# Standard Specification for Molding Compounds, Thermosetting[1]

This standard is issued under the fixed designation D 5948; 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.

$\epsilon^1$ NOTE—Editorially added three ASTM practices to the Referenced Documents section, as well as in paragraph 7.1.3 in November 2002.

## 1. Scope *

1.1 This specification covers the basic properties of thermoset molding compounds and the test methods used to establish the properties.

1.2 *Classification*—Molding thermosetting plastic compounds shall be of the following resins and are covered by the individual specification sheets (see 5.1 and Annex A1-Annex A8).

Resin
Phenolic, cellulose filled
Phenolic, mineral/glass filled
Melamine
Polyester
Diallyl iso-phthalate
Diallyl ortho-phthalate
Silicone
Epoxy

NOTE 1—There is no equivalent ISO standard.

1.3 *Order of Precedence*—In the event of a conflict between the text of this specification and the references cited in Section 2 (except for related specification sheets), the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

1.4 The values stated in SI units are to be considered standard.

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies[2]

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation[2]

D 229 Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation[2]

D 256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics[2]

D 495 Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation[2]

D 570 Test Method for Water Absorption of Plastics[2]

D 618 Practice for Conditioning Plastics for Testing[2]

D 638 Test Method for Tensile Properties of Plastics[2]

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position[2]

D 695 Test Method for Compressive Properties of Rigid Plastics[2]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[2]

D 796 Practice for Compression Molding Test Specimens of Phenolic Molding Compounds[3]

D 883 Terminology Relating to Plastics[2]

D 1896 Practice for Transfer Molding Test Specimens of Thermosetting Compounds[2]

D 3419 Practice for In-Line Screw-Injection Molding Test Specimens from Thermosetting Compounds[4]

D 3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials[5]

D 3638 Test Method for Comparative Tracking Index of Electrical Insulating Materials[5]

D 4350 Test Method for Corrosivity Index of Plastics and Fillers[6]

D 4697 Guide for Maintaining Test Methods in the User's Laboratory[7]

E 994 Guide for Calibration and Testing Laboratory Accreditation Systems General Requirements for Operation and Recognition[8]

E 1224 Guide for Categorizing Fields of Capability for

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.16 on Thermosetting Materials.

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] Discontinued; see *1992 Annual Book of ASTM Standards*, Vol 08.01. Replaced by Practice D 5224.

[4] *Annual Book of ASTM Standards*, Vol 08.02.

[5] *Annual Book of ASTM Standards*, Vol 10.02.

[6] *Annual Book of ASTM Standards*, Vol 08.03.

[7] *Annual Book of ASTM Standards*, Vol 07.02.

[8] *Annual Book of ASTM Standards*, Vol 14.02.

***A Summary of Changes section appears at the end of this standard.**

Laboratory Accreditation Purposes[8]

2.2 *Underwriters Laboratory Standard:*[9]

UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

2.3 *Other Standard:*

DDC AD 297457 Procedure for Determining Toxicity of Synthetic Compounds[10]

## 3. Terminology

3.1 For definitions of technical terms pertaining to plastics used in this specification, refer to Terminology D 883.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *batch*—a homogeneous unit of finished molding compound manufactured at one time.

## 4. Significance and Use

4.1 This specification is a revision of STD MIL-M-14H, Specification for Molding Compound, Thermosetting, retaining the MIL-M-14H material designations and property requirements while conforming to ASTM form and style. It is intended for qualification and batch acceptance for materials used by government and industry, and is intended as a direct replacement for MIL-M-14H.

## 5. Requirements

5.1 *Specification Sheets*—The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet (see Annex A1-Annex A8). In the event of any conflict between the requirements of this specification and the material specification, the latter shall govern.

5.2 *Qualification*—Molding compounds furnished under this specification shall be products which conform to the applicable material specification and quality assurance provisions in this specification.

5.3 *Material Safety Data Sheet (MSDS)*— The user shall be provided with a material safety data sheet.

5.4 *Uniformity*—All molding compound of the same brand from one manufacturer shall be uniform in texture, in color, and in the specified properties as determined by the batch-acceptance inspection specified in 8.3.

5.5 *Property Values*—Standard specimens of the compounds shall conform to the property values shown in the individual specification sheets for qualification (see 8.2) and batch acceptance (see 8.3).

## 6. Conditioning

6.1 Standard test specimens shall be conditioned before testing, as specified in Tables 1-4.

6.1.1 *Nomenclature*—The following letters shall be used to indicate the respective general conditioning procedures:

6.1.1.1 *Condition A*—As received; no special conditioning.

6.1.1.2 *Condition C*—Humidity conditioning in accordance with Practice D 618.

6.1.1.3 *Condition D*—Immersion conditioning in distilled water in accordance with Practice D 618.

6.1.1.4 *Condition E*—Temperature conditioning in accordance with Practice D 618; Condition Desiccation–cooling over silica gel or calcium chloride in a desiccator at 23°C for 16 to 20 h after temperature conditioning in accordance with Practice D 618.

6.2 *Designation*—Conditioning procedures shall be designated as follows:

6.2.1 A capital letter indicating the general condition of the specimen; that is, as-received, humidity, immersion, or temperature conditioning.

6.2.2 A number indicating the duration of the conditioning in hours.

6.2.3 A number indicating the conditioning temperature in degrees Celsius.

6.2.4 A number indicating relative humidity, whenever relative humidity is controlled.

6.3 The numbers shall be separated from each other by slant marks and from the capital letter by a dash. A sequence of

[9] Available from Underwriters Laboratory Inc., 333 Pfingsten Road, Northbrook, IL 60062.

[10] Available from the Department of Commerce, National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22151.

**TABLE 1 Sampling and Conditioning for Mechanical/Physical Qualification Tests**

NOTE 1—A 50 % retention of initial flexural strength is required.
NOTE 2—The side of a test specimen is that area formed by the chase of the mold.
NOTE 3—The face of the test specimen is that area formed by the top or bottom force plug.
NOTE 4—When specified.

| Property to Be Tested-Mechanical/Physical | ASTM Test Method | Modified by | Specimens, Form, and Dimension | Number Tested | Conditioning Procedure (see Section 6) | Unit of Value |
|---|---|---|---|---|---|---|
| Compressive strength, endwise | D 695 | ... | 25.4 by 12.7 by 12.7 mm | 5 | E-48/50 + C-96/23/50 | MPa (minimum average) |
| Dimensional stability | ... | 7.2.1 | 127 bar, 12.7 by 12.7 mm | 5 | C-96/23/50 | Percent (maximum average) |
| Flexural strength | D 790 | 7.2.2 | 127 bar, 6.4 by 12.7 mm | 5 | E-48/50 + C-96/23/50 | MPa (minimum average) |
| Heat deflection temperature | D 648 | 7.2.3 | 127 bar, 12.7 by 12.7 mm | 3 | A | Degrees Celsius (minimum average) |
| Heat resistance (1) | D 790 | 7.2.4 | 127 bar, 6.4 by 12.7 mm | 5 | E-1/at designated temperature test. Test at temperature | Degrees Celsius (minimum average) at temperature |
| Impact strength | | | | | | |
| Side (2) | D 256 | ... | As per Test Method D 256 | 5 | E-48/50 + C96/23/50 | J/m notch (minimum average) |
| Face (3), (4) | D 256 | ... | As per Test Method D 256 | 5 | E-48/50 + C96/23/50 | J/m notch (minimum average) |
| Tensile strength | D 638 | ... | As per Test Method D 638 | 5 | E-48/50 + C-96/23/50 | MPa (minimum average) |
| Water absorption | D 570 | 7.2.5 | 51-mm disk, 3.2 mm thick | 3 | E-24/100 + des + D-48/50 | Percent (maximum average) |

TABLE 2 Sampling and Conditioning for Electrical Qualification Tests

| Property to Be Tested-Mechanical/Physical | ASTM Test Method | Modified by | Specimens, Form, and Dimension | Number Tested | Conditioning Procedure (see Section 6) | Unit of Value |
|---|---|---|---|---|---|---|
| Arc resistance | D 495 | ... | 102-mm disk, 3.17 mm thick | 3 | A | seconds (minimum average) |
| Dielectric breakdown: | | | | | | |
| Short-time test | D 149 | 7.2.6 | 102-mm disk, 12.7 mm thick | 1 | E-48/50 + C-96/23/50 | kilovolt (minimum average) |
| Step-by-step test | | | | 3 | E-48/50 + C-96/23/50 | |
| Short-time test | | | | 1 | E-48/50 + D-48/50 | |
| Step-by-step test | | | | 3 | E-48/50 + D-48/50 | |
| Dielectric constant: | | | | | | |
| At 1 kHz | D 150 | ... | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + des | maximum average |
| | | | | 3 | E-48/50 + D-24/23 | |
| At 1 MHz | | | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + des | |
| | | | | 3 | E-48/50 + D-24/23 | |
| Dielectric strength: | | | | | | |
| Short-time test | D 149 | 7.2.6 | 102-mm disk, 3.2 mm thick | 3 | E-48/50 + C-96/23/50 | kV/mm (minimum average) |
| Step-by-step test | | | | 5 | E-48/50 + C-96/23/50 | |
| Short-time test | | | | 3 | E-48/50 + D-48/50 | |
| Step-by-step test | | | | 5 | E-48/50 + D-48/50 | |
| Dissipation factor: | | | | | | |
| At 1 kHz | D 150 | ... | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + des | maximum average |
| | | | | 3 | E-48/50 + D-24/23 | |
| At 1 MHz | | | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + des | |
| | | | | 3 | E-48/50 + D-24/23 | |
| Surface resistance | ... | 7.2.7 | 102-mm disk, 3.2 mm thick | 5 | C-720/70/100 + dew | megaohms (minimum individual) |
| Comparative track index | D 3638 | 7.2.8 | 51-mm disk, 3.2 mm thick | 5 | A | volts |
| Volume resistance | ... | 7.2.7 | 102-mm disk, 3.2 mm thick | 5 | C-720/70/100 + dew | megaohms (minimum individual) |
| Water extract conductance | D 4350 | ... | ... | ... | E-144/71 | siemens per centimetre |

