

MIL-I-15126F

24 April 1961

SUPERSEDING

MIL-I-0015126E(SHIPS)

29 May 1959

MIL-I-15126D

15 November 1958

MILITARY SPECIFICATION
INSULATION TAPE, ELECTRICAL, PRESSURE
SENSITIVE ADHESIVE AND PRESSURE SENSITIVE
THERMOSETTING ADHESIVE

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. - This specification covers requirements for pressure-sensitive adhesive and pressure sensitive thermosetting adhesive electrical insulation tapes intended for use in construction and repair of electrical and electronic equipment.

1.2 Classification. - Pressure-sensitive adhesive, electrical insulating tape shall be of the following types, as specified (see 6.2):

Type AFT	- Acetate film backing, thermosetting adhesive.
Type ACT	- Acetate cloth backing, thermosetting adhesive.
Type CFT	- Cotton fabric backing, thermosetting adhesive.
Type GFT	- Glass fabric backing, thermosetting adhesive.
Type PCT	- Paper backing-crepe, thermosetting adhesive.
Type PFT	- Paper backing-flat, thermosetting adhesive.
Type EF-7	- Polyethylene backing - 7 mils nominal thickness of tape.
Type EF-9	- Polyethylene backing - 9 mils nominal thickness of tape.
Type EF-20	- Polyethylene backing - 20 mils nominal thickness of tape.
Type MFT-2.5	- Polyethylene terephthalate film backing, thermosetting adhesive - 2.5 mils normal thickness of tape.
Type MF-2.5	- Polyethylene terephthalate film backing - 2.5 mils nominal thickness of tape.
Type MFT-3.5	- Polyethylene terephthalate film backing, thermosetting adhesive - 3.5 mils nominal thickness of tape.

2. APPLICABLE DOCUMENTS

2.1 The following specifications and standards, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

UU-P-270	- Paper, Wrapping, Waxed (Dry).
PPP-B-566	- Boxes, Folding, Paperboard
PPP-B-585	- Boxes, Wood, Wirebound.
PPP-B-591	- Boxes, Fiberboard, Wood-Cleated.

1. For purposes of this specification the terms "thermosetting" and "heat-curing" are considered equivalent.

PPP-B-601	- Boxes, Wood, Cleated-Plywood.
PPP-B-621	- Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636	- Boxes, Fiberboard.
PPP-B-676	- Boxes, Set-Up, Paperboard.
PPP-C-96	- Cans, Metal, 28 Gage and Lighter.
PPP-T-60	- Tape, Pressure-Sensitive Adhesive.
PPP-T-76	- Tape, Pressure-Sensitive Adhesive, Paper, Water-Resistant.
PPP-T-87	- Tape, Pressure-Sensitive Adhesive, Filament Reinforced.

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MIL-P-116	- Preservation, Methods of.
MIL-I-631	- Insulation, Electrical, Synthetic-Resin Composition, Nonrigid.
MIL-Y-1140	- Yarn, Cord, Slewing, Cloth, and Tape - Glass.
MIL-B-10377	- Box, Wood, Cleated, Veneer, Paper Overlaid.
MIL-L-10547	- Liners, Case, Waterproof.

STANDARD

FEDERAL

FED-STD-175	- Adhesives: Methods of Testing.
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MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	- Marking for Shipment and Storage.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

AMERICAN SOCIETY FOR TESTING MATERIALS

A 167-58	- Specification for Corrosion Resistant Chromium Nickel Steel Plate, Sheet, and Strip.
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- D 149-55 - Methods of Test for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulation Materials at Commercial Power Frequencies (Tentative).
- D 295-58 - Methods of Testing Varnished Cotton Fabrics and Varnished Cotton Fabric Tapes Used for Electrical Insulation.
- D 1000-58 - Methods of Testing Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation (Tentative).

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.)

OFFICIAL CLASSIFICATION COMMITTEE Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

3. REQUIREMENTS

3.1 Material -

3.1.1 Backing. - The backing shall be of material, free from defects, dirt, lumps, and irregularities, and shall conform to table I.

Table I - Backing.

Type	Material	Applicable specification
AFT	Acetate film	MIL-I-631, type C
ACT	Acetate cloth	-----
CFT	Cotton fabric	-----
GFT	Glass fabric	MIL-Y-1140
PCT	Paper, crepe	-----
PFT	Paper, flat	-----
EF-7	Polyethylene	MIL-I-631, type A
EF-9	Polyethylene	MIL-I-631, type A
EF-20	Polyethylene	MIL-I-631, type A
MFT-2.5	Polyethylene terephthalate	MIL-I-631, type G
MF-2.5	Polyethylene terephthalate	MIL-I-631, type G
MFT-3.5	Polyethylene terephthalate	MIL-I-631, type G

3.1.2 Adhesive. - The adhesive used in types EF-7, EF-9, EF-20 and MF-2.5 shall be pressure sensitive and shall not require heat, moisture, or other special manner of preparation prior to supplying the tape. The adhesive used in types AFT, ACT, CFT, GFT, PCT, PFT, MFT-2.5, and MFT-3.5 shall be a pressure sensitive thermosetting, or heat-curing adhesive.

