 6000 cycles of operation of reeling and unreeling of the cord. There shall not be evidence of undue wear of brushes or

slip rings, evidence of excessive abrasion to the cord insulation, or other damage to the cord. A polished appearance of the jacket without abrasion to the cord insulation or other damage to the cord is acceptable.

Exception No. 1: This requirement does not apply to a cord reel equipped with Type S, SE, SO, ST, or STO cord, or to a reel that, although not provided with a cord, is intended for use only with cords of these types.

Exception No. 2: This requirement does not apply to a cord reel having manual-type cord retraction, and the cord entry area is free of burrs, sharp edges, or other features that are detrimental to the cord conductors and insulation.

Exception No. 3: A cord reel shall be mounted as intended, and the cord shall be pulled at the angle specified in the installation instructions.

34.2 The cord is to be unreeled to a length of 30 in (762 mm) or more, by any convenient method representative of actual service, and is to be recoiled on the reel automatically by the action of the take-up mechanism. The cord is to be unreeled in such direction, with respect to the body of the reel and the intended method of mounting, that the tendency to abrade the insulation will be greatest.

35 Temperature Test

35.1 A cord reel, when tested as described in 35.2 – 35.13, shall not attain a temperature at any point sufficiently high to constitute a risk of fire, to adversely affect any material employed in the device, or to exceed the temperature rises specified in Table 35.1.

35.2 A thermal or overload protection device intended to operate only under abnormal operating conditions shall not operate during the Temperature Test.

35.3 A motor provided as part of a cord reel shall be tested using the longest recommended cord length until constant winding temperatures are attained. If a motor driven cord reel is marked with a specific duty cycle, the motor drive cord reel shall be operated at that duty cycle until constant temperatures are attained. The stated duty cycle shall be marked on the outer surface of the cord reel enclosure.

35.4 All values for temperature rise in Table 35.1 are based on an assumed ambient temperature of 25°C (77°F). However, it is acceptable to perform tests at any ambient temperature in the range of 10 – 40°C (50 – 104°F).

Table 35.1
Maximum temperature rises

Materials and component parts	°C	°F
1. Varnished-cloth insulation	60	108
2. Wire or flexible cord[c]	35	63
3. Fiber employed as electrical insulation	65	117
4. Wood and other flammable material	65	117
5. Phenolic composition employed as electrical insulation or as a part the deterioration of which may result in a risk of fire, electric shock, or injury to persons[c]	150	302
6. Capacitor		
A. Electrolytic[d]	40	72

Table 35.1 Continued on Next Page

Table 35.1 Continued

Materials and component parts	°C	°F
B. Other Types[e]	65	117
7. Fuses		
A. Class G, J, L, T, and CC		
Tube	100	180
Ferrule or blade	85	153
B. Others	65	117
8. At any point within a terminal box or wiring compartment of a commercial/industrial use cord reel in which power-supply conductors are to be connected, including such conductors themselves, unless the cord reel is marked in accordance with 54.8.	35	63
9. Class 105(A) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 in (178 mm), of a dc motor, and of universal motor[a,b]:		
A. In an open motor and on a vibrator coil		
Thermocouple method	65	117
Resistance method	75	135
B. In a totally enclosed motor		
Thermocouple method	70	126
Resistance method	80	144
10. Class 105(A) insulation system on coil windings of an ac motor having a frame diameter of 7 in (178 mm) or less, not including a universal motor, and on a vibrator coil[a,b]:		
A. In an open motor and on a vibrator coil		
Thermocouple or resistance method	75	135
B. In a totally enclosed motor		
Thermocouple or resistance method	80	144
11. Class 105(A) insulation on windings of relay, a solenoid, and the like[a]		
Thermocouple method	65	117
Resistance method	85	153
12. Class 130(B) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 in (178 mm), of a dc motor, and of a universal motor[a,b]:		
A. In an open motor		
Thermocouple method	85	153
Resistance method	95	171
B. In a totally enclosed motor		
Thermocouple method	90	162
Resistance method	100	180
13. Class 130(B) insulation systems on coil windings of an ac motor having a frame diameter of 7 in (178 mm) or less not including a universal motor[a,b]:		
A. In an open motor method		
Thermocouple and resistance method	95	171
B. In a totally enclosed motor		
Thermocouple method or resistance method	100	180
14. Sealing compound	40°C (104°F) less than the melting point	
15. Varnished cloth insulation	60	108

[a] At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may be higher by the following amount than the maximum specified.