TABLE 3 Sampling and Conditioning for Combustion Qualification Tests

| Property to Be Tested-Mechanical/Physical | ASTM Test Method | Modified by | Specimens, Form, and Dimension | Number Tested | Conditioning Procedure (see Section 6) | Unit of Value |
|---|---|---|---|---|---|---|
| Flame resistance ignition time | D 229 | 7.2.9 | 127-mm bar, 12.7 by 12.7 mm | 5 | A | seconds (minimum average) |
| Burning time | | | | | | seconds (maximum average) |
| Flammability | UL 94 | 7.2.10 | 127-mm bar, 12.7-mm thickness | 5 | A | rating/thickness (1.6, 3.2, or 6.4 mm) |
| Toxicity when heated: | | | | | | |
| Carbon dioxide | | | | | | |
| Carbon monoxide | | | | | | |
| Ammonia | | | | | | |
| Aldehydes as HCHO | | | | | | |
| Cyanide and HCN | — | 7.2.11 | 127-mm bar, 12.7 by 12.7 mm | 4 | A | parts per million (maximum average) |
| Oxide of nitrogen as NO2 | | | | | | |
| Hydrogen chloride | | | | | | |

conditions shall be denoted by use of a plus sign ( + ) between successive conditions.

Examples:

| | |
|---|---|
| Condition C-96/23/50: | Humidity condition, 96 h at 23 ± 1.1°C and 50 ± 2 % relative humidity. |
| Condition D-48/50: | Immersion condition, 48 h at 50 ± 1°C. |
| Condition E-48/50: | Temperature condition, 48 h at 50 ± 3°C. |
| Condition E-48/50 + C-96/23/50: | Temperature condition, 48 h at 50± 3°C followed by + C-96/23/50 humidity condition, 96 h at 23 ± 1.1°C and 50 ± 2 % relative humidity. |

## 7. Test Procedure

7.1 *Standard Test Specimens*:

7.1.1 *Number*—The minimum number of standard test specimens to be tested is specified in Tables 1-4.

7.1.2 *Form*—The form of the standard test specimens shall be as specified in the referenced ASTM test method or other applicable test method.

7.1.3 *Molding of Test Specimens*—Mold test specimens by methods that could include post-cure. No special treatment shall be used to improve the properties of the specimens when compared with parts molded in commercial productions. (Practices D 796, D 1896, and D 3419 represent the best molding practices for thermosets.)

7.1.4 *Tolerance*—Test specimens shall conform to the dimensional tolerances of the appropriate test method, as listed in Tables 1-4. When not otherwise stated, tolerance on dimensions shall be ±5 %.

7.2 *Methods of Test*—Unless otherwise specified, take all test measurements at the standard laboratory atmosphere of 23 ± 1.1°C and 50 ± 2 % relative humidity. The test methods shall be conducted in accordance with the applicable ASTM test method, except where modified (see 7.2.1-7.2.12).

7.2.1 *Dimensional Stability*—Mold or machine the specimens so the 12.7 by 12.7-mm ends are smooth and parallel. Subject the specimens to the condition C-96/23/50 (see 6.2). Then measure the initial length of the specimens to the nearest 0.01 mm. Subject the specimens to 10 cycles, each cycle as follows: 48 h in a circulating air oven at 125 ± 5°C plus 24 h

**TABLE 4 Sampling and Conditioning for Batch Acceptance Tests**

NOTE 1—The side of a test specimen is that area formed by the chase of the mold.

| Property to Be Tested-Mechanical/Physical | ASTM Test Method | Modified by | Specimens, Form, and Dimension | Number Tested | Conditioning Procedure (see Section 6) | Unit of Value |
|---|---|---|---|---|---|---|
| Arc resistance | D 495 | ... | 102-mm disk, 3.2 mm thick | 3 | A | seconds (minimum average) |
| Comparative track index | D 3638 | 7.2.8 | 51-mm disk, 3.17 mm thick | 5 | A | volts |
| Dielectric constant at 1 MHz | D 150 | ... | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + D-24/23 | maximum average |
| Dissipation factor at 1 MHz | D 150 | ... | 51-mm disk, 3.2 mm thick | 3 | E-48/50 + D-24/23 | maximum average maximum average |
| Dielectric strength, step-by-step | D 149 | 7.2.6 | 102-mm disk, 3.2 mm thick | 5 | E-48/50 + D-48/50 | kV/mm (minimum average) |
| Flexural strength | D 790 | 7.2.2 | 127-mm bar, 6.4 by 12.7 mm | 5 | E-48/50 + C-96/23/50 | mPa (minimum average) |
| Impact strength, side (1) | D 256 | ... | in accordance with Test Methods D 256 | 5 | E-48/50 + C-96/23/50 | J/m notch (minimum average) |
| Water absorption | D 570 | 7.2.5 | 51-mm disk, 3.2 mm thick | 3 | E-24/100 + des + D-48/50 | percent (maximum average) |
| Water extract conductance | D 4350 | 7.2.12... | ... | E-144/71 | siemens per centimetre | |

at 23 ± 1.1°C and 50 ± 2 % relative humidity. At the completion of 10 cycles, measure the final length of the specimens to the nearest 0.01 mm. The percentage dimensional change is calculated to the nearest 0.1 % as follows:

$$\text{Dimensional change, \%} = \frac{(\text{initial length} - \text{final length})}{\text{initial length}} \times 100 \quad (1)$$

The average percent dimensional change of the five specimens shall be recorded.

7.2.2 *Flexural Strength*—Use Test Method D 790 to determine flexural strength. The span-depth ratio shall be 16-to-1, and the dimensions of the test bar shall be 127 by 12.7 by 6.4 mm.

7.2.3 *Heat-Deflection Temperature*—Use Test Method D 648 to determine heat-deflection temperature. The specimens shall be placed directly in the oil bath and not in air. The stress load shall be 1.82 MPa.

7.2.4 *Heat Resistance*—Condition the specimen for 1 h at the designated temperature. After conditioning, the flexural strength shall be tested at the same temperature in accordance with Test Method D 790. When measured at the elevated test temperature, the molding compound shall meet the heat resistance requirement of retaining 50 % of the flexural strength value as determined at 23°C. The average of five determinations divided by the average flexural strength as determined at 23°C shall be multiplied by 100 and recorded as percent flexural strength retained at the specified conditioning and testing temperature. For example:

7.2.4.1 Determine temperature at which at least a 50 % retention of flexural strength is maintained. Condition the specimen at this temperature for 1 h before testing. Conduct the test at this temperature.

| Type | Temperature, °C |
|---|---|
| SDG & SDG-F | 100 |
| GDI-30 & GDI-30F | 130 |
| MDG & MDG-F | 90 |
| SIG & SIG-F | 140 |
| GII-30 & GII-30F | 160 |
| MIG & MIG-F | 120 |

7.2.5 *Water Absorption*—Use Test Method D 570 to determine water absorption, modified as follows:

7.2.5.1 Condition the specimens at 100 ± 2°C for 24 h, followed by a 16 to 20-h period of cooling over silica gel or calcium chloride in a desiccator at 23 ± 1.1°C.

7.2.5.2 Immerse the specimens in distilled water and maintain at a temperature of 50 ± 1°C for 48 h. Include in the report only the percentage increase in weight during immersion calculated to the nearest 0.01 % as follows:

$$\text{Increase in weight, \%} = \frac{(\text{wet weight} - \text{conditioned weight})}{\text{conditioned}} \times 100 \quad (2)$$

7.2.6 *Dielectric Test*:

7.2.6.1 *Dielectric Breakdown*—Use the apparatus and procedure specified in Test Method D 149. The electrodes shall be American Standard No. 3 tapered pins.[11] The test potential shall be applied successively between the numbered pairs of electrodes (see Fig. 1), and the average of the three readings shall be taken as the reading for the specimen.

7.2.6.2 *Dielectric Strength*—Use the apparatus and procedure specified in Test Method D 149. Conduct the test under oil at a frequency not exceeding 100 Hz. The electrodes shall be brass or stainless steel cylinders 25.4 mm long with the edges rounded to a 3.2-mm radius.

(*1*) *Short-Time Test*—The voltage shall be increased uniformly at the rate of 500 V/s.

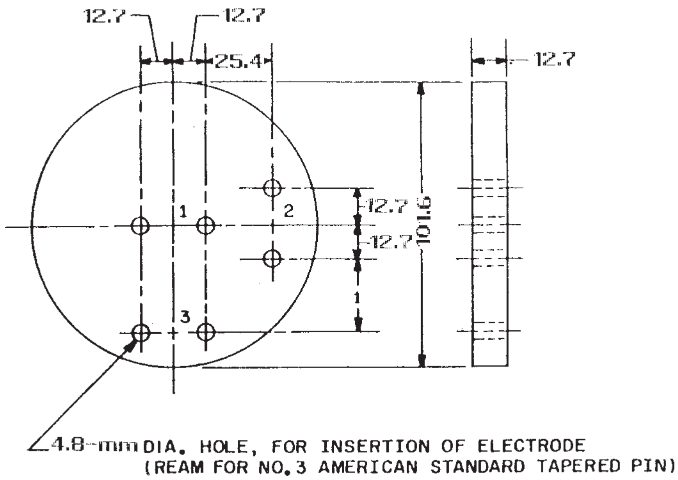
(*2*) *Step-by-Step Test*—Increase the voltage in increments, as shown in Table 5, up to failure and hold it at each step for 1 min. The change from one step to the next higher step shall be made within 10 s.