3.2 Widths. - The tape shall be furnished in the standard widths shown in table II, as specified (see 6.2).

Table II - Standard widths.

Width	Tolerance (\pm)
Inches	Inch
1/2	0.03
5/8	.03
3/4	.03
7/8	.03
1	.03
1-1/4	.03
1-1/2	.03

3.3 Rolls. -

3.3.1 Where the material is required for machine taping, the overall diameter of the roll and the mandrel diameter of the cylindrical core shall be as specified (see 6.2). (Commonly available mandrel diameters of the cylindrical core are 1 inch, 1-1/2 inches and 3 inches.) Where the material is required for application by hand (hand taping) it shall be put up in rolls over a core diameter specified in table III.

3.3.2 The tape shall be furnished in the lengths per roll shown in table III, unless otherwise specified (see 6.2).

Table III - Length per roll and core diameter.

Type	Length per roll	Core diameter
	Yards	Inches
AFT	72	3
ACT	72	3
CFT	60	3
GFT	60	1
PCT	60	3
PFT	60	3
EF-7	22	1
EF-9	18	1
EF-20	18	1
MFT-2.5	72	3
MF-2.5	72	3
MFT-3.5	72	3

3.4 Physical requirements. - When tested as specified in 4.4, the tape shall conform to table IV.

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Table IV - Physical requirements.

Type	Nominal thickness Condition C-96/23/50	Thickness tolerance (+) Condition C-96/23/50	Tensile strength (minimum average) Condi- tion C-96/23/50	Adhesion to steel (minimum average) Condi- tion C-96/23/50	Indirect electro- lytic-corrosion (maximum median) Condi- tion C-18/23/96 (1-inch width)	Dielectric breakdown: (minimum average)		Resistance to penetration at elevated tem- peratures (mini- mum average) Condi- tion C-96/23/50
						Condition C-96/23/50	Condition C-96/23/96	
	Inch	Inch	Pounds per inch width	Ounces per inch width	Micromicromhos	Volts	Volts	Degrees C.
AFT	0.0035	0.0005	15	35	15	4,500	3,500	150
ACT	.0080	.0010	30	25	200	1,500	1,000	---
CFT	.0105	.0015	40	35	2.0×10^5	1,000	500	---
GFT	.0070	.0010	120	16	2.0×10^4	1,000	500	---
PCT	.0105	.0010	15	20	2.0×10^5	1,000	500	---
PFT	.0060	.0010	30	35	2.5×10^5	1,000	500	---
EF-7	.0070	.0010	12	12	15	9,500	8,500	45
EF-9	.0090	.0015	15	18	15	12,000	11,000	45
EF-20	.0200	.0020	25	12	15	15,000	12,000	50
MFT-2.5	.0025	.0005	20	20	2	4,500	4,500	180
NIF-2.5	.0025	.0005	20	20	2	4,500	4,500	200
MFT-3.5	.0035	.0005	30	35	2	7,000	7,000	200

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3.5 Thermosetting requirements. - When tested as specified in 4.4.7 and 4.4.8, the tape shall conform to table V:

Table V - Thermosetting requirements

Type	Adhesion to backing (minimum average) Condition C-2/23/50	Adhesion to backing (minimum average) Condition E-2/130	Bond separation after cure (minimum individual)
	Ounces per inch width	Ounces per inch width	Minutes
AFT	15	40	30
GFT	40	100	30
MFT-2.5	8	25	30

3.6 Workmanship. - The process of manufacture shall be such as to assure compliance with the requirements contained herein and the referenced specifications.

3.6.1 Symmetry. - The rolls of tape shall be uniformly and symmetrically wound. There shall be no visible overlap of the edges of the tape or separations between layers.

3.6.2 Adhesive surface. - The adhesive shall be applied to the backing in a smooth and uniform coating, and the finished tape shall contain no bare spots or lumps.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Sampling for acceptance inspection. -

4.2.1 Definition of lot. - For purposes of sampling, a lot shall consist of all material of the same type, manufactured in one production run, and offered for delivery at the same time.

4.2.2 Sampling for group A inspection. - A random sample of rolls of tape shall be selected from a lot. The sample size shall be in accordance with

Standard MIL-STD-105 at Inspection Level II and at Acceptable Quality Levels (AQL) specified in table VI.

Table VI - Group A inspection.

Inspection	Requirement paragraphs	AQL	
		Major (percent)	Minor (percent)
Visual examination	3.6.1-4.3.1.1	1.0	4.0

4.2.3 Sampling for group B inspection. - Sampling for group B inspection specified in 4.3.1.2, 4.3.1.3, 4.3.1.4 and 4.3.2 shall be in accordance with Standard MIL-STD-105 at the acceptable quality levels and inspection levels specified in table VII. Samples may be taken from the sample which has passed group A inspection.

Table VII - Group B sampling.

Subgroup No.	AQL (percent)	Sampling plan ^{1/}		
		Normal	Tightened	Reduced ^{2/}
1	4.0	L-4	L-4	L-6
2	6.5	L-7	L-7	L-5
3	6.5	L-7	L-7	L-5
4	10.0	L-6	L-6	L-4

^{1/}Small-sample inspection.

^{2/}Special procedure R-1.

