UL 1072

STANDARD FOR SAFETY

Medium-Voltage Power Cables

UL Standard for Safety for Medium-Voltage Power Cables, UL 1072

Fourth Edition, Dated June 30, 2006

SUMMARY OF TOPICS

This revision of ANSI/UL 1072 dated October 2, 2024 includes the Addition of Requirements of Single Input Wire (SIW) Stranded Conductors; Section 3, 6.2, 7.1, 8.1, 9.1, Table 9.1, and 9.8.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 30, 2024.

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Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover the shielded and nonshielded medium-voltage power cables that are described in Table 1.1 (single-conductor) and Table 1.2 (multiple-conductor). Multiple-conductor cables may include one or more individually jacketed non-conductive optical-fiber members. These electrical and hybrid electrical and optical-fiber cables are for use (optical and electrical functions associated in the case of a hybrid cable) in accordance with Article 328 and other applicable parts of the National Electrical Code (NEC), NFPA 70.

1.2 These cables have one or more stranded copper or aluminum conductors that are insulated with a solid, extruded dielectric. Cables that have a metal sheath or interlocked armor incorporate an effective grounding path. A grounding conductor is optional in other cables. Cables for direct burial are so marked and have an overall covering (see 1.4 for direct-burial cables that are not covered). Cables that are for use in cable trays generally are so marked (see 62.1 and 62.2). Cables that are sunlight-resistant generally are so marked (see 64.1 – 64.3). Cables that are marked “MV-90” or “MV-90 dry” have a maximum operating temperature of 90°C (194°F). Cables that are marked “MV-105” have a maximum operating temperature of 105°C (221°F) for use where design conditions require a maximum conductor temperature above 90°C (194°F). Cables that are marked “dry” have insulation for use only in dry locations. All other cables have insulation that is for use in both wet and dry locations. Multiple-conductor cables that include one or more optical-fiber members are surface marked to so indicate. Cables that are marked “oil resistant II” are for exposure to mineral oil at temperatures not in excess of 75°C (167°F). Cables that are marked “oil resistant I” are for exposure to mineral oil at temperatures not in excess of 60°C (140°F).

1.3 A multiple-conductor Type MV cable that has a smooth (other than lead) or corrugated metal sheath or that has interlocked metal armor may be marked for use also as Type MC cable.

1.4 This standard does not include requirements for cables with concentric neutral conductors. However, it is possible to have a single-conductor cable with a concentric neutral conductor manufactured in accordance with the requirements of other standards, that meets the requirements for jacketed single-conductor shielded cable in this standard.

Table 1.1
Single-conductor Type MV cables

Voltage rating	Size	Use	Insulation material	Percent insulation level	Insulation thicknesses	Shield	Overall covering
2400	8 AWG – 1000 kcmil	90°C (194°F) dry	XLPE or EPCV	–	Column A Table 15.3	nonshielded	None
		90°C (194°F) dry	XLPE, EPCV, DREP, or EP	–	Column B Table 15.3	nonshielded	Nonconductive jacket Column B Table 27.20
		90°C (194°F) wet or dry	XLPE, DREP, or EP	–	Column C Table 15.3	nonshielded	Nonconductive jacket Column C Table 27.20
5000	8 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100 or 133	Table 15.1 or Table 15.2	Shielded	a
8000	6 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1 or Table 15.2	Shielded	a
15000	2 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1 or Table 15.2	Shielded	a
25000	1 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1 or Table 15.2	Shielded	a
28000	1 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1 or Table 15.2	Shielded	a
35000	1/0 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1 or Table 15.2	Shielded	a

[a] The overall covering consists of one of the following (see Table 26.1 for complete descriptions):

1) Conductive nonmetallic insulation covering (Table 17.3) as part of shielding, with or without nonmagnetic metal sheath or armor over conductive nonmetallic insulation covering as part of shielding, with or without supplementary non-conductive jacket (Table 29.1) over metal sheath or armor.

2) Non-conductive jacket (Table 27.18) over shielding, with or without nonmagnetic metal sheath or armor over non-conductive jacket, with or without supplementary non-conductive jacket (Table 29.1) over metal sheath or armor.

3) Nonmagnetic metal sheath or armor as part of shielding, with or without supplementary non-conductive jacket (Table 29.1) over metal sheath or armor.