7.2.7 *Volume and Surface Resistance*:

7.2.7.1 *Specimens*—Use five 102-mm diameter 3.2-mm thick specimens. Clean specimens by noninjurious methods to ensure freedom from contamination. Take precautions in handling the specimens to avoid additional contamination.

7.2.7.2 *Electrodes*—Electrodes shall consist of a guarded electrode 51 mm in diameter, 6.4-mm guard ring spaced 6.4 mm from the guarded electrode on the same side, and the third

[11] Can be found in Machinery's Handbook.

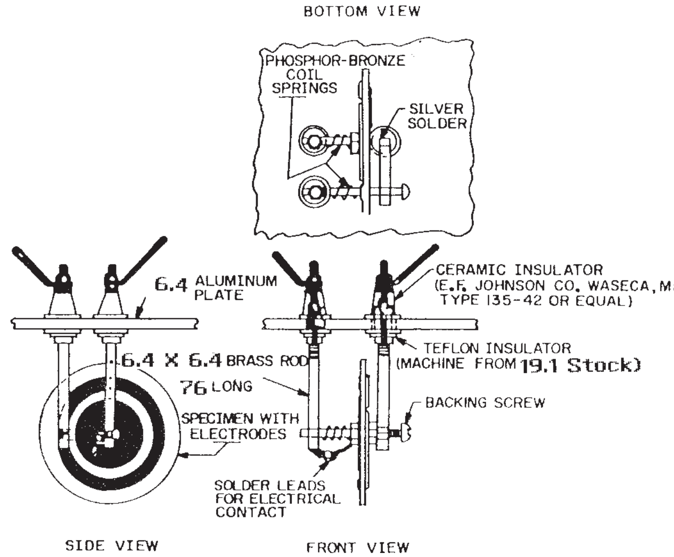



NOTE 1—All dimensions in millimetres.
NOTE 2—Tolerances with dimensions, ±5 %.
NOTE 3—Disks shall be furnished undrilled and shall be drilled by the laboratory.

**FIG. 1 Standard Test Specimen Drilled for Three Pairs of Electrodes—Dielectric Breakdown Test**

**TABLE 5 Voltage Increase for Step-by-Step Test**

| Breakdown by Short-Time Method, kV | Increment of Increase, kV |
|---|---|
| 12.5 or less | 0.5 |
| Over 12.5 to 25, inclusive | 1.0 |
| Over 25 to 50, inclusive | 2.5 |
| Over 50 to 100, inclusive | 5.0 |
| Over 100 | 10.0 |




NOTE 1—All dimensions in millimetres.
NOTE 2—Material — brass except as indicated.
NOTE 3—Silver plate all metallic parts except plate.

**FIG. 2 Specimen Holders Electrodes Test Samples and Humidity Chamber Cover—Volume and Surface Resistance Test**

electrode 76 mm in diameter on the opposite side and concentric with the guarded electrode. Dimensions of electrodes shall be maintained at a tolerance of ±0.40 mm (±1⁄64 in.). Silver paint, permeable to moisture,[12] shall be used for painting electrodes on the specimens. The electrodes shall exhibit a resistance of not more than 5 Ω both before and after the C-720/70/100 + dew conditioning when measured with a potential of not greater than 3 V between points diametrically opposite each electrode. After painting, permit the specimens to air dry for at least one week in an atmosphere of less than 60 % relative humidity at a temperature of 25 ± 5°C.

7.2.7.3 *Humidity Chamber*—The humidity chamber shall consist of a glass container with a corrosion-resistant cover. The cover shall be provided with through-panel-type insulators. The insulators may serve as supports for the electrode holders as shown in Fig. 2. The chambers shall be of such size that the ratio of specimen surface area to water surface area shall not exceed 2.5. The ratio of volume of air in the humidity chamber to surface area of the water shall not exceed 10. Obtain 100 % relative humidity with condensation by natural evaporation from a quantity of distilled water located at the bottom of the chamber. Seal the cover to the chamber with an inert sealing compound applied to the exterior points formed by the cover and the walls of the chamber. Provide a small vent hole in the cover to equalize the pressure. Seal the vent hole as soon as the air temperature in the humidity chamber has reached 70°C.

7.2.7.4 *Specimen Holders*—Install the specimens in a vertical plane in the conditioning chamber with the lower edge of the specimen not closer than 25.4 mm from the surface of the water. Hold the specimens in position with the electrode contactors in a matter similar to that shown in Fig. 2. Make the electrical connection to the specimen holders with through-panel insulators. The insulators shall be capable of withstanding the adverse conditions within the chamber without excessive loss of insulating properties. (Insulator resistance to cover plate shall at all times exceed 10 MΩ). Polytetrafluoroethylene insulators on the humidity side of the conditioning chamber are recommended to meet this requirement. These should be cleaned with alcohol before the start of each test. Electrode contactors and all other metallic parts of the sample shall be silver plated. Contact pressure against the electrodes may be provided by backing the contactors with phosphor bronze springs or other corrosion-resistant spring material.

7.2.7.5 *Heating Chamber*—Install the humidity chamber in an oven or other heating chamber capable of maintaining a temperature of 70 ± 1°C. The rate of heating of the oven shall be so that the air temperature at a point near the volumetric center of the humidity chamber shall attain 70°C in 4 ± 1 h. The quality of water in the chamber shall be so that the water temperature shall attain 65°C in 4 ± 1 h. Maintain room temperature at 25 ± 5°C. The insulation of the conductors connecting the through-panel insulators to the measuring equipment shall not be significantly deteriorated by the elevated temperatures encountered in the oven. Polytetrafluoroethylene-coated wire is recommended.

[12] DuPont silver paint No. 4517, or its equivalent, available from DuPont Corp., Electronic Materials, Photo Products Dept., Wilmington, DE 19898, has been found suitable for this purpose.

7.2.7.6 *Measurements*—Measure volume and surface resistances using the three-terminal method, employing measuring equipment such as a megaohm bridge capable of applying 500-V direct current (dc) to the specimen. A single set of measurements shall be made of each specimen while in the conditioning chamber after 30 days of the specified conditioning.

NOTE 2—Because of the variability of the resistance of a given specimen with test conditions and because of nonuniformity of the same material from specimen to specimen, determinations are usually not reproducible to closer than 10 % and are often even more widely divergent. A range of values from 10 to 1 may be obtained under apparently identical conditions. Errors in resistance determinations may result from the fact that the current measuring device is shunted by the resistance between the guarded terminal and the guard system. To ensure validity of the volume and surface resistance measurements obtained by the bridge methods, the resistance between the unguarded and the guarded terminal should be at least five times greater than the standard resistance employed in the bridge. This may be ascertained by direct two-terminal measurements between these two terminals. Conversion of the measurements to resistivities is not required since electrode dimensions are specified. The potentials shall be applied to the specimens as shown in Fig. 3 or with polarities opposite to those shown on Fig. 3. Take surface resistance measurements on the same specimens as those used for volume resistance, except interchange the potentials of guard and low electrodes. Measure the volume and surface resistance in each case, 1 min after the potentials are applied. Low values of volume and surface resistance (below 5 MΩ) may be measured by the circuits shown on Fig. 4.

7.2.8 *Track Resistance*—Measure the track resistance by the comparative tracking index method described in Test Method D 3638.
Example:

| DAP type | Volts, min |
|---|---|
| SDG & SDG-F | 600 + |
| MDG & MDG-F | 600 + |
| GDI-30 & GDI-30F | 600 + |
| SIG & SIG-F | 600 + |
| MIG & MIG-F | 600 + |
| GII-30 & GII-30F | 600 + |

7.2.9 *Flame Resistance*—Determine flame resistance in accordance with Method II of Test Methods D 229, with the following exceptions:

7.2.9.1 *Flame Cabinet*—The 14.3-mm slot at the bottom of the flame cabinet shall be on all four sides. The door shall be provided with a 31.8-mm diameter peep hole located directly opposite the heater coil when the door is closed. Keep the hole closed during testing with a cover.

7.2.9.2 *Pyrometer*—The means of correction from black-body radiation to actual conditions of this test shall be as follows:

(*1*) When a pyrometer calibrated for black-body emission is used, add 6°C to the pyrometer to obtain the true temperature of the Nichrome V coil.

7.2.9.3 *Specimens*—Test specimens shall be as follows:

(*1*) Specimens shall be molded to 12.7 by 12.7 by 127 ± 1 mm.

(*2*) The test sample shall consist of five test specimens.

7.2.9.4 *Calibration*—In the calibration of this equipment, adjust the heater current to obtain an equilibrium temperature of 860 ± 2°C.

7.2.9.5 *Calculation of Burning Time*—Arrange the five values of burning time in increasing order of magnitude, as $T_1$, $T_2$, $T_3$, $T_4$, $T_5$. Compute the following ratios:

$$\frac{T_2 - T_1}{T_5 - T_1} \text{ and } \frac{T_5 - T_4}{T_5 - T_1} \tag{3}$$

If either of these ratios exceeds 0.642, then $T_1$ or $T_5$ is judged to be abnormal and is eliminated. The burning time reported shall be the average of the remaining four values.

7.2.9.6 *Average Ignition Time*—The average ignition time is calculated as the arithmetic mean time for the five specimens.

7.2.10 *Flammability*—Determine the flammability rating in accordance with UL 94 using the vertical or horizontal burning test and either 1.6, 3.2, or 6.4-mm thick specimens. Record as rating/thickness in inches.

7.2.11 *Toxicity When Heated*—The method described in DDC AD 297457 shall be used to determine toxicity of the test specimen when heated.

7.2.12 *Water Extract Conductance*—This test shall be performed in accordance with Test Method D 4350, using the conditioning procedure listed in the specification tables.

7.3 *Toxicological Product Formulations*— The supplier shall have the toxicological product formulations and associated information available for review by the user to evaluate the safety of the material for the proposed use.