4.2.3.1 Disposition of samples. - Samples which have been subjected to group B inspection shall not be delivered on the contract or order.

4.2.4 Six yards of tape shall be unrolled for group A inspection, measurement of width and thickness, and examination of adhesive surface.

4.3 Acceptance inspection. -

4.3.1 Examination. -

4.3.1.1 Visual. - Sample rolls of tape selected in accordance with table VI shall be visually examined to verify compliance with 3.6.1.

4.3.1.2 Thickness. - The thickness of sample rolls selected in accordance with table VII shall be determined in accordance with ASTM Method D 1000-58. The thickness shall be reported to the nearest 0.0001 inch and shall meet the requirements of table IV.

4.3.1.3 Width. - The width of the samples selected in accordance with table VII shall be

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determined by the use of a standard steel scale graduated to read within 0.01 inch. The tape shall lie flat on a smooth surface at the time of measurement. At least 10 measurements shall be made and the average value shall be taken as the tape width and shall comply with table II.

4.3.1.4 Adhesive surface. - The unrolled sections of tape selected in accordance with table VII (see 4.2.4) shall be examined for conformance to 3.6.2.

4.3.2 Tests. - The sample rolls selected in accordance with table VII shall be subjected to the subgroup 2, 3, and 4 tests specified in table VIII.

Table VIII - Group B Inspection

Characteristic	Requirement paragraph	Inspection paragraph
<u>Subgroup 1: (All types)</u>		
Width	3.2	4.3.1.3
Thickness	3.4	4.3.1.2
Adhesive surface	3.6.2	4.3.1.4
<u>Subgroup 2: (All types)</u>		
Tensile strength	3.4	4.4.2
Adhesion to steel	3.4	4.4.3
Indirect electrolytic corrosion	3.4	4.4.4
Dielectric breakdown	3.4	4.4.5
<u>Subgroup 3: (Types AFT, GFT, MFT-2.5)</u>		
Adhesion to backing	3.5	4.4.7
Bond separation after cure	3.5	4.4.8
<u>Subgroup 4: (Types AFT, EF-7, EF-9, EF-20, MF-2.5, MFT-2.5, MFT-3.5)</u>		
Resistance to penetration at elevated temperatures	3.4	4.4.6

4.4 Test procedures. -

4.4.1 Conditioning of test specimens. -

4.4.1.1 The designations indicating conditioning of test specimens shall be as follows:

First. - A capital letter indicating the general condition of the specimen, that is, humidity conditioning and temperature conditioning.

Second. - A number indicating in hours the duration of the conditioning.

Third. - A number indicating in degrees centigrade the conditioning temperature.

Fourth. - A number indicating in percent the conditioning relative humidity.

The numbers shall be separated from each other by slant marks and from the capital letter by a hyphen.

4.4.1.2 The following letter shall be used to indicate the general conditioning:

Condition C - humidity conditioning.

Condition E - temperature conditioning.

4.4.1.3 Examples. -

Condition C-96/23/50 - The specimens shall be conditioned for a period of 96 hours at a temperature of $23^{\circ} \pm 1.1^{\circ}\text{C}$. (73.4°F .) and a relative humidity of 50 ± 2 percent.

Condition C-2/23/50 - The specimens shall be conditioned for a period of 2 hours at a temperature of $23^{\circ} \pm 1.1^{\circ}\text{C}$. (73.4°F .) and a relative humidity of 50 ± 2 percent.

Condition C-96/23/96 - The specimens shall be conditioned for a period of 96 hours at a temperature of $23^{\circ} \pm 1.1^{\circ}\text{C}$. (73.4°F .) and a relative humidity of 96 ± 1 percent. The samples shall be tested immediately after removal from the conditioning chamber.

Condition C-18/23/96 - The specimens shall be conditioned for a period of 18 hours at a temperature of $23^{\circ} \pm 1.1^{\circ}\text{C}$. (73.4°F .) and a relative humidity of 96 ± 1 percent. The samples shall be tested while in the conditioning chamber.

Condition E - 2/130 - The specimens shall be conditioned for a period of 2 hours at a temperature of $130^{\circ} \pm 2^{\circ}\text{C}$. (266°F .) in an air circulating

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oven followed by four hours cooling at $23^{\circ} \pm 1^{\circ}\text{C}$. (73.4°F .) and 50 ± 2 percent relative humidity.

4.4.1.4 Selecting test specimens. - The rolls of tape to be tested shall be placed on a freely revolving mandrel. The first three layers of tape shall be discarded from the roll. The required length of specimen shall be removed at the rate of approximately 2 inches per second. The specimen shall be placed on a smooth clean surface, adhesive side up, or suspended from one end in free air for the conditioning period, unless otherwise specified. The adhesive surface shall be protected from dust. The test specimens shall then be prepared and measured as provided for in the individual test methods and the results shall comply with the requirements of tables IV and V.

4.4.2 Tensile strength.

4.4.2.1 Apparatus. - Tensile strength shall be determined on a dead weight pendulum testing machine. The machine shall be preferably power-driven and equipped with a tension-weighting device having a maximum capacity of 250 pounds, graduated to read 1 pound or less (preferably 0.5 pound or less) per scale division.

