



Standard Specification for Electrical Insulating Varnishes¹

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1. Scope

1.1 This specification lists the tests and values for electrical insulating varnishes suitable for the impregnation and treatment of electrical coils and windings applied by dip process.

1.2 Varnishes, flexible or rigid, included in this specification are:

Grade DA—Air-dry

Grade DO—Organic solvent containing, baking,

Grade DM—Reactive diluent containing,

Grade DS—Silicone,

Grade DW—Water containing, and

Grade DT—Thixotropic.

1.3 The values stated in inch-pound units are the standard.

NOTE 1—This specification resembles IEC 455 in title only. The content is significantly different.

2. Referenced Documents

2.1 ASTM Standards:

D 93 Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester²

D 115 Test Methods for Varnishes Used for Electrical Insulation³

D 1711 Terminology Relating to Electrical Insulation³

D 2519 Test Method for Bond Strength of Electrical Insulating Varnishes by the Helical Coil Test⁴

D 3056 Test Method for Gel Time of Solventless Varnishes⁴

D 3145 Test Method for Thermal Endurance of Electrical Insulating Varnishes by the Helical Coil Method⁴

D 3251 Test Method for Thermal-Aging Characteristics of Electrical Insulating Varnishes Applied over Film-Insulated Magnet Wire⁴

D 3278 Test Methods for Flash Point of Liquids by Set-

aflash Closed-Cup Apparatus⁵

D 4733 Test Methods for Solventless Electrical Insulating Varnishes⁴

D 4880 Test Method for Salt Water Proofness of Insulating Varnishes Over Enamelled Magnet Wire⁴

D 5637 Test Method for Moisture Resistance of Electrical Insulation Varnishes⁴

D 5638 Test Method for Chemical Resistance of Electrical Insulation Varnishes⁴

2.2 Military Specifications:⁶

MIL-H-17672 Hydraulic Fluid, Petroleum, Inhibited

MIL-L-17331 Lubricating Oil, Synthetic Base P-D-680, Dry Cleaning Solvent

MIL-D-16791 Detergent, General Purpose, (Liquid, Non-Ionic)

2.3 Nema Standard:

MW1000—Magnet Wire⁶

3. Terminology

3.1 *Definitions:* —For definitions of terms used in this specification refer to Terminology D 1711.

4. Flexible or Rigid Classification

4.1 This specification covers both flexible and rigid, solvent (including water) and solventless insulating varnishes.

5. Thermal Classification

5.1 The thermal classification of insulating varnishes covered by this specification is determined by using Test Methods D 3145 and D 3251 in conjunction with 18 awg magnet wire conforming to MW35C and MW16C in accordance with NEMA MW1000. Determine the temperature index at 20 000 h.

5.2 The thermal class is determined from the temperature index range as follows:

Thermal Class	Temperature Index Range
130	130.0 to 154.9
155	155.0 to 179.9

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ *Annual Book of ASTM Standards*, Vol 10.01.

⁴ *Annual Book of ASTM Standards*, Vol 10.02.

⁵ *Annual Book of ASTM Standards*, Vol 06.01.

⁶ Available from Global Engineering Documents, 15 Inverness Way East, Englewood CO 80112.

180	180.0 to 199.9
200	200.0 to 219.9
220	220.0 and above

6. General Specifications and Qualification Requirements

6.1 All varnishes supplied under this specification must conform to the limits outlined in Table 1, and must meet, or exceed, all specification requirements.

6.2 A varnish supplied under this specification is to be manufactured from one specific formula and one specific process at one or more plants of the same company.

6.3 Changes involved solely with percent nonvolatile content or compatible solvent system, do not require requalification, if agreed upon between supplier and purchaser.

6.4 If any formula or process changes are desired after qualification approval has been granted, conduct the tests in Table 1, except for thermal class.

6.5 If varnishes from different suppliers are to be mixed or used in a common tank or container, determine their compat-

ibility by Test Methods D 115. They must be compatible, both in the liquid and solid state, with the varnish currently being used in the system.

6.6 Varnishes containing silicone in any portion, must not be mixed with non-silicone varnishes.

6.7 The qualification requirements of the varnish shall be as mutually agreed upon between supplier and purchaser, with tests to be performed in accordance with the appropriate methods, and limits as shown in Table 1.

6.8 *Preconditioning: Grade DA Varnishes Only*—Precondition all Grade DA varnish specimens, both flexible and rigid, in air at room temperature for seven days prior to carrying out dielectric strength and bond strength tests shown in Table 1.