## 8. Quality Assurance Provisions

8.1 *Responsibility for Inspection*— The supplier is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. The supplier shall use a laboratory accredited in accordance with Guide E 994, within the required categories in compliance with Guide E 1224.

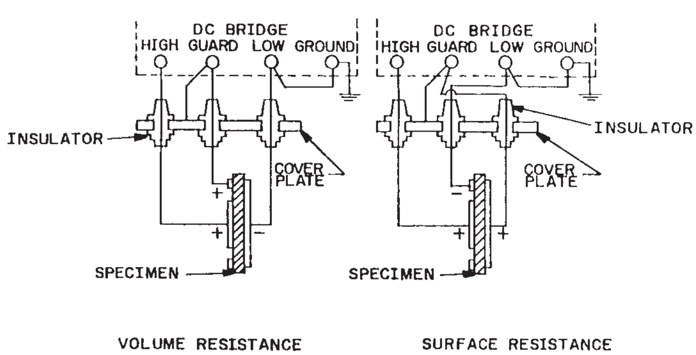



FIG. 3 Arrangements for Volume Resistance and Surface Resistance Test

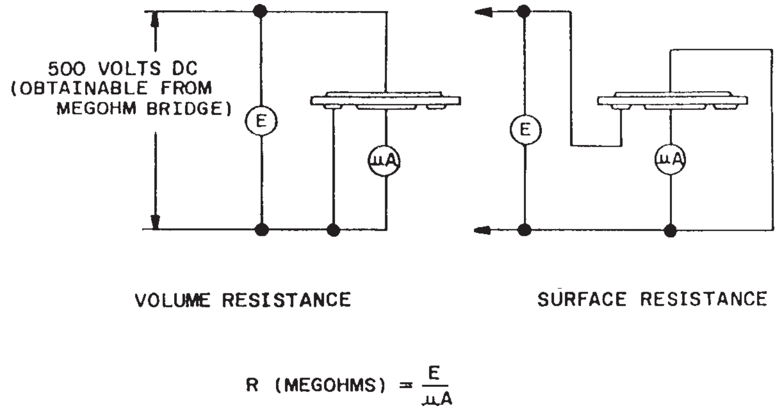



FIG. 4 Circuits for Measuring Low Values of Volume and Surface Resistance

8.1.1 *Responsibility for Compliance*— The absence of any inspection requirements in the specification shall not relieve the supplier of the responsibility of ensuring that all products or supplies comply with all requirements. Sampling inspection, as part of the manufacturing operations and in accordance with Practice D 3636, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the user to accept defective material.

8.2 *Retention of Qualification*—Any manufacturer who makes a significant change in raw materials or process used in the manufacture of such compounds shall continue to meet the applicable material qualification test requirements.

8.3 *Quality Conformance Inspection*— Quality conformance inspection shall consist of the batch acceptance tests and shall be as specified in the applicable material specification (see 8.1). They shall be conducted at an accredited laboratory in compliance with Guide D 4697, on each batch of compound to be supplied to molders for production of molded parts.

## 9. Keywords

9.1 diallyl phthalate plastics; epoxy plastics; melamine-formaldehyde plastics; molding compounds; phenolic plastics; plastics; polyester plastics; silicone resin molding compounds

# ANNEXES

**(Mandatory Information)**

## A1. MOLDING COMPOUNDS, PHENOLIC, THERMOSETTING, CONTAINING CELLULOSE FILLERS

A1.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A1.2 *Requirements*—Qualification test requirements are specified in Table A1.1. Batch acceptance test requirements are specified in Table A1.2.

A1.2.1 *Type CFG*—This type is a general-purpose, wood-flour-filled phenolic compound.

A1.2.2 *Type CFI-5*— This type is a moderate-impact, cotton- or paper-filled phenolic compound.

A1.2.3 *Type CFI-10*— This type is a medium-impact, cotton rag-filled phenolic compound.

A1.2.4 *Type CFI-20*— This type is a high-impact, rag- or cotton-filled phenolic compound.

A1.2.5 *Type CFI-30*— This type is a high-impact, cotton-filled phenolic compound.

A1.2.6 *Type CFI-40*— This type is the highest impact grade of cotton-filled phenolic compound.

**TABLE A1.1 Qualification Test Requirements for Phenolic Resin Molding Compounds: Cellulose Filled**

| Requirement | Type CFG | Type CFI-5 | Type CFI-10 | Type CFI-20 | Type CFI-30 | Type CFI-40 |
|---|---|---|---|---|---|---|
| | | | Mechanical/Physical | | | |
| Compressive strength, endwise | 172 | 159 | 138 | 138 | 131 | 124 |
| Flexural strength | 62 | 55 | 55 | 55 | 55 | 55 |
| Heat deflection temperature | 115 | 115 | 115 | 115 | 115 | 115 |
| Heat resistance | 115 | 115 | 115 | 115 | 115 | 115 |
| Impact strength, side[A] | 11 | 27 | 53 | 93 | 160 | 187 |
| Tensile strength | 41 | 39 | 39 | 39 | 39 | 41 |
| Water absorption | 3.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| | | | Electrical | | | |
| Dielectric breakdown: | | | | | | |
| Short-time test[B] | | | | | | |
| Step-by-step test | 30 | 18 | 18 | 18 | 18 | 18 |
| Short-time test[B] | | | | | | |
| Step-by-step test | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Dielectric strength: | | | | | | |
| Short-time test | 11.8 | 9.8 | 9.5 | 8.3 | 9.8 | 6.9 |
| Step-by-step test | 7.9 | 5.9 | 7.1 | 5.9 | 5.9 | ... |
| Short-time test | 3.0 | 2.0 | 1.6 | 1.8 | 0.3 | 1.0 |
| Step-by-step | 1.8 | 1.1 | 1.1 | 1.0 | 0.4 | 0.6 |
| | | | Combustion | | | |
| Flame resistance: | | | | | | |
| Ignition time | 60 | 60 | 60 | 60 | 60 | 60 |
| Burning time | 270 | 330 | 330 | 330 | 330 | 330 |
| Flammability | | | | | | |
| Rating | 94HB | 94HB | 94HB | 94HB | 94HB | 94HB |
| Thickness | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for determining initial voltage in the step-by-step test.

**TABLE A1.2 Batch Acceptance Test Requirements for Phenolic Resin Molding Compounds, Cellulose Filled**

| Property to Be Tested | Type CFG | Type CFI-5 | Type CFI-10 | Type CFI-20 | Type CFI-30 | Type CFI-40 |
|---|---|---|---|---|---|---|
| Arc resistance | ... | ... | ... | ... | ... | ... |
| Dielectric strength, step-by-step | 1.8 | 1.1 | 1.1 | 1.0 | 0.4 | 0.6 |
| Flexural strength | 62 | 55 | 55 | 55 | 55 | 55 |
| Impact strength, side[A] | 11 | 27 | 53 | 93 | 160 | 187 |
| Water absorption | 3.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |

[A] The side of the test specimen is that area formed by the chase of the mold.

## A2. MOLDING COMPOUNDS, PHENOLIC, THERMOSETTING, CONTAINING MINERAL/GLASS FILLERS

A2.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A2.2 *Requirements*—Qualification test requirements are specified in Table A2.1. Batch acceptance test requirements are specified in Table A2.2.

A2.2.1 *Type MFE*—This type is a low-loss, high-dielectric-strength, low-water absorption mineral-filled phenolic compound.

A2.2.2 *Type MFH*—This type is a mineral-filled phenolic compound intended for applications requiring heat resistance.

A2.2.3 *Type GPG*—This type is a general purpose glass-filled phenolic compound intended for applications requiring good mechanical, electrical, and heat resistant properties.

A2.2.4 *Type GPI-5*— This type is a heat-resistant, moderate-impact, glass-filled phenolic compound having good electrical properties.

A2.2.5 *Type GPI-10*— This type is a heat-resistant, medium-impact, glass-filled phenolic compound having good electrical properties.

A2.2.6 *Type GPI-20*— This type is the heat-resistant, moderately high-impact, glass-filled phenolic compound having good electrical properties.

A2.2.7 *Type GPI-30*— This type is a heat-resistant, high-impact, glass-filled phenolic compound having good electrical properties.