4.4.2.2 Specimen holders. - The preferred fixture for holding the test specimens shall be two metal cylinders, 2 inches in outside diameter by approximately 1-1/2 inches long. Both cylinders shall be arranged to revolve so that the specimen can be wrapped on them and shall be equipped with a locking device to prevent revolving during test. The fixture shall be offset on each head of the machine to provide alignment of the periphery of each cylinder with the center axis of the tensile machine.

4.4.2.3 Procedure. - Test specimens shall be held in place for test by smoothly wrapping the specimen 270 degrees around each cylinder, with the adhesive side of the specimen toward each cylinder. The length of the specimen between tangent points on the cylinders shall be 5 plus or minus 1/4 inches. The rate of jaw separation shall be constant and shall be 12 inches per minute. All breaks obtained at point of fixture contact shall be rejected. In the case of high elongation materials such as types EF-7, EF-9, and EF-20, 1/2-inch dumbbell, die-cut specimens with bench marks 2 inches apart may be used. The tensile strength in pounds per inch width shall be determined from the average of 10 readings.

4.4.3 Adhesion to steel.

4.4.3.1 Apparatus.

4.4.3.1.1 Testing machine. - The testing machine shall be similar to that described in method 1041, of Standard FED-STD-175 with at least a 10-inch jaw separation, a preferable working range of 0 to 10 pounds, with readings in 0.1 pound increments or less, and the speed of the pulling clamp shall be 12.0 ± 0.5 inches per minute.

4.4.3.1.2 Steel strip. - A cold rolled corrosion resisting steel strip, (ASTM Standard Designation A167, type 302 or 304), 1/16 inch by 2 inches by 5 inches, finished to a surface roughness of not more than 20 nor less than 10 microinches as measured by a surfindicator or equivalent surface measuring device shall provide a rigid base for testing adhesion of tape. Plates shall be polished lengthwise with a number 150 grit belt and measurements taken crosswise. One-quarter inch scribe marks shall be placed on one edge of the plates at 1/2 inch intervals.

4.4.3.1.3 Roller. - The steel roller required shall be approximately 3.25 inches ± 0.1 inch in diameter, by 1.75 ± 0.05 inches in width, covered with rubber approximately 1/4 inch thick, having a durometer hardness of 80 ± 5 . The weight of the complete assembly shall be 4.5 ± 0.1 pounds which is controlled by the original diameter of the steel roller.

4.4.3.2 Specimen. - The test specimen shall be 10 inches in length and not over 1 inch in width. The specimen shall be removed from the roll in order that neither surface contacts either the fingers or any other foreign object. The test specimen shall be removed at a 90-degree pull-off angle at a rate of approximately 2 inches per second.

4.4.3.3 Procedure. - The polished surface on the steel plate shall be prepared by washing thoroughly with n-heptane, trichloroethylene, or other suitable solvent, using a clean piece of lintless wiping tissue for each washing. After all traces of the solvent have evaporated, the surface shall be wiped with a clean dry piece of the tissue. Immediately after removing the specimen from the roll, the specimen shall be placed on the steel plate adhesive side down so that a 5-inch length extends beyond one end of the plate. In the case of tapes of less than 1 inch width, another strip shall be cut from the same sample roll and the strip shall be of such width that it shall be placed alongside the full width of tape on the steel plate and the total width of tape shall be one inch. The roller shall then be passed over the tape specimen, once in each direction, at a rate of approximately 2 inches per second, without application of pressure other than that due to the weight of the roller. The 5-inch length of tape which extends beyond the steel plate may have its adhesive side covered with pumice powder, talc, or a strip of paper in order

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to prevent adhesion during the rolling. The narrow strip added to make up the 1-inch width shall then be removed and discarded. After the tape specimen has remained on the plate for 20 ± 5 minutes, the free end of the tape shall be doubled back at an angle of 180 degrees and pulled back so that one inch of tape shall be peeled off the plate. This portion of the exposed plate shall be clamped in the lower jaw and the free end of the tape shall be clamped in the upper jaw of the testing machine. The driven jaw of the testing machine shall move at a rate of 12 ± 0.5 inches per minute. The pawls of the testing machine, if of the pendulum type, shall be disengaged to provide a free swinging pendulum during test. After the first inch of tape is pulled from the plate, five readings shall be taken at approximately one-half inch intervals and averaged. No reading shall be taken during the removal of the last inch of tape from the plate.

4.4.4 Indirect electrolytic corrosion. -

4.4.4.1 Apparatus. -

4.4.4.1.1 Electrodes. - The electrodes shall be 1/4 inch square brass or copper rods having the side in contact with the tape polished smooth and flat and the corners slightly rounded. The electrodes shall be mounted in such a way that the tape under test will be clamped between pairs spaced one inch edge-to-edge and shall be guarded so that only the current flowing along the tape will be measured.

4.4.4.1.2 Measuring equipment. - The measuring equipment shall consist of a source of reasonably constant direct current (d.c.) voltage within the range 100 to 130 volts and a means of measuring currents ranging from 0.001 to 1000 microamperes. Dry cells or shop lines are satisfactory voltage sources. A galvanometer having a sensitivity of 0.001 microampere per one millimeter deflection and equipped with an Ayrton shunt is satisfactory for measuring the current. A d.c. conductance bridge or any other conductance or resistance measuring instrument which will impress the required voltage on the sample and cover the required conductance range is also satisfactory.