Table 35.1 Continued on Next Page

Table 35.1 Continued

Materials and component parts	°C	°F
Item	Additional Temperature Rise	
Part A of Items 9 and 11	15°C (27°F)	
Part A of Item 10	5°C (9°F)	
Part A of Item 12	20°C (36°F)	
Part A of Item 13	10°C(18°F)	

Provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.

[b] This is the diameter, measured in the plane of the laminations, of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like used solely for motor mounting, cooling assembly, or connection.

[c] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to be acceptable for a higher temperature.

[d] For an electrolytic capacitor that is integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure shall not be more than 65°C (117°F).

[e] A capacitor that operates at a temperature rise of more than 65°C (117°F) may be judged on the basis of its marked temperature limit.

35.5 Temperatures are to be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). Where thermocouples are used in determining temperatures in electrical equipment, it is standard practice to employ thermocouples consisting of 30 AWG iron and constantan wire and a potentiometer-type instrument. This equipment is to be used for referee temperature measurements.

35.6 The thermocouples and related instruments are to be accurate and calibrated. The thermocouple wire is to comply with the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

35.7 A thermocouple junction and adjacent thermocouple lead wire are to be held in thermal contact with the surface of the material the temperature of which is being measured. In most cases, acceptable thermal contact will result from taping or cementing the thermocouple in place. If a metal surface is involved, brazing or soldering the thermocouple to the metal might be necessary.

35.8 For the temperature test of a reel that is equipped with a cord by the manufacturer, the cord is to be subjected to an essentially sinusoidal 60 Hz current or direct current having a numerical value equal to the maximum root-mean-square (rms) current rating of the reel. A low-voltage source for the current is acceptable.

35.9 If flexible cord is not provided, a cord of the type, gauge, size, and length recommended for use with the reel is to be mounted on the reel, and the reel is to be caused to carry the maximum rated current. If a reel is not provided with cord, and if more than one type, gauge, size, or length of cord is recommended for use with the reel, the reel is to be tested by using the recommended type, gauge, size, and length of cord that will result in maximum heating.

35.10 Normally, for a reel that may use a number of different cords or multiple brush arrangement, it may be necessary to conduct more than one temperature test considering each of the following:

a) The combination that dissipates the most power along the cord. The combination that dissipates the most power is determined by the length of cord times the number of current-carrying conductors times the d-c resistance per foot times the square of the rated current. A conductor intended for grounding is not counted as a current-carrying conductor,

b) Different cord types, and

c) The cord that subjects the brushes and slip rings to the greatest current.

35.11 The length of cord to be unreeled during the test is to be as specified in Table 35.2.

Table 35.2
Unreeled length of cord

Total length of cord can be retracted onto reel	Total length of cord provided on reel	Length of cord to be unreeled for test
Yes	18 ft or more	6 ft
Yes	Less than 18 ft but more than 6 ft	One-third of the total length
Yes	6 ft or less	2 ft
No	18 ft or more	The length that cannot be retracted, but not less than 6 ft
No	Less than 18 ft but more than 6 ft	The length that cannot be retracted, but not less than one-third of the total length
No	6 ft or less	The length that cannot be retracted, but not less than 2 ft
NOTE – SI units for the dimensions specified in this table are: 2 ft = (0.61 m) 6 ft = (1.83 m) 18 ft = (5.49 m)		

35.12 The temperature test is to be continued until constant temperatures are attained as indicated when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test but not less than 5-min intervals, indicate no change.