**TABLE A2.1 Qualification Test Requirements for Phenolic Resin Molding Compounds, Mineral/Glass Filled**

| Requirement | Type MFE | Type MFH | Type GPG | Type GPI-5 | Type GPI-10 | Type GPI-20 | Type GPI-30 | Type GPI-50 | Type GPI-100 |
|---|---|---|---|---|---|---|---|---|---|
| Mechanical/Physical | | | | | | | | | |
| Compressive strength, endwise | 103 | 103 | 159 | 172 | 172 | 159 | 138 | 138 | 138 |
| Flexural strength | 55 | 48 | 62 | 83 | 83 | 83 | 83 | 97 | 103 |
| Heat deflection temperature | 115 | 130 | 170 | 175 | 175 | 175 | 175 | 175 | 200 |
| Heat resistance | 175 | 200 | 175 | 200 | 175 | 175 | 175 | 175 | 175 |
| Impact strength, side[A] | ... | 13 | 16 | 27 | 53 | 107 | 160 | 267 | 534 |
| Tensile strength | 29 | 29 | 31 | 48 | 45 | 45 | 45 | 41 | 31 |
| Water absorption | 0.10 | 0.35 | 0.30 | 0.35 | 0.35 | 0.40 | 0.50 | 1.0 | 1.5 |
| Electrical | | | | | | | | | |
| Dielectric breakdown: | | | | | | | | | |
| Short-time test[B] | | | | | | | | | |
| Step-by-step test | 45 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 40 |
| Short-time test[B] | | | | | | | | | |
| Step-by-step test | 40 | 10 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Dielectric constant: | | | | | | | | | |
| at 1 kHz | 6.0 | ... | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| | 6.0 | ... | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| at 1 MHz | 6.0 | ... | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| | 6.0 | ... | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 |
| Dielectric strength: | | | | | | | | | |
| Short-time test | 12.8 | 8.5 | 10.8 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 | 11.8 |
| Step-by-step test | 10.8 | 5.9 | 8.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| Short-time test | 12.8 | 4.9 | 8.9 | 6.9 | 6.9 | 6.9 | 6.9 | 6.9 | 6.9 |
| Step-by-step test | 10.8 | 3.2 | 7.9 | 4.9 | 4.9 | 4.9 | 4.9 | 4.9 | 2.0 |
| Dissipation factor | | | | | | | | | |
| at 1 kHz | 0.03 | ... | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| | 0.03 | ... | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| at 1 MHz | 0.15 | ... | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 0.02 | ... | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Surface resistance | 5.0 | ... | ... | ... | ... | ... | ... | ... | ... |
| Volume resistance | 2.0 | ... | ... | ... | ... | ... | ... | ... | ... |
| Combustion | | | | | | | | | |
| Flame resistance:[C] | | | | | | | | | |
| Ignition time | 60 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Burning time | 210 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Flammability/Thickness-Inch:[D] | | | | | | | | | |
| | V-1/1.6 | V-0/1.6 | V-1/1.6 | V-0/1.6 | V-1/1.6 | V-1/1.6 | V-1/1.6 | V-1/1.6 | V-1/1.6 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for determining initial voltage in step-by-step test.
[C] Units–Seconds (minimum average) Test Method D 229 (see 7.2.9).
[D] UL 94 (see 7.2.10).

**TABLE A2.2 Batch Acceptance Test Requirements for Phenolic Resin Molding Compounds, Mineral/Glass Filled**

| Property to Be Tested | Type MFE | Type MFH | Type GPG | Type GPI-5 | Type GPI-10 | Type GPI-20 | Type GPI-30 | Type GPI-50 | Type GPI-100 |
|---|---|---|---|---|---|---|---|---|---|
| Dielectric constant at 1 MHz | 6.0 | ... | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 |
| Dielectric strength, step-by-step | 10.8 | 3.2 | 7.9 | 4.9 | 4.9 | 4.9 | 4.9 | 4.9 | 2.0 |
| Dissipation factor at 1 MHz | 0.02 | ... | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Flexural strength | 55 | 48 | 62 | 83 | 83 | 83 | 83 | 97 | 103 |
| Impact strength, side[A] | ... | 13 | 16 | 27 | 53 | 107 | 160 | 267 | 534 |
| Water absorption | 0.10 | 0.35 | 0.30 | 0.35 | 0.35 | 0.40 | 0.50 | 1.0 | 1.5 |

[A] The side of the test specimen is that area formed by the chase of the mold.

A2.2.8 *Type GPI-50*— This type is a heat-resistant, high-impact, glass-filled phenolic compound having good electrical properties.

A2.2.9 *Type GPI-100*— This type is a glass-fiber-filled phenolic resin molding compound of very high-impact strength and good electrical properties.

## A3. MOLDING COMPOUNDS, MELAMINE, THERMOSETTING, CONTAINING CELLULOSE, MINERAL, OR GLASS FILLERS

A3.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A3.2 *Requirements*—Qualification test requirements are specified in Table A3.1. Batch-acceptance test requirements are specified in Table A3.2.

A3.2.1 *Type CMG*—This type is a cellulose-filled, general-purpose, melamine molding compound.

A3.2.2 *Type CMI-5*— This type is a cellulose-filled, moderate-impact, melamine compound.

A3.2.3 *Type CMI-10*— This type is a cellulose-filled, moderate-impact, phenol modified melamine compound.

A3.2.4 *Type MME*—This type is a mineral-filled melamine compound for use where good dielectric properties and arc and flame resistance are required.

A3.2.5 *Type MMI-30*— This type is a glass-fiber-filled melamine compound of high-impact strength for use where heat resistance, arc resistance, and flame resistance are required.

A3.2.6 *Type MMI-5*— This type is a glass-fiber-filled melamine resin molding compound of lower impact strength than Type MMI-30 but with superior molding properties between Type MME and Type MMI-30.

**TABLE A3.1 Qualification Test Requirements for Melamine Resin Molding Compounds, Cellulose, Mineral/Glass Filled**

| Requirement | Type CMG | Type CMI-5 | Type CMI-10 | Type MME | Type MMI-5 | Type MMI-30 |
|---|---|---|---|---|---|---|
| Mechanical/Physical | | | | | | |
| Compressive strength, endwise | 138 | 172 | ... | 172 | 193 | 138 |
| Dimensional stability | ... | ... | ... | 0.7 | ... | ... |
| Flexural strength | 55 | 52 | 76 | 41 | 59 | 59 |
| Heat deflection temperature | 120 | 160 | ... | 120 | 200 | 200 |
| Heat resistance | 110 | 110 | 110 | 110 | 110 | 110 |
| Impact strength, side[A] | ... | 27 | 53 | ... | 27 | 160 |
| Tensile strength | 34 | 39 | ... | 29 | 34 | 38 |
| Water absorption | 4.0 | 4.0 | 4.0 | 0.5 | 1.5 | 4.0 |
| Electrical | | | | | | |
| Arc resistance | 100 | 125 | ... | 125 | 180 | 180 |
| Dielectric breakdown: | | | | | | |
| Short-time test[B] | | | | | | |
| Step-by-step test | 30 | 18 | ... | 40 | 40 | 40 |
| Short-time test[B] | | | | | | |
| Step-by-step test | 5 | 2.5 | ... | 35 | 5 | 5 |
| Dielectric constant: | | | | | | |
| at 1 kHz | ... | ... | ... | 7.0 | 9.6 | 8.0 |
| | ... | ... | ... | 7.0 | 10.0 | 9.0 |
| at 1 MHz | ... | ... | ... | 6.5 | 7.5 | 7.5 |
| | ... | ... | ... | 6.5 | 8.0 | 8.0 |
| Dielectric strength: | | | | | | |
| Short-time test | 10.8 | 9.8 | ... | 12.8 | 8.5 | 5.9 |
| Step-by-step | 7.9 | 5.9 | ... | 10.8 | 5.9 | 4.9 |
| Short-time test | 4.9 | 2.0 | ... | 10.8 | 3.9 | 3.9 |
| Step-by-step | 3.9 | 1.2 | ... | 8.9 | 2.0 | 2.0 |
| Dissipation factor: | | | | | | |
| at 1 kHz | ... | ... | ... | 0.06 | 0.08 | 0.06 |
| | ... | ... | ... | 0.07 | 0.10 | 0.08 |
| at 1 MHz | ... | ... | ... | 0.04 | 0.03 | 0.03 |
| | ... | ... | ... | 0.05 | 0.04 | 0.04 |
| Combustion | | | | | | |
| Flame resistance: | | | | | | |
| Ignition time | 60 | 120 | ... | 90 | 600 | 600 |
| Burning time | 180 | 60 | ... | 180 | 0 | 0 |
| Flammability | | | | | | |
| Rating | 94V-0 | ... | ... | 94V-1 | 94V-1 | 94V-1 |
| Thickness | 1.6 | ... | ... | 1.6 | 1.6 | 1.6 |
| Toxicity when heated: | | | | | | |
| Carbon dioxide | 15 000 | 15 000 | 15 000 | 15 000 | 15 000 | 15 000 |
| Carbon monoxide | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Ammonia | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 |
| Aldehydes as HCHO | 50 | 50 | 50 | 50 | 50 | 50 |
| Cyanide as HCN | 60 | 60 | 60 | 60 | 60 | 60 |
| Oxide of nitrogen as $NO_2$ | 100 | 100 | 100 | 100 | 100 | 100 |
| Hydrogen chloride | 100 | 100 | 100 | 100 | 100 | 100 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for determining initial voltage in step-by-step test.

**TABLE A3.2 Batch-Acceptance Test Requirements for Melamine Resin Molding Compounds, Cellulose, Mineral or Glass Filled**

| Property to Be Tested | Type CMG | Type CMI-5 | Type CMI-10 | Type MME | Type MMI-5 | Type MMI-30 |
|---|---|---|---|---|---|---|
| | Performance Requirement for Each Compound | | | | | |
| Arc resistance | 100 | 125 | ... | 125 | 180 | 180 |
| Dielectric constant at 1 MHz | ... | ... | ... | 6.5 | 8.0 | 8.0 |
| Dielectric strength, step-by-step | 3.9 | 1.2 | ... | 8.9 | 2.0 | 2.0 |
| Dissipation factor at 1 MHz | ... | ... | ... | 0.05 | 0.04 | 0.04 |
| Flexural strength | 55 | 52 | 76 | 41 | 59 | 59 |
| Impact strength, side[A] | ... | 27 | 53 | ... | 27 | 160 |
| Water absorption | 4.0 | 4.0 | 4.0 | 0.5 | 1.5 | 4.0 |

[A] The side of the test specimen is that area formed by the chase of the mold.

## A4. MOLDING COMPOUNDS, POLYESTER, THERMOSETTING, CONTAINING MINERAL/GLASS FILLERS

A4.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A4.2 *Requirements*—Qualification test requirements are specified in Table A4.1. Batch-acceptance test requirements are specified in Table A4.2.

A4.2.1 *Type MAG*—This type is a mineral-filled, polyester compound for use where good dielectric properties and arc resistance are required.

A4.2.2 *Type MAI-30*— This type is a mineral-filled, glass-fiber-reinforced, polyester resin molding compound. It is an arc-resistance, flame-resistant, heat-resistant, high-impact compound having good mechanical and excellent electrical characteristics.