4.4.4.2 Procedure. - The surface of the electrodes in contact with the tape shall be polished and cleaned before each test. A satisfactory method is to polish with number 0 emery polishing paper, rinse in acetone and then wipe with cleaning tissue. Strips of tapes, not exceeding 1 inch in width, shall be tested. The section placed between the electrodes shall not be touched by the hands. The bar electrodes shall be evenly and firmly clamped over the tape. The tape mounted in the electrodes shall be conditioned 18 hours at a relative humidity of 96 ± 2 percent at 23°C . At the end of the conditioning period, the conductance of the tape, between each

adjacent pair of electrodes, shall be measured while still in the humidity chamber. Readings shall be taken 1 minute after impressing 100 to 130 volts d.c. between the electrodes. Ten specimens shall be tested and the median conductance in micromicrohmohms reported calculated to one inch width. Conductance is assumed to be proportional to width.

4.4.5 Dielectric breakdown. -

4.4.5.1 Any well designed, high-tension transformer connected to an alternating-current supply, conforming to ASTM method of test D 149-55, may be used. The transformer and the source of supply of energy shall be not less than 2 kilovolts amperes (KVA). The frequency shall not exceed 100 cycles per second. Regulation shall be so controlled that the high-tension testing voltage taken from the secondary of the testing transformer can be raised gradually from any point, and in no case more than 500 volts at a step. The control may be made by generator field regulation, with an induction regulator, or with a variable ratio autotransformer. Any method of regulating the voltage conforming to ASTM method of test D 149-55 will be satisfactory.

4.4.5.2 The voltage may be measured by a satisfactory method which will give root mean-square value, preferably by means of a voltmeter connected to a well designed tertiary coil in the testing transformer, or to a separate step-down transformer. The electrodes shall be opposing cylindrical rods 1/4 inch in diameter with edges rounded to a radius of 1/32 inch. The upper movable electrode shall weigh 0.1 ± 0.005 pound.

4.4.5.3 For the tests it is necessary to use a special form of testing device with 1/4 inch-diameter electrodes, whereby the test specimen shall be clamped under pressure in order to prevent flashover around the edges of the material. (Note. - Two forms of these testers are described in the appendix to ASTM methods of test D-295.) The test specimens may be of any sufficient size that will prevent flashover. The total area of the specimens of each sample of material subjected to Conditions C-96/23/50 and C-96/23/96 shall be sufficient to permit making 10 tests after each condition. The tests shall be made with the specimens in air at the conditioning temperature.

4.4.5.4 Tests shall be made by the short-time test method on a single tape with the adhesive side down. Special attention should be given to keeping the electrodes clean. Starting at zero, the voltage shall be increased uniformly to breakdown at a rate of 500 volts per second. Ten tests shall be made for each condition and the average of these 10 readings in volts shall be taken as the average dielectric breakdown of the sample.

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4.4.6 Resistance to penetration at elevated temperature. -

4.4.6.1 Apparatus. - The apparatus shall consist of an oven capable of raising the temperature of a 4-inch long by 1-1/4 inch wide by 1/8-inch thick corrosion-resistance steel plate at the rate of 1°C. per 2 minutes; a 1/16-inch magnetized steel rod, recessed at one end to hold a 1/16-inch ball bearing, in contact with and equipped to exert a pressure of 1000 grams vertically down against the corrosion-resisting steel plate, lying in a horizontal plane; an electric circuit with a 110-volt source of electricity; a 110-volt glow lamp; and a suitable means of measuring the temperature of the steel plate as near the point of test application as is practicable. The use of a thermocouple to measure this temperature is suggested. A penetration tester as shown on figure 1 is recommended. The light C-clamp, containing the steel rod, counterbalance, and weight, shall be mounted on a bearing capable of giving the unit the necessary freedom of clockwise motion. With no load on lower leg of C-clamp, the counterbalance shall consist of a rider capable of being adjusted to neutralize the pressure of the ball bearing against the steel plate.

4.4.6.2 Specimens. - After subjecting the rolls of tape to Condition C-96/23/50, five 1-inch-long specimens shall be cut from the roll and prepared for test.

4.4.6.3 Procedure. - With no load on rod, each specimen shall be inserted between steel ball and steel plate with adhesive side in contact with the plate. The electric circuit shall be connected in such a way that when the steel ball comes in contact with the plate the lamp contained outside the oven shall light. The specimen in the oven at room temperature shall then be put under a compression load of 1000 grams. The temperature of the steel plate shall be uniformly raised at the rate of 1°C. per 2 minutes until failure of specimen is indicated by current flowing through the circuit. The average temperature at failure shall be reported in degrees centigrade.

4.4.7 Adhesion to backing. -

4.4.7.1 Apparatus. - A device as shown on figure 2 shall consist of a removable stainless steel drum 2.25 inches in diameter, mounted on frictionless bearings in a yoke suitable for clamping in the lower jaw of a cross head tensile testing machine. The drum shall be finished in the circumferential direction with a 150 grit dry silicon carbide paper, and when mounted on bearings its center shall be in a vertical plane with the upper jaw of the tensile machine.