Exception: If a thermoplastic-insulated cord is to be used with a reel, the test time is to be as specified in 35.13.

35.13 If a thermoplastic-insulated cord is to be used with a reel, the reel is to be equipped with such a cord, and the temperature test is to be continued for 8 h. The latching mechanism of the reel, if any, shall be disengaged in order to place the cord under tension. There shall not be visible reduction in the thickness of the insulation on the side of the cord nearest the center of the reel as determined by examination of three separate cuts across the retracted length of cord.

36 Dielectric Voltage-Withstand Test

36.1 A cord reel, while heated from the temperature test, shall withstand for 1 min without breakdown the application of a 60-Hz essentially sinusoidal potential between live parts and dead-metal parts. For a cord reel rated 250 V or less, the test potential shall be 1000 V; for a reel rated more than 250 V, the test potential shall be 1000 V plus twice the rated voltage of the reel.

36.2 If a cord reel has more than one voltage rating, the applied test voltage is to be based on the highest rating.

36.3 To determine if a cord reel complies with 36.1, the reel is to be tested by means of a 500 VA or larger capacity testing transformer, the output voltage of which is essentially sinusoidal at 60 Hz and can be varied. The applied potential is to be increased from zero until the required test voltage is reached, and

is to be held at that voltage for 1 min. The increase in the applied potential is to be at a substantially uniform rate as rapid as is consistent with correct indication of the applied potential by a voltmeter.

Exception: A 500 VA or larger capacity transformer is not required if the output potential of the transformer is measured directly with a voltmeter.

37 Grounding-Path Resistance Test

37.1 A reel employing or intended to employ a cord with an equipment-grounding conductor shall not have a resistance greater than 0.1 ohm when tested in accordance with 37.2 prior to and after:

a) The Overload Test as described in Section 38, and

b) The Short-Circuit Test as described in Section 39.

Exception No. 1: A cord reel constructed in accordance with all of the following is not required to be subjected to this test:

a) The reel enclosure is molded of polymeric material,

b) The cord reel is not provided with any brushes and slip rings,

c) The power-supply cord grounding conductor connects directly to the grounding terminal of the receptacle or receptacles,

d) The power-supply cord is in accordance with all the applicable requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817, and

e) The receptacles are in accordance with the applicable requirements in the Standard for Attachment Plugs and Receptacles, UL 498.

Exception No. 2: A cord storage device is not required to be subject to this test.

37.2 To determine compliance with 37.1, a minimum 25-A alternating current from a supply of not more than 6 V is to be passed between the points as specified in Table 37.1. The resulting drop in potential is to be measured. The resistance in ohms is then to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

Table 37.1
Grounding-path resistance

Means of connection		Points between which resistance is measured
Input	Output	
Provision for permanent connection to power supply	Flexible cord	Equipment-grounding terminal or lead if provided, otherwise metal of reel enclosure where power-supply wiring system will be connected; and grounding conductor of cord 6 in from point of connection to reel
Flexible cord	Leads or terminals for permanent connection to equipment	Grounding conductor of cord 6 in from point of connection to reel; and grounding terminal or lead, if provided, otherwise dead metal of stationary part of reel
Flexible cord	Flexible cord	Grounding conductor of retractable cord 6 in from point of connection to reel; and point where grounding conductor of other cord is connected to reel
NOTE – SI units for the dimensions specified in this table are: 6 in = (152 mm)		

38 Overload Test

38.1 The grounding bonding paths between any exposed dead-metal part and the point of connection of the wiring system shall not open when subjected to the test as described in 38.2.

38.2 With reference to the requirements in 37.1 (a) and 38.1, the sample is to be connected between the points specified in Table 37.1 and subjected to a current of:

a) 60 A for 2 min if the current rating of the reel is 30 A or less, or

b) 120 A for 4 min if the current rating of the reel is more than 30 A and not more than 60 A.