A4.2.3 *Type MAI-60*— This type is a glass-fiber-filled polyester compound for use where high-impact strength, good dielectric properties, and arc resistance are required.

A4.2.4 *Type MAT-30*— This type is a heat-resistant, track-resistant, flame-resistant, high-impact, mineral-filled, glass-fiber-reinforced polyester compound.

**TABLE A4.1 Qualification Test Requirements for Polyester Resin Molding Compounds, Mineral/Glass Filled**

| Requirement | Type MAG | Type MAI-30 | Type MAI-60 | Type MAI-30 |
|---|---|---|---|---|
| | Mechanical/Physical | | | |
| Compressive strength, endwise | 103 | 138 | 124 | 124 |
| Dimensional stability | 0.2 | ... | ... | ... |
| Flexural strength | 52 | 97 | 83 | 103 |
| Heat deflection temperature | 175 | 200 | 200 | 225 |
| Heat resistance | 130 | 155 | 120 | 155 |
| Impact strength, side[A] | ... | 160 | 320 | 160 |
| Tensile strength | 24 | 41 | 24 | 41 |
| Water absorption | 0.5 | 0.5 | 1.5 | 0.5 |
| | Electrical | | | |
| Arc resistance | 175 | 160 | 130 | 180 |
| Comparative track index | ... | ... | ... | 180 |
| Dielectric breakdown: | | | | |
| Short-time test[B] | | | | |
| Step-by-step test | 40 | 45 | 40 | 40 |
| Short-time test[B] | | | | |
| Step-by-step test | 35 | 45 | 35 | 40 |
| Dielectric constant: | | | | |
| at 1 kHz | 6.2 | 6.3 | 6.0 | 6.0 |
| | 6.5 | 6.4 | 7.0 | 6.0 |
| at 1 MHz | 5.7 | 6.2 | 5.7 | 5.5 |
| | 6.0 | 6.4 | 6.0 | 5.5 |
| Dielectric strength: | | | | |
| Short-time test | 14.8 | 11.8 | 5.9 | 12.8 |
| Step-by-step | 12.8 | 9.3 | 4.9 | 10.8 |
| Short-time test | 11.3 | 10.8 | 3.9 | 10.8 |
| Step-by-step | 9.8 | 9.8 | 2.0 | 8.9 |
| Dissipation factor: | | | | |
| at 1 kHz | 0.04 | 0.02 | 0.03 | 0.03 |
| | 0.06 | 0.02 | 0.08 | 0.05 |
| at 1 MHz | 0.02 | 0.01 | 0.03 | 0.03 |
| | 0.03 | 0.02 | 0.05 | 0.05 |
| | Combustion | | | |
| Flame resistance: | | | | |
| Ignition time | 60 | 100 | 90 | 100 |
| Burning time | 200 | 75 | 90 | 50 |
| Flammability | | | | |
| Rating | 94V-1 | 94V-1 | 94V-1 | 94V-1 |
| Thickness | 3.2 | 3.2 | 3.2 | 3.2 |
| Toxicity when heated: | | | | |
| Carbon dioxide | 15 000 | 15 000 | 15 000 | 15 000 |
| Carbon monoxide | 1000 | 1000 | 1000 | 1000 |
| Ammonia | 2500 | 2500 | 2500 | 2500 |
| Aldehydes as HCHO | 50 | 50 | 50 | 50 |
| Cyanide as HCN | 60 | 60 | 60 | 60 |
| Oxide of nitrogen as $NO_2$ | 100 | 100 | 100 | 100 |
| Hydrogen chloride | 100 | 100 | 100 | 100 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for determining initial voltage in step-by-step test.

**TABLE A4.2 Batch-Acceptance Test Requirements for Polyester Molding Compounds, Mineral/Glass Filled**

| Property to Be Tested | Type MAG | Type MAI-30 | Type MAI-60 | Type MAT-30 |
|---|---|---|---|---|
| Arc resistance | 175 | 160 | 130 | 180 |
| Comparative track index | ... | ... | ... | 180 |
| Dielectric constant at 1 MHz | 6.0 | ... | ... | ... |
| Dielectric strength, step-by-step | 9.8 | 9.8 | 2.0 | 8.9 |
| Dissipation factor at 1 MHz | 0.03 | ... | ... | ... |
| Flexural strength | 52 | 97 | 83 | 103 |
| Impact strength, side[A] | ... | 160 | 320 | 160 |
| Water absorption | 0.5 | 0.5 | 1.5 | 0.5 |

[A] The side of the test specimen is that area formed by the chase of the mold.

## A5. MOLDING COMPOUNDS, DIALLYL ISO-PHTHALATE THERMOSETTING, CONTAINING MINERAL FILLERS, GLASS, OR POLYMERIC FILLERS

A5.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A5.2 *Requirements*—Qualification test requirements are specified in Table A5.1. Batch-acceptance test requirements are specified in Table A5.2.

A5.2.1 *Type GII-30*— This type is a glass fiber-filled diallyl iso-phthalate resin molding compound of low-loss, high-dielectric strength, low shrinkage, excellent moisture resistance, and relatively high-impact strength.

A5.2.2 *Type GII-30F*— This type is the same as GII-30 but is also flame-resistant.

A5.2.3 *Type MIG*—This type is a mineral-filled diallyl iso-phthalate compound for use where good dielectric and heat-resistance properties are required.

A5.2.4 *Type MIG-F*— This type is a mineral-filled diallyl iso-phthalate compound for use where good dielectric and heat resistance properties in addition to flame resistance are required.

A5.2.5 *Type SIG*—This type is a glass-filled diallyl iso-phthalate resin compound of low-loss, high-dielectric strength, low shrinkage, heat resistance, good moisture resistance, and relatively low-impact strength.

A5.2.6 *Type SIG-F*— This type is a glass-filled diallyl iso-phthalate resin compound of low-loss, high dielectric strength, low shrinkage, flame-resistant, heat resistance, good moisture resistance, and relatively low-impact strength.

A5.3 Diallyl ortho-phthalate molding compounds cannot be substituted for diallyl iso-phthalate molding compounds.

**TABLE A5.1 Qualification Test Requirements for Diallyl Iso-Phthalate Resin Molding Compounds, Mineral/Glass Filled**

| Requirement | Type GII-30 | Type GII-30F | Type MIG | Type MIG-F | Type SIG | Type SIG-F |
|---|---|---|---|---|---|---|
| Compressive strength, endwise | 138 | 138 | 124 | 124 | 110 | 110 |
| Dimensional stability | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| Flexural strength | 90 | 90 | 69 | 69 | 90 | 90 |
| Heat deflection temperature | 230 | 230 | 200 | 200 | 230 | 230 |
| Heat resistance | 160 | 160 | 120 | 120 | 140 | 140 |
| Impact strength, | | | | | | |
| Side[A] | 147 | 147 | 19 | 19 | 27 | 27 |
| Face[B] | 160 | 160 | 19 | 19 | 27 | 27 |
| Tensile strength | 41 | 41 | 41 | 41 | 41 | 41 |
| Water absorption | 0.5 | 0.5 | 0.7 | 0.7 | 0.5 | 0.5 |
| Electrical | | | | | | |
| Arc resistance | 115 | 115 | 115 | 115 | 115 | 115 |
| Dielectric breakdown: | | | | | | |
| Short-time test[C] | | | | | | |
| Step-by-step test | 45 | 45 | 45 | 45 | 45 | 45 |
| Short-time test[C] | | | | | | |
| Step-by-step test | 40 | 40 | 45 | 45 | 40 | 40 |
| Dielectric constant: | | | | | | |
| at 1 kHz | 4.6 | 4.6 | 5.0 | 5.0 | 4.6 | 4.6 |
| | 4.7 | 4.7 | 5.2 | 5.2 | 4.7 | 4.7 |
| at 1 MHz | 4.6 | 4.6 | 5.0 | 5.0 | 4.6 | 4.6 |
| Dielectric strength: | 4.7 | 4.7 | 5.2 | 5.2 | 4.7 | 4.7 |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 |
| Step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 |
| Step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 |
| Dissipation factor: | | | | | | |
| at 1 kHz | 0.015 | 0.015 | 0.019 | 0.019 | 0.010 | 0.010 |
| | 0.018 | 0.018 | 0.020 | 0.020 | 0.013 | 0.013 |
| at 1 MHz | 0.020 | 0.020 | 0.025 | 0.025 | 0.020 | 0.020 |
| | 0.023 | 0.023 | 0.025 | 0.025 | 0.023 | 0.023 |
| Surface resistance | 5000 | 5000 | 5.0 | 5.0 | 10 | 5000 |
| Volume resistance | 5000 | 5000 | 2.0 | 2.0 | 10 | 5000 |
| Water extract conductance | $60 \times 10^{-6}$ | $60 \times 10^{-6}$ | ... | ... | ... | ... |
| Combustion | | | | | | |
| Flame resistance: | | | | | | |
| Ignition time | ... | 90 | ... | 90 | ... | 90 |
| Burning time | ... | 90 | ... | 90 | ... | 90 |
| Flammability/Thickness-Inch | ... | V-0/3.2 | ... | V-0/ 1.6 | ... | V-0/ 1.6 |
| Toxicity when heated: | | | | | | |
| Carbon dioxide | ... | 15 000 | ... | 15 000 | ... | ... |
| Carbon monoxide | ... | 1000 | ... | 1000 | ... | ... |
| Ammonia | ... | 2500 | ... | 2500 | ... | ... |
| Aldehydes as HCHO | ... | 50 | ... | 50 | ... | ... |
| Cyanide as HCN | ... | 60 | ... | 60 | ... | ... |
| Oxide of nitrogen as $NO_2$ | ... | 100 | ... | 100 | ... | ... |
| Hydrogen chloride | ... | 100 | ... | 100 | ... | ... |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] The face of a test specimen is that area formed by the top or bottom force plug.
[C] To be recorded as the basis for determining initial voltage in step-by-step test.