Table 1.2
Multiple-conductor Type MV cables

Voltage rating	Circuit conductors							Grounding conductor	Overall covering
	Size	Use	Insulation material	Percent insulation level	Insulation thicknesses	Shield	Individual covering		
2400	8 AWG – 1000 kcmil	90°C (194°F) dry	XLPE or EPCV	–	Column A Table 15.3	nonshielded	None	Optional Covered 23.1	None – assembly of single-conductor cables
		90°C (194°F) dry	XLPE, EPCV, DREP, or EP	–	Column B Table 15.3	nonshielded	Non-conductive jacket Column B Table 27.20	Optional Covered 23.1	None – assembly of single-conductor cables
		90°C (194°F) wet or dry	XLPE, DREP, or EP	–	Column C Table 15.3	nonshielded	Non-conductive jacket Column C Table 27.20	Optional Covered Table 23.1	None – assembly of single-conductor cables
		90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	–	Column C Table 15.3	nonshielded	None or Non-conductive jacket (Table 19.1)	Optional Bare 23.5	Non-conductive jacket (Table 27.18)
				–				Required Bare 23.1	Interlocked armor with or without Supplementary jacket
								May be required Bare 23.3 and 23.4	Metal sheath with or without Supplementary jacket
5000	8 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F)	XLPE, DREP, or EP	100	Table 15.1, Table 15.2	Shielded	Non-conductive jacket (Table 27.18) over shield	Optional Covered 23.1	None
							Conductive nonmetallic insulation covering (Table 17.3) as part of shield	Optional Covered Table 23.1	None

Table 1.2 Continued on Next Page

Table 1.2 Continued

Voltage rating	Circuit conductors							Grounding conductor	Overall covering
	Size	Use	Insulation material	Percent insulation level	Insulation thicknesses	Shield	Individual covering		
							Metal sheath as part of shield with or without Supplementary jacket	Optional Covered 23.1	None
8000	6 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1, Table 15.2	Shielded	None or Non-conductive jacket (Table 19.1)	Optional Bare 23.5	Non-conductive jacket (Table 27.18)
								Required Bare 23.1	Interlocked armor with or without Supplementary jacket
15000	2 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173				May be required to Bare 23.3 and 23.4	Metal sheath with or without Supplementary jacket
							Non-conductive jacket (Table 27.18) over shield	Optional Covered 23.1	None
25000	1 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173			Conductive nonmetallic insulation covering (Table 17.3) as part of shield	Optional Covered 23.1	None
							Metal sheath as part of shield with or without supplementary jacket	Optional Covered 23.1	None
28000	1 AWG – 2000 kcmil	90°C (194°F) or 105°C	XLPE, DREP, or EP	100, 133, or 173	Table 15.1, Table 15.2		None or Non-conductive	Optional Bare 23.5	Non-conductive jacket (Table 27.18)

Table 1.2 Continued on Next Page

Table 1.2 Continued

Voltage rating	Circuit conductors							Grounding conductor	Overall covering
	Size	Use	Insulation material	Percent insulation level	Insulation thicknesses	Shield	Individual covering		
		(221°F) wet or dry					jacket (Table 19.1)		
								Required Bare 23.2	Interlocked armor with or without Supplementary jacket
								May be required Bare 23.3 and 23.4	Metal sheath with or without Supplementary jacket
35000	1/0 AWG – 2000 kcmil	90°C (194°F) or 105°C (221°F) wet or dry	XLPE, DREP, or EP	100, 133, or 173	Table 15.1, Table 15.2	Shielded	Non-conductive jacket (Table 27.18) over shield	Optional Covered Table 23.1	None
							Conductive nonmetallic insulation covering (Table 17.3) as part of shield	Optional Covered 23.1	None
							Metal sheath as part of shield with or without Supplementary jacket	Optional Covered 23.1	None

2 Units of Measurement

2.1 In addition to being stated in the inch/pound units that are customary in the USA, each numerical requirement in this standard is also stated in units that make the requirement conveniently usable in countries employing the various metric systems (practical SI and customary). Equivalent – although not necessarily exactly identical – results are to be expected from applying a requirement in USA or metric terms. Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

3 Referenced Publications

3.1 Wherever the designation “UL 1581” is used in this cable standard, reference is to be made to the designated part(s) of the Reference Standard for Electrical Wires, Cables, and Flexible Cords (UL 1581).