4.4.7.2 Procedure. - Three turns of the flexible cord shall be wound in the groove at the side of the drum and the end attached to the upper jaw of the tensile tester. A 20-inch length of the tape shall be affixed to the top of the drum, in an opposite direction to the cord winding, and a weight shall then be suspended from its lower end to provide a tension of 8 pounds per inch width. The tensile machine shall be started and two complete turns of the tape shall be thus wound upon the drum at a speed of 12 inches per minute. The specimen consists of one layer of tape adhering to the steel drum and a second layer superimposed on the backing of the first. The machine shall then be stopped and the weight left suspended for one minute before removal. Prepared specimens shall be stored for 2 hours at $23 \pm 1.1^\circ\text{C}$. and at 50 ± 2 percent relative humidity, and duplicate specimens shall be placed in $130^\circ \pm 2^\circ\text{C}$. ovens for 2 hours, removed and cooled for 4 hours at $23 \pm 1.1^\circ\text{C}$. and 50 ± 2 percent relative humidity. Specimens shall then be placed in turn in the yoke, clamped in the lower jaw of the tensile strength machine. The free end of the tape shall be clamped in the upper jaw and it shall be pulled off at the rate of 12 inches per minute and adhesion to backing recorded at 90 degrees to the drum. The recorded reading shall be averaged.

4.4.8 Bond separation after cure. -

4.4.8.1 Specimens. - Six-inch long strips shall be removed from the roll in accordance with 4.4.1.4 so that the adhesive surface contacts neither the fingers or any foreign object. Each specimen shall consist of two strips from the same roll fastened together to form a single 1/2 inch long adhesive-to-backing lap joint. A rubber-covered steel roller, as described in 4.4.3.1.3, without application of additional pressure, shall then be passed over the lapped joint once in each lengthwise direction. The specimen shall be cut to 1/2 inch width with a sharp razor blade. A weight shall be attached to the lower end of each specimen by doubling the tape back about 2 inches with adhesive sides in contact. A weight of 500 grams shall be used on types AFT and MFT-2.5 tapes and a weight of 1000 grams shall be used on type GFT tape. Three assemblies of adhesive-to-backing specimens shall be placed on the shelf of an oven maintained at $130 \pm 2^\circ\text{C}$. for 2 hours with no stress on the bond. The assemblies shall then be removed from the oven, and allowed to cool at $23 \pm 1.1^\circ\text{C}$. for 5 minutes. The specimens shall then be hung vertically in the oven at $130 \pm 2^\circ\text{C}$. with the weights freely suspended by the tapes for 30 minutes or until failure occurs by bond separation whichever occurs first. If failure occurs in less than 30 minutes, the time shall be recorded.

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4.5 Inspection of preparation for delivery. - Sample packages and packs shall be selected and inspected in accordance with Specification MIL-P-116 to verify conformance to the requirements of section 5 herein.

5. PREPARATION FOR DELIVERY

5.1 Packaging. -

5.1.1 Level A. -

5.1.1.1 Single packaging. - Each roll shall be individually packaged in a metal, fiber or plastic container. The container shall meet the test requirements of method 1A of Specification MIL-P-116. The roll shall be held in position within the container in such a way as to prevent the outside laps of the rolls from contacting the sides of the container. (This may be accomplished by either an inside or outside centering device such as a tube, concentric ring, etc.)

5.1.1.2 Multiple packaging. - The number of identical rolls, specified by the procuring activity (see 6.2) shall be packaged in a curved edge, slip cover metal can, conforming to Specification PPP-C-96, type VI. Exterior plan B coating will be required. Wax paper conforming to Specification UU-P-270, type II, class 3, shall be used as separators between each roll and at top and bottom of the container. The slip cover metal can shall be sealed with tape conforming to Specification PPP-T-60, type III, class 2 or 3.

5.1.1.3 Intermediate packaging. - Single rolls packaged as specified in 5.1.1, quantity as specified in contract or order (see 6.2), shall be intermediate packaged in paperboard or fiber boxes conforming to Specification PPP-B-566, PPP-B-676, or PPP-B-636, respectively, at the option of the contractor. Box closure shall be as specified in the applicable box specification or appendix thereto. The gross weight of paperboard containers shall not exceed 10 pounds; fiber boxes shall not exceed 20 pounds. When specified (see 6.2), tape, multiple packages as specified in 5.1.1.2 shall be intermediate packaged in fiber boxes conforming to Specification PPP-B-636. Box closure shall be as specified in the box specification or appendix thereto. Gross weight shall not exceed 20 pounds.