**TABLE A5.2 Batch-Acceptance Test Requirements for Diallyl Iso-Phthalate Molding Compounds Mineral/Glass Filled**

| Property to Be Tested | Type GII-30 | Type GII-30F | Type MIG | Type MIG-F | Type SIG | Type SIG-F |
|---|---|---|---|---|---|---|
| Arc resistance | 115 | 115 | 115 | 115 | 115 | 115 |
| Dielectric constant at 1 MHz | 4.7 | 4.7 | 5.2 | 5.2 | 4.7 | 4.7 |
| Dielectric strength, step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 |
| Dissipation factor at 1 MHz | 0.023 | 0.023 | 0.025 | 0.025 | 0.023 | 0.023 |
| Flexural strength | 90 | 90 | 69 | 69 | 90 | 90 |
| Impact strength, side[A] | 147 | 147 | 19 | 19 | 27 | 27 |
| Water absorption | 0.5 | 0.5 | 0.7 | 0.7 | 0.5 | 0.5 |
| Water extract conductance | $60 \times 10^{-6}$ | $60 \times 10^{-6}$ | ... | ... | ... | ... |

[A] The side of the test specimen is that area formed by the chase of the mold.

## A6. MOLDING COMPOUNDS, DIALLYL ORTHO-PHTHALATE THERMOSETTING, CONTAINING MINERAL FILLERS, GLASS, OR POLYMERIC FILLERS

A6.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A6.2 *Requirements*—Qualification test requirements are specified in Table A6.1. Batch-acceptance test requirements are specified in Table A6.2.

A6.2.1 *Type GDI-30*— This type is a glass fiber-filled diallyl ortho-phthalate resin molding compound of low-loss, high-dielectric strength, low shrinkage, excellent moisture resistance, and relatively high-impact strength.

A6.2.2 *Type GDI-30F*— This type is the same as GDI-30 but is also flame-resistant.

A6.2.3 *Type GDI-300*— This type is a glass fiber-filled diallyl ortho-phthalate resin molding compound of low-loss, high-dielectric strength, low shrinkage, moisture resistance, and very high-impact strength.

**TABLE A6.1 Qualification Test Requirements for Diallyl Ortho-Phthalate Resin Molding Compounds, Mineral, Glass, or Polymer Fiber Filled**

| Requirement | Type GDI-30 | Type GDI-30F | Type GDI-300 | Type GDI-300F | Type MDG | Type MDG-F | Type SDG | Type SDG-F | Type SDI-5 | Type SDI-30 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mechanical/Physical | | | | | | |
| Compressive strength, endwise | 138 | 138 | 138 | 138 | 124 | 124 | 110 | 110 | 124 | 110 |
| Dimensional stability | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Flexural strength | 90 | 90 | 241 | 241 | 69 | 69 | 90 | 90 | 55 | 69 |
| Heat deflection temperature | 180 | 180 | 200 | 200 | 148 | 148 | 160 | 160 | 100 | 115 |
| Heat resistance | 130 | 130 | 130 | 130 | 90 | 90 | 100 | 100 | 80 | 90 |
| Impact strength, | | | | | | | | | | |
| Side[A] | 147 | 147 | 1600 | 1600 | 19 | 19 | 27 | 27 | 32 | 147 |
| Face[B] | 160 | 160 | 1600 | 1600 | 19 | 19 | 27 | 27 | 32 | 160 |
| Tensile strength | 41 | 41 | 124 | 124 | 41 | 41 | 41 | 41 | 24 | 24 |
| Water absorption | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.5 | 0.5 | 0.5 | 0.5 |
| | | | | Electrical | | | | | | |
| Arc resistance | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 100 | 115 |
| Dielectric breakdown: | | | | | | | | | | |
| Short-time test[C] | | | | | | | | | | |
| Step-by-step test | 45 | 45 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 |
| Short-time test[C] | | | | | | | | | | |
| Step-by-step test | 40 | 40 | 35 | 35 | 40 | 40 | 40 | 40 | 40 | 40 |
| Dielectric constant: | | | | | | | | | | |
| at 1 kHz | 4.6 | 4.6 | 5.0 | 5.0 | 5.0 | 5.0 | 4.6 | 4.6 | 4.1 | 4.1 |
| | 4.7 | 4.7 | 5.0 | 5.0 | 5.2 | 5.2 | 4.7 | 4.7 | 4.2 | 4.2 |
| at 1 MHz | 4.6 | 4.6 | 5.0 | 5.0 | 5.0 | 5.0 | 4.6 | 4.6 | 3.8 | 3.8 |
| | 4.7 | 4.7 | 5.0 | 5.0 | 5.2 | 5.2 | 4.7 | 4.7 | 3.9 | 3.9 |
| Dielectric strength: | | | | | | | | | | |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 |
| Step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 |
| Step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 |
| Dissipation factor: | | | | | | | | | | |
| at 1 kHz | 0.015 | 0.015 | 0.020 | 0.020 | 0.019 | 0.019 | 0.015 | 0.015 | 0.025 | 0.020 |
| | 0.018 | 0.018 | 0.025 | 0.025 | 0.020 | 0.020 | 0.015 | 0.015 | 0.028 | 0.025 |
| at 1 MHz | 0.020 | 0.020 | 0.025 | 0.025 | 0.025 | 0.025 | 0.020 | 0.020 | 0.035 | 0.025 |
| | 0.023 | 0.023 | 0.030 | 0.030 | 0.025 | 0.025 | 0.023 | 0.023 | 0.025 | 0.025 |
| Surface resistance | 5000 | 5000 | 5000 | 5000 | 5.0 | 5.0 | 10 | 5000 | 100 | 10 |
| Volume resistance | 5000 | 5000 | 5000 | 5000 | 2.0 | 2.0 | 10 | 5000 | 100 | 10 |
| Water extract | $60 \times 10^{-6}$ | $60 \times 10^{-6}$ | ... | ... | ... | ... | ... | ... | ... | ... |
| | | | | Combustion | | | | | | |
| Flame resistance: | | | | | | | | | | |
| Ignition time | ... | 90 | ... | 90 | ... | 90 | ... | 90 | ... | ... |
| Burning time | ... | 90 | ... | 90 | ... | 90 | ... | 90 | ... | ... |
| Flammability/Thickness-Inch: | ... | V-0/3.2 | ... | V-0/3.2 | ... | V-0/1.6 | ... | V-0/1.6 | ... | ... |
| Toxicity when heated: | | | | | | | | | | |
| Carbon dioxide | ... | 15 000 | ... | 15 000 | ... | 15 000 | ... | 15 000 | ... | ... |
| Carbon monoxide | ... | 1000 | ... | 1000 | ... | 1000 | ... | 1000 | ... | ... |
| Ammonia | ... | 2500 | ... | 2500 | ... | 2500 | ... | 2500 | ... | ... |
| Aldehydes as HCHO | ... | 50 | ... | 50 | ... | 50 | ... | 50 | ... | ... |
| Cyanide as HCN | ... | 60 | ... | 60 | ... | 60 | ... | 60 | ... | ... |
| Oxide of nitrogen as $NO_2$ | ... | 100 | ... | 100 | ... | 100 | ... | 100 | ... | ... |
| Hydrogen chloride | ... | 100 | ... | 100 | ... | 100 | ... | 100 | ... | ... |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] The face of the test specimen is that area formed by the top or bottom force plug.
[C] To be recorded as the basis for determining initial voltage in step-by-step test.

**TABLE A6.2 Batch-Acceptance Test Requirements for Diallyl Ortho-Phthalate Molding Compounds, Mineral, Glass, or Polymer Fiber Filled**

| Property to Be Tested | Type GDI-30 | Type GDI-30F | Type GDI-300 | Type GDI-300F | Type MDG | Type MDG-F | Type SDG | Type SDG-F | Type SDI-5 | Type SDI-50 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Performance Requirement for Each Compound | | | | | | | | | |
| Arc resistance | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 100 | 115 |
| Dielectric constant at 1 MHz | 4.7 | 4.7 | 5.0 | 5.0 | 5.2 | 5.2 | 4.7 | 4.7 | 3.9 | 3.9 |
| Dielectric strength, step-by-step | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Dissipation factor at 1 MHz | 0.023 | 0.023 | 0.030 | 0.030 | 0.025 | 0.025 | 0.023 | 0.023 | 0.025 | 0.025 |
| Flexural strength | 90 | 90 | 241 | 241 | 69 | 69 | 90 | 90 | 55 | 69 |
| Impact strength, side[A] | 147 | 147 | 1600 | 1600 | 16 | 16 | 27 | 27 | 32 | 147 |
| Water absorption | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.5 | 0.5 | 0.5 | 0.5 |
| Water extract conductance | $60 \times 10^{-6}$ | $60 \times 10^{-6}$ | ... | ... | ... | ... | ... | ... | ... | ... |

[A] The side of the test specimen is that area formed by the chase of the mold.

A6.2.4 *Type GDI-300F*— This type is the same as GDI-300 but is also flame-resistant.

A6.2.5 *Type MDG*—This type is a mineral-filled diallyl ortho-phthalate compound for use where good dielectric properties are required.

A6.2.6 *Type MDG-F*— This type is the same as MDG but is also flame-resistant.

A6.2.7 *Type SDG*—This type is a glass-filled diallyl ortho-phthalate resin compound of low-loss, high-dielectric strength, low shrinkage, good moisture resistance, and relatively low-impact strength.

A6.2.8 *Type SDG-F*— This type is the same as SDG but is also flame-resistant.

A6.2.9 *Type SDI-5*— This type is an acrylic polymer fiber-filled diallyl ortho-phthalate resin compound of low-loss, high-dielectric strength, good moisture resistance, and moderate-impact strength.