39 Short-Circuit Test

39.1 The grounding bonding paths between any exposed dead-metal part and the point of connection of the wiring system shall not open when subjected to the test described in 39.2.

39.2 With reference to the requirements in 37.1 (b) and 39.1, the grounding or bonding circuit is to be connected, in series with a nonrenewable cartridge fuse and a power supply. The power supply voltage is to be equal to the rated voltage of the reel. The power supply is to be capable of delivering 1000 A, at a power factor of 0.95 – 1.0, when the supply is short-circuited at the supply's output terminals. If the current rating of the reel is 30 A or less, the fuse is to be a 30-A fuse. If the current rating of the reel is more than 30 but not more than 60 A, the current rating of the fuse is to be 60 A. The test is considered complete when the fuse opens.

40 Strain-Relief Test

40.1 Unless it can be established by other means that stress is not transmitted to connections inside a reel, the strain-relief means provided on the flexible cord shall be subjected to the test described in 40.2. As a result of the test the strain-relief means shall not be displaced and there shall not be movement of the cord indicating that stress is transmitted to the connections inside the reel.

40.2 For a reel provided with cord, connections to the cord inside the reel are to be disconnected. If a cord is to be field installed, cord – of the lightest service type, smallest gauge size, and fewest conductors for which the reel is intended – is to be secured by the strain-relief means, but is not to be connected. A 35-lb (16-kg) weight is to be suspended from the cord and supported by the reel for 1 min so that the strain-relief means is stressed from any angle consistent with the construction of the reel. The test of a plastic strain-relief means is to be conducted with the device heated, by any convenient means, to operating temperature.

41 Abnormal and Limited Short-Circuit Tests

41.1 Thermoplastic-insulated cord tests

41.1.1 If a thermoplastic-insulated cord of lighter service than SVT or SVE is to be used with a cord reel, the abnormal operation and the limited short-circuit tests described in 41.1.2 and 41.1.3 shall be performed. As a result of the tests, there shall not be a risk of fire or opening of the fuse connected to ground. The reel is not required to be operable at the completion of the tests.

41.1.2 Abnormal operation tests are to be performed with the cord reel carrying a current equal to:

a) One hundred and ten percent of the current rating of the maximum-current-rated fuse accommodated by the fuseholder of a branch circuit to which the reel is intended to be connected, and

b) Any value less than that specified in (a) and greater than the rated values that results in the most severe conditions of test.

The test is to be repeated a sufficient number of times to determine that the most unfavorable results have been obtained. The reel is to be placed on and under a double layer of cheesecloth. If the enclosure is of metal, the enclosure is to be connected to ground through a 3-A fuse. Each test is to be continued with the cord and reel energized until ultimate results are attained or for 7 hours, whichever is less.

41.1.3 A short-circuit test is to be conducted on a circuit limited to a current of 1000 A at 120 V for cord reels rated 110 – 120 V or 240 V for cord reels rated 220 – 240 V. The cord and reel are to be connected in series with a nonrenewable cartridge fuse. The fuse is to be of the maximum current rating that can be accommodated by the fuseholder of a branch circuit to which the reel is intended to be connected. The enclosure of the reel, if of metal, is to be connected to ground through a 3-A fuse.

41.1.4 The cheesecloth used for the test described in 41.1.2 is to be bleached, running 14 – 15 yd^2/lbm (28 – 30 m^2/kg). The cheesecloth is to have what is known to the trade as a count of 32 by 28, that is, for any square in, 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 in the other direction).

41.2 Thermal protector tests

41.2.1 With reference to 12.1, a cord reel having a thermal protector shall be subjected to the tests in 41.2.2 – 41.2.4. As a result of the tests, there shall not be a risk of fire or opening of the fuse connected to ground. The protector is not required to open the circuit. The reel is not required to be operable at the completion of these tests.