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

3.3 The following publications are referenced in this standard:

ASTM B3, *Standard Specification for Soft or Annealed Copper Wire*

ASTM B8, *Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft*

ASTM B33, *Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes*

ASTM B230, *Standard Specification for Aluminum 1350-H19 Wire for Electrical Purposes*

ASTM B231/B231M, *Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors*

ASTM D257, *Standard Test Methods for DC Resistance or Conductance of Insulating Materials*

ASTM B400/B400M, *Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension*

ASTM B496, *Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors*

ASTM D746, *Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact*

ASTM B801, *Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation*

ASTM B835, *Standard Specification for Compact Round Stranded Copper Conductors Using Single Input Wire Construction*

ASTM B836, *Standard Specification for Compact Round Stranded Aluminum Conductors Using Single Input Wire Construction*

ASTM B901, *Standard Specification for Compressed Round Stranded Aluminum Conductors Using Single Input Wire Construction*

ASTM B902/B902M, *Standard Specification for Compressed Round Stranded Copper Conductors, Hard, Medium-Hard, or Soft Using Single Input Wire Construction*

ASTM D1248, *Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable*

ASTM D1693, *Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics*

ASTM D4703, *Standard Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets*

ASTM D2132, *Standard Test Method for Dust-and-Fog Tracking and Erosion Resistance of Electrical Insulating Materials*

ASTM D2275, *Standard Test Method for Voltage Endurance of Solid Electrical Insulating Materials Subjected to Partial Discharges (Corona) on the Surface*

ASTM D2765, *Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics*

ICEA T-32-645, *Test Method for Establishing Volume Resistivity Compatibility of Water Blocking Components with Extruded Semiconducting Shield Materials*

NFPA 70, *National Electrical Code (NEC)*

UL 486A-486B, *Wire Connectors*

UL 1581, *Reference Standard for Electrical Wires, Cables, and Flexible Cords*

UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*

UL 2556, *Wire and Cable Test Methods*

CONSTRUCTION

4 Materials

4.1 Only materials that are acceptable for the particular use shall be used in a cable.

4.2 Each material used in a cable shall be compatible with all of the other materials used in the cable.

5 General

5.1 Medium-voltage cable shall be designated as Type MV and shall comply in all respects with the applicable requirements for construction details, test performance, and markings.

CONDUCTOR(S)

6 Materials

6.1 The conductor(s) in a cable shall be of soft-annealed copper or of semi-annealed (1/2 – 3/4 hard) or hard-drawn aluminum. Soft-annealed copper wires (strands) shall comply with ASTM B 3. A metal coating that is provided on soft-annealed copper in accordance with 9.1 or 9.2 shall be of tin complying with ASTM

B 33. An aluminum conductor shall comply with the Requirements for Aluminum Conductors of an 8000 Series Alloy, Section 10 of UL 1581, or shall be of a 1/2 – 3/4 hard 1350 Series aluminum alloy having either the tensile strength required for a 1350-H19 (extra-hard) aluminum alloy in the American Society for Testing and Materials Standard Specification for Aluminum 1350-H19 Wire for Electrical Purposes, ASTM B 230, or the tensile strength required for a semi-annealed 8000 Series alloy.

6.2 An individual conductor shall not be smaller than 8 AWG (8.367 mm^2) and shall not be larger than 2000 kcmil or 113 mm^2.

7 Resistance

7.1 The direct-current resistance of any length of conductor in ohms per thousand conductor feet or in ohms per conductor kilometer shall not be higher than the maximum (nominal x 1.02) resistance indicated in the applicable table in D-C Conductor Resistance, Section 30 of UL 1581, at 20°C (68°F) or at 25°C (77°F) when measured as described in D-C Resistance, of UL 2556. If, as provided for in 11.2, metal-coated wires are used in only the outer layer of an uncoated copper conductor, the direct-current resistance of the resulting conductor shall not exceed the value tabulated for an uncoated conductor of the same size and construction. See 7.2 for cabling factors applicable to multiple-conductor cables.

7.2 In a finished multiple-conductor cable, the increased resistance of a conductor because of cabling shall not be higher than the applicable value multiplied by the following factor, with the result rounded off to the same number of decimal places as the tabulated value.

a) One layer of conductors: 1.02

b) More than one layer of conductors: 1.03

8 Conductor Diameter

8.1 The nominal, maximum (1.01 x nominal), and minimum (0.98 x nominal) diameters of solid and stranded conductors are shown in Tables 20.1, 20.2, 20.3, 20.3.1, 20.4, and 20.6 of UL 1581. Conductor diameter is to be measured using the method shown in Conductor Diameter, of UL 2556.

8.2 Compressed unilay copper conductors that are smaller in diameter than the requirement (0.98 x nominal as indicated in Table 20.3 of UL 1581) for compressed concentric-lay conductors shall be marked the same as compact conductors in accordance with 70.1(n).