A6.2.10 *Type SDI-30*— This type is a polyethylene terephthalate fiber-filled diallyl ortho-phthalate resin compound of low-loss, high-dielectric strength, good moisture resistance, and high-impact strength.

A6.3 *Substitutability:* :

A6.3.1 Diallyl iso-phthalate molding compounds may be substituted for diallyl ortho-phthalate molding compounds, as follows:

| Diallyl Ortho-Phthalate Molding Compounds Type | Diallyl Iso-Phthalate Molding Compounds Substitute |
|---|---|
| GDI-30 | GII-30 |
| GDI-30F | GII-30F |
| MDG | MIG |
| MDG-F | MIG-F |
| SDG | SIG |
| SDG-F | SIG-F |

## A7. MOLDING COMPOUNDS, SILICONE, THERMOSETTING, CONTAINING MINERAL/GLASS FILLERS

A7.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A7.2 *Requirements*—Qualification test requirements are specified in Table A7.1. Batch-acceptance test requirements are specified in Table A7.2.

A7.2.1 *Type MSG*—This type is a mineral-filled silicone compound of low-loss, dielectric strength, and excellent heat resistance.

A7.2.2 *Type MSI-30*— This type is a glass-fiber-filled silicone compound of high-impact strength and heat resistance but somewhat poorer electrical properties than Type MSG.

**TABLE A7.1 Qualification Test Requirements for Silicone Resin Molding Compounds, Mineral/Glass Filled**

| Requirement | Type MSG | Type MSI-30 |
|---|---|---|
| Mechanical/Physical | | |
| Compressive strength, endwise | 103 | 69 |
| Flexural strength | 41 | 48 |
| Heat deflection temperature | 200 | 200 |
| Heat resistance | 150 | 150 |
| Impact strength, side[A] | 13 | 171 |
| Tensile strength | 17 | 14 |
| Water absorption | 0.50 | 0.50 |
| Electrical | | |
| Arc resistance | 210 | 175 |
| Comparative track index | | |
| Dielectric breakdown: | | |
| Short-time test[B] | | |
| Step-by-step test | 35 | 30 |
| Short-time test[B] | | |
| Step-by-step test | 35 | 30 |
| Dielectric constant: | | |
| at 1 kHz | 5.0 | 5.0 |
| | 5.2 | 5.5 |
| at 1 MHz | 4.7 | 4.7 |
| | 5.0 | 5.1 |
| Dielectric strength: | | |
| Short-time test | 12.8 | 6.3 |
| Step-by-step test | 11.8 | 4.9 |
| Short-time test | 11.8 | 3.0 |
| Step-by-step test | 10.8 | 2.0 |
| Dissipation factor: | | |
| at 1 kHz | 0.015 | 0.015 |
| | 0.020 | 0.050 |
| at 1 MHz | 0.010 | 0.010 |
| | 0.015 | 0.060 |
| Surface resistance | 1000 | ... |
| Volume resistance | 1000 | ... |
| Combustion | | |
| Flame resistance: | | |
| Ignition time | 90 | 90 |
| Burning time | 120 | 120 |
| Flammability | | |
| Rating | 94V-1 | 94V-1 |
| Thickness | 1.6 | 1.6 |
| Toxicity when heated: | | |
| Carbion dioxide | 15 000 | 15 000 |
| Carbon monoxide | 1000 | 1000 |
| Ammonia | 2500 | 2500 |
| Aldehydes as HCHO | 50 | 50 |
| Cyanide as HCN | 60 | 60 |
| Oxide of nitrogen as $NO_2$ | 100 | 100 |
| Hydrogen chloride | 100 | 100 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for initial voltage in the step-by-step test.

**TABLE A7.2 Batch Acceptance Test Requirements for Silicone Resin Molding Compounds, Mineral/Glass Filled**

| Property to Be Tested | Type MSG | Type MSI-30 |
|---|---|---|
| Arc resistance | 210 | 175 |
| Dielectric constant at 1 MHz | 5.0 | 5.1 |
| Dielectric strength, step-by-step | 10.8 | 10.8 |
| Dissipation factor at 1 MHz | 0.015 | 0.060 |
| Flexural strength | 41 | 48 |
| Impact strength, side[A] | 13 | 171 |
| Water absorption | 0.50 | 0.50 |

[A] The side of the test specimen is that area formed by the chase of the mold.

## A8. MOLDING COMPOUNDS, EPOXY THERMOSETTING, CONTAINING MINERAL/GLASS FILLERS

A8.1 The requirements for acquiring the product described herein shall consist of this specification sheet.

A8.2 *Requirements*—Qualification test requirements are specified in Table A8.1. Batch-acceptance test requirements are specified in Table A8.2.

A8.2.1 *Type MEC*—This type is a mineral-filled epoxy compound intended for encapsulation purposes.

A8.2.2 *Type MME*—This type is a mineral-filled, epoxy compound for use in encapsulation with good dielectric properties and arc and flame resistance.

A8.2.3 *Type MEG*—This type is a mineral-filled, general purpose, epoxy compound.

A8.2.4 *Type MEH*—This type is a mineral-filled, epoxy compound intended for applications requiring heat resistance.

**TABLE A8.1 Qualification Test Requirements for Epoxy Resin Molding Compounds, Mineral/Glass Filled**

| Requirement | Type MEC | Type MEE | Type MEG | Type MEH | Type GEI-5 | Type GEI-20 | Type GEI-100 | Type GEI-250 |
|---|---|---|---|---|---|---|---|---|
| | | | | Mechanical/Physical | | | | |
| Compressive strength, endwise | 138 | 138 | 138 | 138 | 172 | 172 | 172 | 179 |
| Dimensional stability | ... | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| Flexural strength | 83 | 83 | 83 | 83 | 103 | 110 | 110 | 241 |
| Heat deflection temperature | 130 | 130 | 130 | 175 | 130 | 150 | 175 | 200 |
| Heat resistance | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Impact strength, side[A] | 11 | 16 | 16 | 19 | 27 | 107 | 534 | 1334 |
| Tensile strength | 41 | 41 | 41 | 41 | 48 | 55 | 55 | 103 |
| Water absorption | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.25 |
| | | | | Electrical | | | | |
| Arc resistance | 120 | 180 | 150 | 150 | 150 | 130 | 130 | 120 |
| Dielectric breakdown: | | | | | | | | |
| Short-time test[B] | | | | | | | | |
| Step-by-step test | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Short-time test[B] | | | | | | | | |
| Step-by-step test | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| Dielectric constant: | | | | | | | | |
| at 1 kHz | 5.2 | 5.0 | 5.3 | 5.8 | 5.8 | 5.8 | 5.8 | 6.3 |
| | 5.4 | 5.2 | 5.5 | 6.0 | 6.0 | 6.0 | 6.0 | 6.6 |
| at 1 MHz | 5.0 | 4.8 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 6.0 |
| | 5.2 | 5.0 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 6.3 |
| Dielectric strength: | | | | | | | | |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 11.8 | 11.8 | 11.8 |
| Step-by-step test | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 10.8 | 10.8 | 10.8 |
| Short-time test | 12.8 | 12.8 | 12.8 | 12.8 | 12.8 | 11.8 | 11.8 | 11.8 |
| Step-by-step test | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 10.8 | 10.8 | 10.8 |
| Dissipation factor: | | | | | | | | |
| at 1 kHz | 0.018 | 0.018 | 0.020 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |
| | 0.020 | 0.020 | 0.025 | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 |
| at 1 MHz | 0.018 | 0.018 | 0.025 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 |
| | 0.020 | 0.020 | 0.030 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |
| Surface resistance | 1.0 | 10 | 6.0 | 100 | 10 | 10 | 10 | 10 |
| Volume resistance | 1.0 | 10 | 6.0 | 100 | 10 | 10 | 10 | 10 |
| | | | | Combustion | | | | |
| Flame resistance: | | | | | | | | |
| Ignition time | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Burning time | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Flammability | | | | | | | | |
| Rating | 94V-0 | 94V-0 | 94V-0 | 94V-0 | 94V-0 | 94V-0 | 94V-0 | 94V-0 |
| Thickness | 3.2 | 3.2 | 3.2 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |

[A] The side of the test specimen is that area formed by the chase of the mold.
[B] To be recorded as the basis for determining initial voltage in the step-by-step test.

**TABLE A8.2 Batch-Appearance Test Requirements for Epoxy Molding Compounds, Mineral/Glass Filled**

| Property to be tested | Type MEC | Type MEE | Type MEG | Type MEH | Type GEI-5 | Type GEI-20 | Type GEI-100 | Type GEI-250 |
|---|---|---|---|---|---|---|---|---|
| Arc resistance | 120 | 180 | 150 | 150 | 150 | 130 | 130 | 120 |
| Dielectric constant at 1 MHz | 5.2 | 5.0 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 6.3 |
| Dielectric strength, step-by-step | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | 10.8 | 10.8 | 10.8 |
| Dissipation factor at 1 MHz | 0.020 | 0.020 | 0.030 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |
| Flexural strength | 83 | 83 | 83 | 83 | 103 | 103 | 110 | 241 |
| Impact strength, side[A] | 11 | 16 | 16 | 19 | 27 | 107 | 534 | 1334 |
| Water absorption | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.25 |

[A] The side of the test specimen is that area formed by the chase of the mold.

A8.2.5 *Type GEI-5*— This type is a glass-filled epoxy compound of moderate-impact strength.

A8.2.6 *Type GEI-20*— This type is a glass-filled epoxy compound with good impact strength.

A8.2.7 *Type GEI-100*— This type is a glass-filled epoxy compound having high-impact strength.

A8.2.8 *Type GEI-250*— This type is a glass-filled epoxy compound with very high-impact strength.

## SUMMARY OF CHANGES

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

*D 5948 - 96(02)$^{\epsilon 1}$:*

(*1*) Editorially added references to thermoset molding standards to Section 2.2.