41.2.2 Abnormal operation tests are to be conducted with the cord reel carrying a current equal to:

a) One hundred and ten percent of the current rating of the maximum-current-rated fuse that is able to be accommodated by the fuseholder of a branch circuit to which the reel is intended to be connected, and

b) Any value less than that specified in (a) and greater than the rated values that results in the most severe conditions of test.

The reel is to be placed on and under a double layer of cheesecloth. If the enclosure is of metal, the enclosure is to be connected to ground through a 3-A fuse. For a manual reset type protector that operates during the test, the test is to be continued for 50 cycles of protector operation. Each test cycle is to be continued with the cord and reel energized until ultimate results are attained or for 7 h, whichever is less.

41.2.3 Short-circuit tests are to be conducted using circuits limited to currents of 200 A and 1000 A. The test voltage is to be 120 V for a cord reel rated 110 – 120 V or 240 V for a cord reel rated 220 – 240 V. The cord and reel are to be connected in series with a nonrenewable cartridge fuse. The fuse is to be of the maximum current rating that is able to be accommodated by the fuseholder of a branch circuit to which the reel is intended to be connected. The reel is to be placed on and under a double layer of cheesecloth as described in 41.1.4. If the enclosure of the reel is of metal, the enclosure is to be connected to ground through a 3-A fuse. Three samples are to be tested at each current.

41.2.4 For cord reels rated over 240 V and employing a thermal protector, the cord reel shall comply with the short-circuit requirements in the Standard for Industrial Control Equipment, UL 508.

42 Rain Test

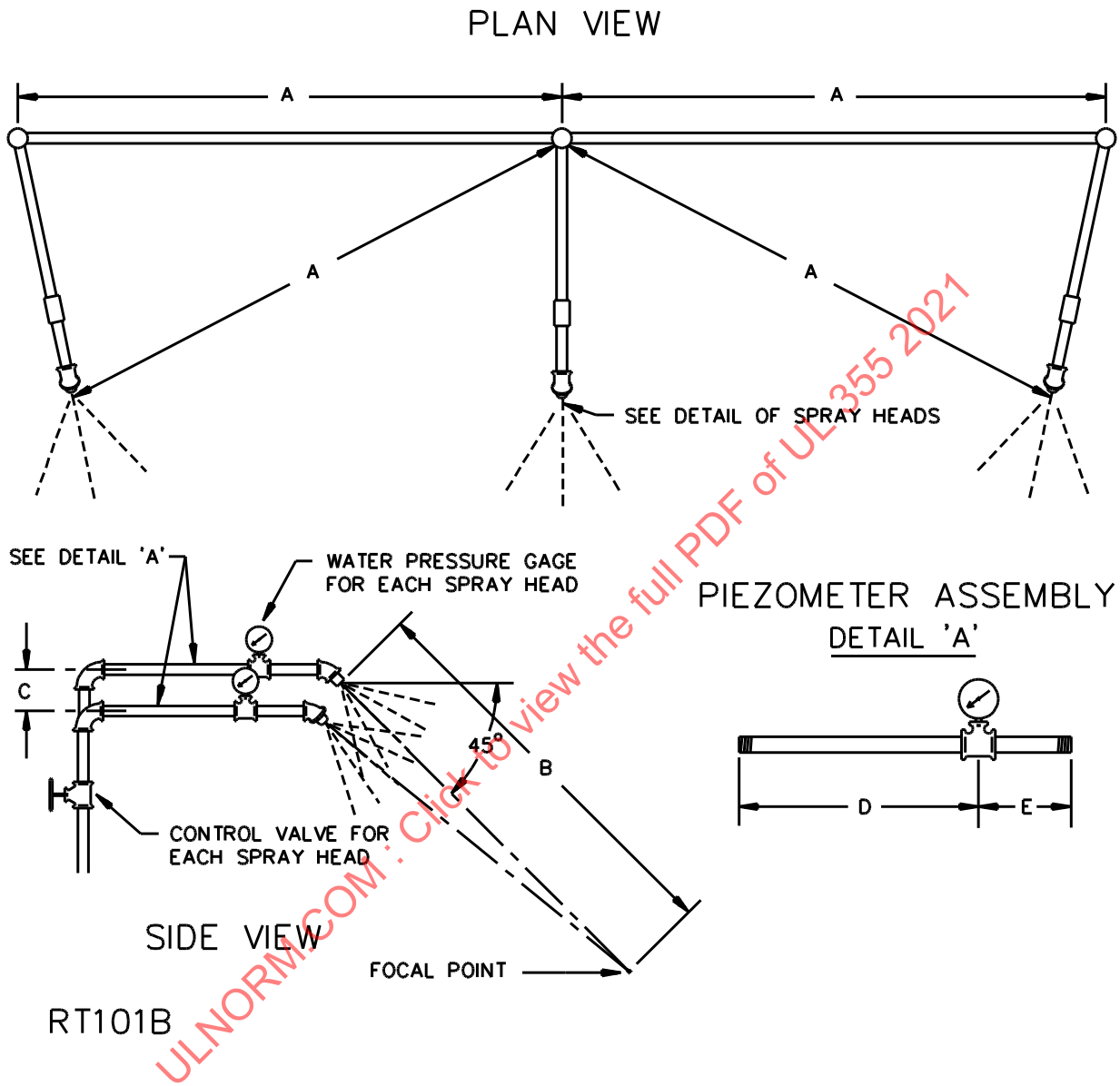
42.1 With reference to 25.4, a cord reel is to be tested as specified in 42.2 and 42.3. As a result of the test, there shall not be wetting of uninsulated live parts (including, but not limited to, fuseholder contacts, receptacle contacts, fittings, and wiring) or other electrical parts that are not inherently waterproof.