9 Stranding

9.1 Each conductor shall be solid: concentric-lay-stranded (in this standard, this term includes compressed-stranded and compact-stranded), with at least the number of strands indicated in Table 9.1, or shall be rope-lay-stranded. The outer layer shall be left-hand in all cases. Copper wires (strands) smaller than 36 AWG (0.005 inch or 0.127 mm in diameter) and aluminum wires (strands) smaller than 22 AWG (0.0253 inch or 0.642 mm in diameter) shall not be used. Single Input Wire (SIW) stranded conductors shall be in accordance with ASTM B801, ASTM B835, ASTM B836, ASTM B901, or ASTM B902/B902M.

Table 9.1
Conductor stranding

Conductor size	Number of strands in combination unilay	Minimum number of strands	
		Compact stranded	All others
8 AWG	19[a]	7	7
7	–	7	7
6 – 2	19	7	7
1 – 4/0	19	18	19
213 – 500 kcmil	–	35	37
501 – 1000	–	58	61
1001 – 1500	–	–	91
1501 – 2000	–	–	127

[a] Copper only

[b] Conductors with a lesser number of strands shall be permitted based on the results of an investigation which shall include testing for connectability and bending.

NOTE: Single Input Wire (SIW) Stranded conductors shall meet the minimum number of wires as defined in the applicable ASTM standard.

9.2 A compact-stranded conductor shall be a round conductor consisting of a central core wire (one or more strands) surrounded by one or more layers of helically laid (strands). A compact-stranded copper conductor shall consist of uncoated strands. Compact-stranded aluminum conductor and compact-stranded copper conductor shall have all layers with the same direction of lay (unidirectional) or shall have the direction of lay reversed in adjacent layers (concentric-lay-stranded). Each layer shall be rolled, drawn, or otherwise compressively formed to change the originally round strands to various close-fitting shapes that achieve almost complete filling of the spaces originally present between the strands. Each compacted layer – including the outermost layer – shall have a smooth, round outer surface. The length of lay of the strands in the outer layer of a 1 AWG – 1000 kcmil conductor shall be 8 – 16 times the overall diameter of that layer. The length of lay of the strands in the outer layer of an 8 – 2 AWG conductor shall be 8.0 – 17.5 times the overall diameter of that layer. A compact-stranded conductor shall not be segmented.

9.3 A compressed-stranded conductor shall be a round conductor consisting of a central core wire (one or more strands) surrounded by one or more layers of helically laid (strands) having the unilay construction, the unidirectional lay construction, or with the direction of lay reversed in successive layers. The strands of one or more layers shall be slightly compressed by rolling, drawing, or other means to change the originally round strands to various shapes that achieve filling of some of the spaces originally present between the strands.

9.4 A 19-wire combination round-wire unilay-stranded soft-annealed copper or an acceptable aluminum alloy conductor shall be round and shall consist of a straight central wire, an inner layer of six wires of the same diameter as the central wire with the six wires having identical lengths of lay, and an outer layer consisting of six wires of the same diameter as the central wire alternated with six smaller wires having a diameter of 0.732 times the diameter of the central wire and with all twelve wires of the outer layer having the same length of lay and direction of lay as the six wires of the inner layer.

9.5 Concentric-lay-stranded coated or uncoated annealed copper conductors (including compressed conductors) shall comply with the applicable parts of ASTM B 8. Compact round concentric-lay-stranded uncoated copper conductors shall comply with the applicable parts of ASTM B 496.

9.6 Concentric-lay-stranded aluminum conductors (including compressed conductors) shall comply with the applicable parts of ASTM B 231. Compact stranded aluminum shall comply with the applicable parts of ASTM B 400.

9.7 The length of lay in only the outer layer of a 1 AWG – 1000 kcmil round compact-stranded conductor shall neither be less than 8 nor more than 16 times the overall diameter of that layer. The length of lay of the strands in the outer layer of a 8 – 2 AWG compact-stranded conductor shall be 8.0 – 17.5 times the overall diameter of that layer. The direction of lay of the outer layer shall be left-hand.

9.8 Every stranded conductor other than a compact-stranded conductor or single input wire conductor shall comply with the following:

a) The direction of lay of the strands, members, or ropes in a 6 AWG – 2000 kcmil conductor other than a combination unilay, compressed unilay, or compressed unidirectional lay conductor shall be reversed in successive layers. Rope-bunched lay and rope-concentric lay conductors shall be either unidirectional or reversed.

b) For a bunch-stranded member of a rope-lay-stranded conductor in which the members are formed into rope-stranded components that are then cabled into the final conductor, the length of lay of the individual strands within each component shall not be more than 30 times the outside diameter of one of those members.

c) For a concentric-stranded member of a rope-lay-stranded conductor, the length of lay of the individual strands in a member shall be 8 – 16 times the outside diameter of the member. The direction of lay of the strands in each member shall be reversed in successive layers of the member.

d) The length of lay of the strands in both layers of a 19-wire combination round-wire unilay-stranded copper or aluminum conductor shall be 8 – 16 times the outside diameter of the completed conductor. Otherwise, the length of lay of the strands in every layer of a concentric-lay-stranded conductor consisting of fewer than 37 strands shall be 8 – 16 times the outside diameter of that layer.

e) The length of lay of the strands in the outer two layers of a concentric-lay-stranded conductor consisting of 37 or more strands shall be 8 – 16 times the outside diameter of the conductor.

f) The length of lay of the members or ropes in the outer layer of a rope-lay-stranded conductor shall be 8 – 16 times the outside diameter of that layer.