5.1.2 Level C. - Tape shall be packaged to conform to the manufacturer's commercial practice.

5.2 Packing. -

5.2.1 Level A. Tape, packaged as specified (see 6.2), shall be packed in overseas type, wood-created fiberboard, nailed wood, wirebound wood,

fiber, wood-created veneer paper overlaid, or wood-created plywood boxes conforming to Specification PPP-B-591, PPP-B-621, PPP-B-585, PPP-B-636 (class 3), MIL-B-10377, or PPP-B-601, respectively at the option of the contractor. Shipping containers shall have case liners conforming to Specification MIL-L-10547. Case liners shall be closed and sealed in accordance with the appendix to Specification MIL-L-10547. Case liners for boxes conforming to Specification PPP-B-636 may be omitted provided all joints and corners of the boxes are sealed with minimum 1-1/2 inch wide tape conforming to Specification PPP-T-76. Boxes shall be closed and strapped in accordance with the applicable box specification or appendix thereto, except fiber boxes may be banded with tape conforming to type IV of Specification PPP-T-97 and the appendix thereto. The gross weight of wood or wood-created boxes shall not exceed 200 pounds. Fiber boxes shall not exceed the weight limitations of the applicable box specification. Intermediate fiber containers conforming to class 2 or 3 of Specification PPP-B-636, closed, sealed and banded as specified herein, and used as the shipping containers need not be overpacked.

5.2.2 Level B. - Tape, packaged as specified (see 6.2), shall be packed in domestic type wood-created fiberboard, nailed wood, wirebound wood, created plywood, or wood-created veneer paper overlaid boxes or class 2 fiber boxes conforming to Specification PPP-B-591, PPP-B-621, PPP-B-585, PPP-B-601, MIL-B-10377 or PPP-B-636, respectively, at the option of the contractor. Box closures shall be as specified in the applicable box specification or appendix thereto, except strapping of class 2 of Specification PPP-B-636 fiber boxes shall not be required. The gross weight of wood or wood-created boxes shall not exceed 200 pounds; fiber boxes shall not exceed the weight limitations of the applicable box specification. Intermediate fiber containers, conforming to Specification PPP-B-636, closed, as specified herein and used as the shipping containers, shall not be overpacked.

5.2.3 Level C. - Tape, packaged as specified (see 6.2), shall be packed in containers which will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply with the Uniform Freight Classification Rules or other regulations as applicable to the mode of transportation.

5.3 Marking. - In addition to any special marking required by the contract or order or herein, interior and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129.

5.3.1 Special marking. - In addition to the marking requirements specified above, each unit

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and intermediate package shall be marked with the month and year of manufacture. Exterior shipping container shall be marked on two opposite sides with the following:

"Store in cool dry place.

Do not remove contents until ready for use."

6. NOTES

6.1 Intended use.

6.1.1 Type AFT is used for internal coil applications and other uses requiring high dielectric strength, good insulation resistance and good moisture resistance.

6.1.2 Type ACT is used in all types of fine wire coils and transformers where good strength characteristics, fine electrical properties and noncorrosiveness are desired.

6.1.3 Type CFT is used for small motors, dynamotor armatures, generators and transformer coils where good varnish penetration and high tensile strength are desired.

6.1.4 Type GFT is used in high heat locations where other adhesive tapes cannot be used.

6.1.5 Types PCT and PFT are used for motor insulating, coil winding, repair of electric motors and reinforcing slot insulation.

6.1.6 Types EF-7, EF-9, and EF-20 are used where high dielectric strength and non-corrosiveness are desired.

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6.1.7 Types MFT-2.5, MF-2.5, and MFT-3.5 are suitable for internal coil applications and other uses requiring high dielectric strength, good insulation and moisture resistance. They are suitable for use at higher temperatures than type AFT.

6.2 Ordering data. - Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type required (see 1.2).
- (c) Width required (see 3.2).
- (d) If required for machine taping, the overall diameter of roll and the mandrel diameter of the cylindrical core; if required for application by hand (hand taping), the inside diameter of the cylindrical core (see 3.3.1 and 3.3.2).
- (e) The length per roll, if other than specified in 3.3.2.
- (f) Level of packaging and packing required (see 5.1 and 5.2).