42.2 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 42.1. Spray heads are to be constructed in accordance with the details shown in Figure 42.2. The reel is to be set up or mounted in accordance with the manufacturer's installation instructions.

42.3 The cord reel is to be positioned in the focal area of the spray heads to produce a uniform spray over the entire surface or surfaces under test. The cord reel is to be positioned so that the greatest quantity of water is able to enter the enclosure. The water pressure is to be maintained at 5 lbs/in^2 (34.5 kPa) at each spray head. The cord reel is to be exposed to the water spray for 1 h. At the conclusion of the test, the cord reel is to be rotated in all directions and examined for the entrance of water.

Figure 42.1

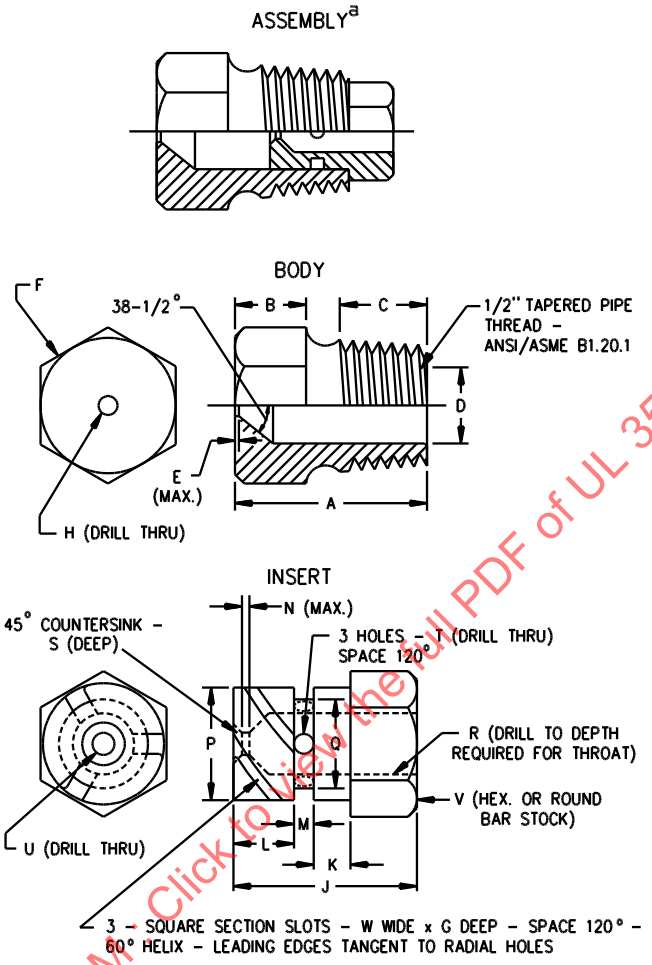
Rain-test spray-head piping



Item	in	mm
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

Figure 42.2

Rain-test spray head



Item	in	mm	Item	in	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No. 9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories Inc.

[b] ANSI B94.11M Drill size

[c] Optional – To serve as wrench grip.

43 Low-Temperature Insertion Test

43.1 Each outlet of a general-use outdoor cord reel shall mate with a solid-blade attachment plug specifically configured to mate with such outlet, at a temperature of minus 20 ±1°C (minus 4.0 ±1.8°F) without resulting in a gap, between the faces of the mated fittings, exceeding 0.079 in (2 mm).

43.2 Six samples of the receptacle and six samples of the mating attachment plug are to be conditioned at a temperature of minus 20 ±1°C (minus 4.0 ±1.8°F) for 4 h.

43.3 Following the 4 h conditioning, one cord reel and one mating attachment plug are to be taken from the conditioning chamber, and upon removal, the fittings are to be mated with an insertion force of 40 lbf (178 N) applied for a maximum of 1 min. This procedure is to be repeated five additional times, using a previously unused plug and cord reel for each consecutive mating, until all cord reels have been tested.

43.4 For cord reels with multiple outlets, additional samples and test plugs are to be tested so that each outlet of the cord reel being investigated is subjected to six of the insertions described in 43.3.