10 Strand Filler

10.1 A moisture-excluding filler material is acceptable in the interstices of the inner layers of the conductor strands for the purpose of keeping moisture from entering the cable. Such a material shall be investigated and found acceptable. The investigation shall consist of testing to determine that the material does not have a detrimental effect on either of the following:

a) The conductor stress relief layer – The test is described in ICEA T-32-645, Test Method for Establishing Volume Resistivity Compatibility of Water Blocking Components with Extruded Semiconducting Shield Materials.

b) The ability to properly terminate the cable as intended – The tests are described in the Standard for Wire Connectors, UL 486A-486B. These tests could include one or all of the following: secureness, heating, pullout, and cyclic heating.

11 Metal Coating

11.1 If the insulation or other material adjacent to a copper conductor corrodes unprotected copper in the test in 32.1, each of the individual strands of that conductor shall be separately covered with a metal coating that complies with 6.1.

11.2 In the case of a copper conductor on whose wires a coating is not needed for corrosion protection but is used, it is acceptable to coat only the wires of the outer layer (see 7.1) or to coat all of the wires. The metal coating used shall comply with 6.1.

12 Joints

12.1 A joint in one of the individual wires (strands) shall be made in a workmanlike manner, shall not change the diameter of the wire (strand) or of the overall conductor, and shall not lessen the mechanical strength or impair the flexibility of the overall conductor. A joint shall not be made in the stranded conductor as a whole but, for other than a rope-lay-stranded conductor (see 12.2) shall be made by separately joining each individual wire (strand) in a manner that does not increase the overall diameter of the entire stranded conductor. A joint in a compact-stranded or compressed-stranded conductor shall be made before compacting or compressing. A joint in any conductor shall be made before the conductor-stress-relief material, the insulation, and other coverings are applied.

12.2 In a rope-lay-stranded conductor consisting of a central core surrounded by one or more layers of stranded members (primary groups), each member may be considered to be equivalent to a solid wire and, as such, may be spliced as a unit. These joints are to be dispersed throughout the length of the conductor so that the diameter and configuration of the completed conductor are not substantially affected, and so that the flexibility of the completed conductor is not adversely affected thereby. In no case shall these joints be closer together than two lay lengths.

CONDUCTOR STRESS RELIEF (CONDUCTOR SHIELDING)

13 Details

13.1 Conductor stress relief shall be provided on each circuit conductor. It shall be readily removable from the conductor and shall be bonded to the insulation (the tension necessary to remove the stress relief from the insulation is not specified). The conductor stress relief used with XLPE or EPCV insulation shall be of conductive nonmetallic material. The conductor stress relief used with EP or DREP insulation shall be of either conductive or non-conductive nonmetallic material. The conductor stress relief shall comply with Table 13.1 (form), Table 13.2 (thicknesses), and Table 13.3 (material).

13.2 The thickness(es) of a conductive tape used alone, of a conductive or non-conductive extrusion used alone, or of a conductive or non-conductive extrusion plus a conductive tape are to be determined on a full cross section of the conductor shielding produced by cutting a specimen of the finished conductor through perpendicular to its longitudinal axis. All measurements are to be made over the tops of strands or at the impressions left by strands. In the case of a conductive tape used alone, the minimum thickness is to be measured directly by means of one of the following:

a) A dead-weight dial micrometer having a presser foot 0.250 ±0.010 inch or 6.4 ±0.2 mm in diameter and exerting a total of 3.0 ±0.1 ozf or 85 ±3 gf or 0.84 ±0.02 N on the specimen – the load being applied by means of a weight, or

b) An optical device that is accurate to at least 0.001 inch or 0.01 mm.

In all other cases, the minimum thicknesses are each to be measured directly by means of an optical device that is accurate to at least 0.001 inch or 0.01 mm.

13.3 The volume resistivity of the finished conductive conductor shielding taken as a unit shall comply with 44.1. The relative permittivity and the dielectric withstand stress of specimens of the non-conductive conductor stress control shall comply with 45.1.