Designation: D4881 – 05 (Reapproved 2012)

Standard Test Method for Thermal Endurance of Varnished Fibrous- or Film-Wrapped Magnet Wire[1]

This standard is issued under the fixed designation D4881; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of thermal endurance of rectangular and square fibrous- or film-wrapped magnet wire coated with an insulating varnish.

1.2 The values given in SI units are the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* A specific precautionary statement is given in Section 5.

NOTE 1—There is no similar or equivalent IEC Standard.

2. Referenced Document

2.1 *ASTM Standards:*[2]

D1711 Terminology Relating to Electrical Insulation

D2307 Test Method for Thermal Endurance of Film-Insulated Round Magnet Wire

D3353 Test Methods for Fibrous-Insulated Magnet Wire

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *varnish, electrical insulating, n*— a liquid resin system that is applied to and cured on electrical components providing electrical, mechanical, and environmental protection.

3.1.1.1 *Discussion*—There are two types of electrical insulating varnishes: solvent-containing and solventless. Solvent-containing types are solutions, dispersions, or emulsions of a polymer or a mixture of polymers in a volatile, nonreactable liquid. Solventless types are liquid resin systems free of volatile, nonreactable solvents.

3.1.2 Refer to Terminology D1711 for definitions of other terms.

4. Significance and Use

4.1 Individual varnishes behave differently when applied to the same fibrous- or film-wrapped magnet wire when exposed to elevated temperatures. Likewise, a varnish does not always behave the same when applied to different types of fibrous or film-wrapped magnet wires and when exposed to elevated temperatures.

5. Safety Precautions

5.1 It is unsafe to use varnish at temperatures above the flash point without adequate ventilation, especially if the possibility exists that flames or sparks are present. Store varnish in sealed containers.

6. Test Specimens

6.1 *Construction of Test Specimens:*

6.1.1 Cut two 250-mm (10-in.) lengths of wire for each specimen to be made.

6.1.2 Determine the thickness dimensions per Test Method D3353.

6.1.3 Form each length in a fixture as shown in Fig. 1.

6.1.4 Prepare a test specimen by placing the two formed wires together back to back and wrap tightly with a minimum of 6 turns of glass yarn over the middle 6-in. (150-mm) section. The glass yarn shall have a gap between turns and there must be intimate contact of the two wires.

6.1.5 Prepare ten specimens for each test temperature.

6.2 *Varnishing the Test Specimens:*

6.2.1 Adjust the consistency of a solvent-containing varnish to give a 0.025 ± 0.005-mm (0.0010 ± 0.0002-in.) cured film on each side of a 0.13-mm (0.005-in.) copper strip withdrawn at a rate of 100 mm/min (4 in./min). Use solventless varnish as received.

6.2.2 Submerge the test specimens vertically in the varnish to be tested. Withdraw them at a rate of 100 mm/min (4 in./min). Drain the test specimens for 10 to 12 min. Cure according to the manufacturer's recommendations. If a

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

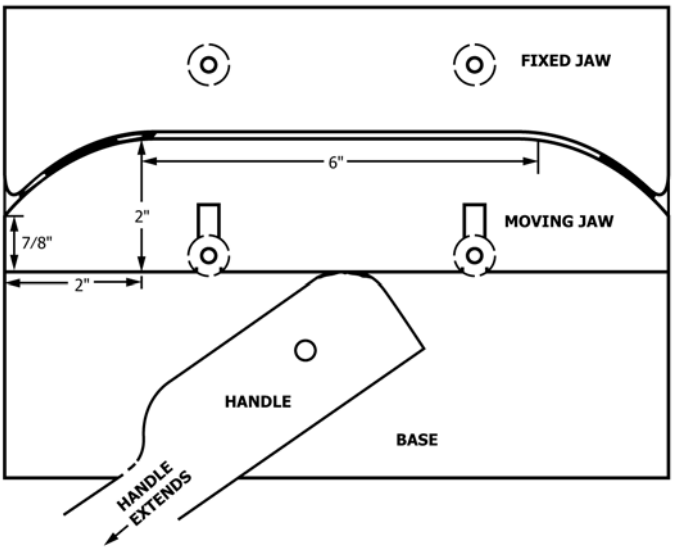

FIG. 1 Jig for Forming Wire

solvent-containing varnish is being tested, the test specimens shall be dipped in the reverse direction and cured as before.

6.2.3 Expose ½ in. of bare conductor at one end of each wire to facilitate electrical connections.

7. Procedure

7.1 After selecting the test voltage from Table 1, follow the procedure in Test Method D2307 with the following exceptions:

7.1.1 The described specimen holder and electrical connection device are not required. Instead, lay samples flat on a vented tray during oven exposure.

7.1.2 Test individual specimens by carefully attaching test leads to each specimen.

8. Calculation

8.1 After all specimens have failed, calculate the endpoint time at each test temperature in accordance with Test Method D2307.

TABLE 1 Test Voltages

Difference Between Bare and Insulated Wire Thickness, mm (in.)	Test Voltage, 60 Hz ac RMS
0.036 – 0.050 (0.0015 – 0.0020)	300
0.051 – 0.064 (0.0021 – 0.0025)	375
0.065 – 0.076 (0.0026 – 0.0030)	450
0.077 – 0.089 (0.0031 – 0.0035)	550
0.090 – 0.102 (0.0036 – 0.0040)	650
0.103 – 0.114 (0.0041 – 0.0045)	700
0.115 – 0.127 (0.0046 – 0.0050)	750
0.128 – 0.140 (0.0051 – 0.0055)	800
0.141 – 0.152 (0.0056 – 0.0060)	850
>0.153 (>0.0061)	1000

8.2 Plot the results using the endpoint time calculated for each temperature as the ordinate on a logarithmic time scale and the reciprocal of the absolute temperature as the abscissa.

8.3 Calculate the temperature index at 20 000 and correlation coefficient using the procedure given in Test Method D2307.

9. Report

9.1 Report the following information:

9.1.1 Identification of the varnish used,

9.1.2 Identification of the magnet wire used including size and build,

9.1.3 Temperature index, and

9.1.4 Correlation coefficient.

10. Precision and Bias

10.1 *Precision*—This test method has been in use for many years, but no statement of precision has been made and no activity is planned to develop such a statement.

10.2 *Bias*—This test method has no bias because the value for thermal endurance of varnished-fibrous or film-wrapped magnet wire is defined in terms of this test method.

11. Keywords

11.1 electrical insulating; fibrous-wrapped wire; film-wrapped wire; thermal endurance; varnish