7. Safety Precautions

7.1 It is unsafe to use varnish at temperatures above the flash point without adequate ventilation, especially if the

TABLE 1 Specification Requirements

Class	Grade Type of magnet wire over which varnish is applied	ASTM Test Method	Minimum Thermal Class					
			DA	DO	DM	DS	DW	DT
130	MW35C and MW16C	D 3251 and D3145	Class 130 for both wire types and both test methods					
155	MW35C and MW16C	D 3251 and D3145	Class 155 for both wire types and both test methods					
180	MW35C and MW16C	D 3251 and D3145	Class 180 for both wire types and both test methods					
200	MW35C and MW16C	D 3251 and D3145	Class 200 for both wire types and both test methods					
220	MW35C and MW16C	D 3251 and D3145	Class 220 for both wire types and both test methods					
Dielectric strength, V/mil, min, on metal panels		D 115/D 4733						
24/23/50			1500	2000	1500	1800	2000	1500
24/23/96			975	1500	1125	1350	1500	1125
24/23/water			900	1500	1125	1350	1500	1125
Bond strength (minimum pounds) over 18AWG MW16C or MW35C		D 2519						
Flexible at 25°C/150°C			5/0	10/1	10/1	6/0.5	20/1	15/2
Rigid at 25°C/150°C			NA ^A	20/3	25/4	NA	25/3	30/5
Salt water proofness over MW35C or MW16C		D 4880	100 ^B	100 ^B	100 ^B	100 ^B	100 ^B	100 ^B
Moisture resistance percent retained, min		D 5637	50	50	50	50	50	50
Chemical resistance minimum percent retained after 168 h at 23°C		D 5638						
Hydraulic fluid ^C			50	50	50	50	50	50
Lubricating oil ^D			50	50	50	50	50	50
Cleaning fluid ^E			50	50	50	50	50	50
Distilled water			50	50	50	50	50	50
Detergent solution ^F			50	50	50	50	50	50
Storage life, months min ^G			12	12	6	6	6	6
Viscosity (cps at 25°C)		D 115/D 4733	80–1200	100–1200	100–1300	80–240	100–1300	15 000 ^H 5000 ^I
Thixotropic index, min		D 4733	NA	NA	NA	NA	NA	1.1
% Nonvolatile matter, min		D 115	30	40	NA	40	35	NA
Variation in specific gravity/density (% of reported value)		D 115/D 4733	±1.0	±1.0	±1.0	±1.0	±1.0	±1.0
Build as received (mils, min)		D 115/D 4733	0.9	0.9	0.3	0.5	0.8	1.1
Flash point (°C, min)		D 93/D 3278	23 ^J	23 ^J	93 ^J	23 ^J	90 ^J	93 ^J
Drying time (h at °C) max		D 115	3 at 110	2 at 150	NA	6 at 200	2 at 150	NA
Variation in gel time (% of reported value)		D 3056	NA	NA	±10.0	NA	NA	±10.0

^ANot applicable.

^BPassing is defined as 7 of 9 specimens still passing at specified time.

^CIn accordance with MIL-H-17672.

^DIn accordance with MIL-L-17331.

^EIn accordance with P-D-680[1,1,2-trichloro 1,2,2-trifluoroethane].

^FDetergent per MIL-D-16791, non-ionic detergent (1 lb per 2¼gal water).

^GAs warranted by the manufacturer.

^HMaximum at 2 r/min.

^IMaximum at 20 r/min.

^Jor as agreed to by manufacturer and user.

possibility exists that flames or sparks are present. Store varnish in sealed containers.

8. Sampling

8.1 Obtain varnish samples and appropriate thinner either from the manufacturer or directly from shipping containers supplied from the manufacturer. Suitable samples may also be obtained from material in process. It is important that new, or thoroughly cleaned sampling containers be used. The sample may be obtained by any of a number of procedures commonly used in the industry. Normally, the sample is simply poured from the shipping container. The sample container should have a tight fitting cover to minimize the loss of solvents. A dipping ladle may be used, or, if it is desirable to obtain a sample from various levels, use appropriate sampling techniques.

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8.2 The quantity of sample is that required as indicated in 9.1.

9. Quality Conformance Tests

9.1 *General Requirements*—From each batch of varnish, take a 2-qt, or 2-L sample and test. The values must meet the limits listed for specification requirements shown in Table 1, or as agreed upon between supplier and purchaser.

9.2 *Inspection and Preparation for Delivery*—Select samples and inspect to verify conformance with the requirements in Section 6 of this specification.

10. Keywords

10.1 varnish, air-dry; varnish, electrical; varnish, silicone; varnish, solvent containing; varnish, water containing; varnish, thixotropic