44 Exposure to High-Temperature Test

44.1 Following the high-temperature conditioning and impact described in 44.2 – 44.4, the polymeric enclosure of a general-use outdoor cord reel shall not have permanent damage, such as distortion, cracking, or splitting of the nonmetallic material.

44.2 The polymeric enclosure of a general-use outdoor cord reel shall be capable of withstanding an impact of 5 ft-lbf (7 N·m) after an exposure to a temperature of 85 ±3°C (185 ±5.4°F) for a period of 72 h. Three samples are to be tested. At the end of 72 h, each polymeric enclosure is to be removed from the oven and subjected to a single impact of 5 ft-lbf within 30 s after removal.

44.3 The impact is to be applied from any direction in a plane perpendicular to the center axis of the enclosure.

44.4 The impact is to be produced by dropping a steel sphere 2 in (51 mm) in diameter and weighing approximately 1.18 lb (535 g) from a height of 51 in (1.3 m). For impacts to surfaces other than the top, the steel sphere is to be suspended by a cord and allowed to swing as a pendulum dropping through a vertical distance of 51 in (1.3 m). For impacts to the top surface, free fall dropping the sphere through a vertical distance of 51 in (1.3 m) is acceptable.

45 Ozone Resistance Test

45.1 With reference to 25.3, samples are to be subjected to the test described in 45.2. As a result of the test, there shall not be permanent damage, such as distortion to the enclosure, or cracking or splitting of the nonmetallic material.

45.2 Three samples of the polymeric enclosure, in whole or machined to fit within the test chamber of the ozone test apparatus, of a general-use outdoor cord reel shall be exposed for 70 h to an ozone concentration of 50 ±5 ppm at a temperature of 40 ±1°C (104 ±1.8°F). At the end of the 70 h, each sample is to be subjected to a single impact of 5 ft-lbf (7 N·m) produced as described in 44.3 and 44.4.

46 Exposure to Ultraviolet and Water Test

46.1 With reference to 25.3, samples are to be subjected to the test described in 46.2 and 46.3 shall not be permanent damage, such as distortion, to the enclosure, or cracking or splitting of the nonmetallic material.