Notice. - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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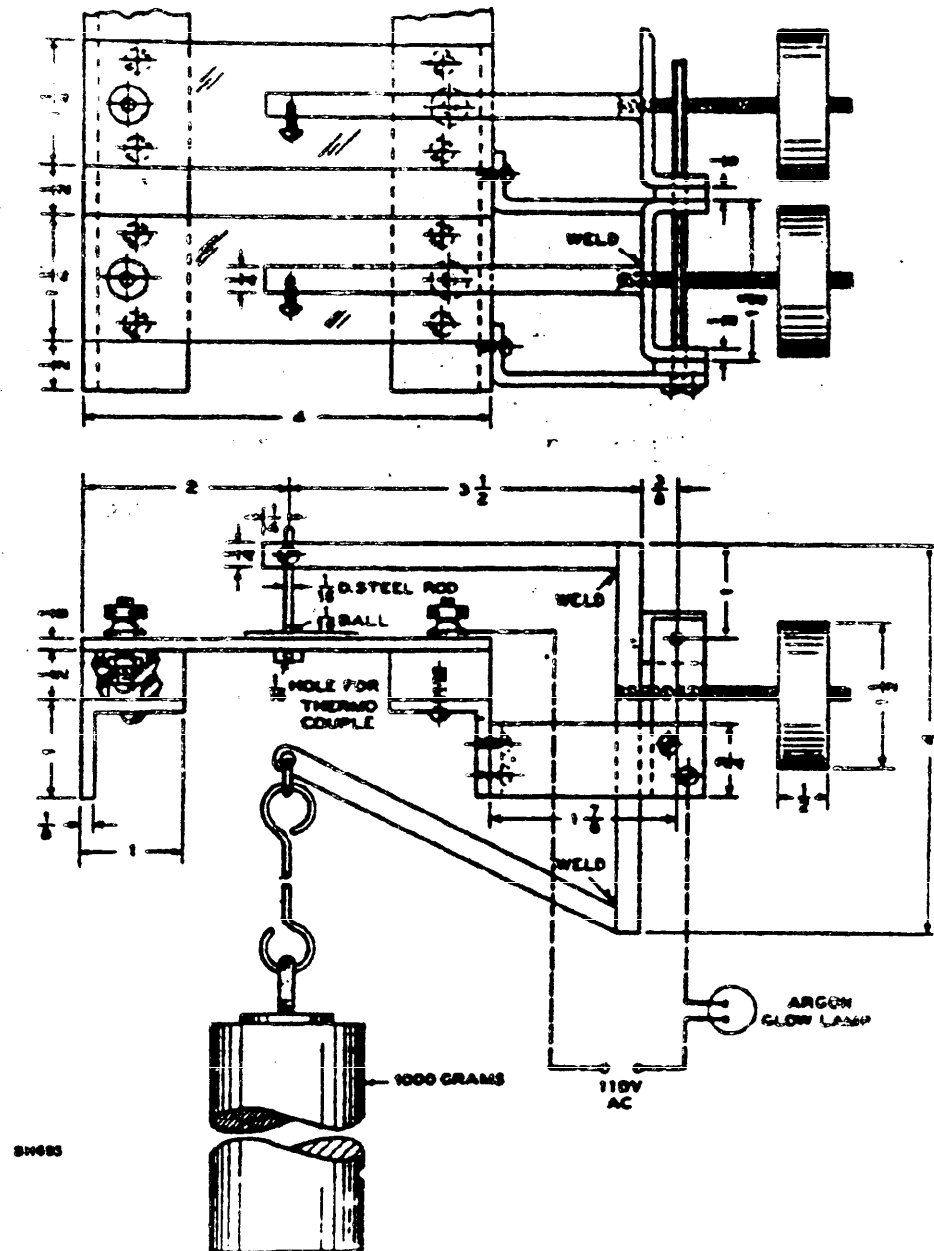


Figure 1 - Penetration tester.

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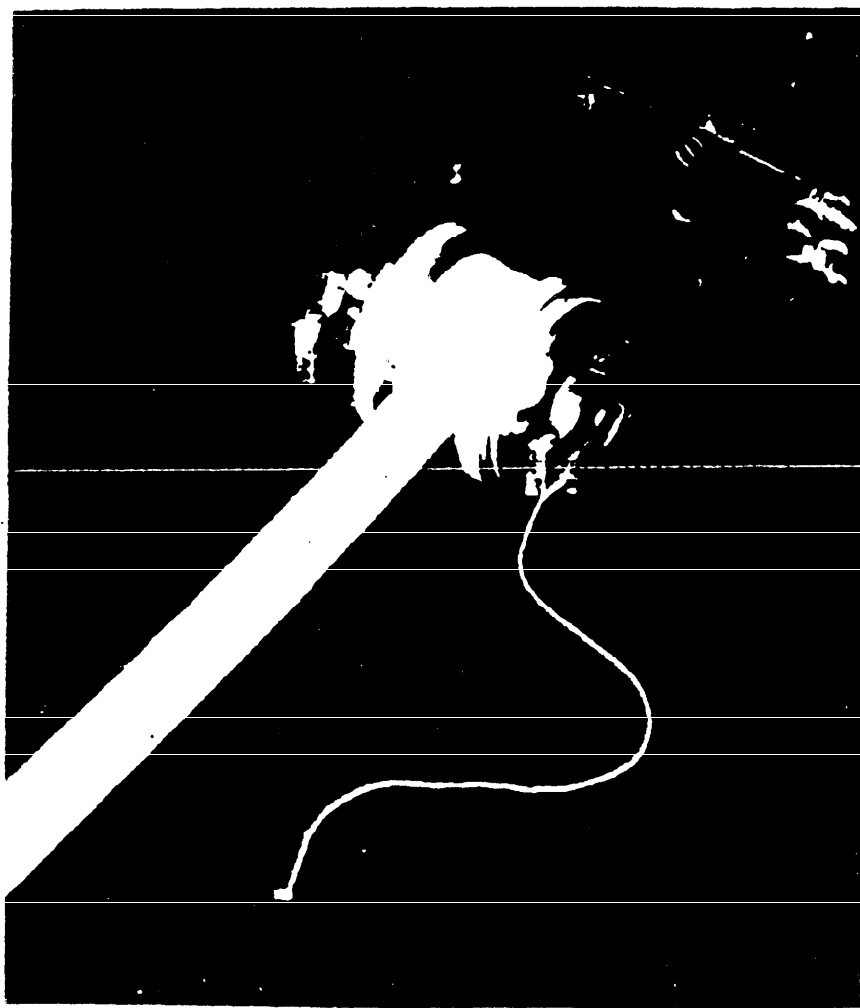


Figure 2 - Unwinding equipment (adhesion to backing).

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