

## VINYLESTER SMC - COMPRESSION MOLDED

## GMP.UP.018

**1 SCOPE.** This specification covers the properties of an unsaturated vinylester, reinforced with randomly oriented 50:50 mixture of 12.5 and 25 mm glass fibers, that is compression molded.

1.1 APPLICATIONS. Typical application for this material is an engine cam cover.

## 2 REFERENCED STANDARDS.

|            |          |           |
|------------|----------|-----------|
| GMW3059    | ISO 62   | ISO 1183  |
| GM9077P    | ISO178   | ISO6603-2 |
| ASTM C177  | ISO 527  | ISO 6721  |
| ASTM D2584 | ISO 1172 | ISO 8302  |

**3 TEST PROCEDURES.** Tests shall be conducted using the latest issue of the test methods indicated. Suitable precautions should be taken to ensure that applicable safe limits are not exceeded when conducting test procedures, processes, and/or handling the materials required by this specification.

3.1 Determine the material properties using test specimens router cut from compression molded test plaques. These plaques shall be molded using the mold temperatures, mold pressure and cure cycle that will be used to mold production parts. Each material vendor shall define these molding conditions in the certifiable data package. The length and width of the test mold, as well as the charge pattern, shall be as shown in Figure 1. Plaques shall be 2.5 - 3.0 mm thick. Weight variation between plaques shall not exceed  $\pm 3.0\%$ .

3.2 Raw materials used for compounding shall be within their vendor defined shelf life. Plaques shall be molded 7 days max after compounding. At least 1 radiograph of the molded plaque per batch should be included with the data for initial material approval. Plaques shall be flat and uniform in appearance and free from blisters, pregels, knit lines, cracks, and surface contamination. Porosity shall be 1 pit max per 625 mm<sup>2</sup>. Surfaces shall be free of external mold release. (Mold and scrap a min of 3 plaques after using external mold release.)

3.3 An equal number of specimens shall be cut from both the longitudinal and transverse plaque directions for each mechanical property. All mechanical property testing should be done on samples cut out from plaques and not on as molded samples. The results of all the samples should be reported and not just the min value. The average value is the material property value. This value is compared to the required value shown in the Compound Properties table(s).

3.4 Tests shall be conducted 40 h min after molding and immediately following a conditioning period of 24 h min @ 22  $\pm 3^{\circ}\text{C}$  and 50  $\pm 5\%$  RH unless otherwise specified. All testing shall be done on unannealed samples.

## 4 COMPOUND PROPERTIES.

4.1 RESTRICTED AND REPORTABLE SUBSTANCES FOR PARTS (GMW3059). All materials supplied to this specification must comply with the requirements listed in GMW3059, **Restricted and Reportable Substances for Parts**.

4.2 COMPOUND CERTIFICATION. Material suppliers must certify molding compound properties to the specific GM Test Sampling Plan approved for their material.

4.3 CONSTITUENT MATERIALS. Individual specifications for the materials which constitute the SMC molding compound shall be established by the molder. Incoming materials shall be approved to those specifications by the molders laboratory before release for production. Test results shall be maintained by the molder and be available for GM review.

## 5 SUGGESTED COMPOUND VERIFICATION.

Inherent compound properties and test procedures that may be used to identify this material are listed below. The test value and test procedure requirements are identical to those listed in section 4, Compound Properties.

Filler Content  
Glass Fiber Content  
Infrared Characterization Scan  
Specific Gravity

## 6 COMPOUND AND SOURCE APPROVAL.

Each vehicle group and component division will have its own approved compound list. No shipment shall be made by a new source until a sample of the compound manufactured at a production facility has been approved by the appropriate vehicle group and/or component division. Shipment receipt and certification requirements will vary among receiving locations.

6.1 A completed copy of the GM Material Safety Data Sheet (available from a GM Materials Engineering Laboratory or engineering department) must be submitted with any new submissions or when a composition change has occurred.

**7 IDENTIFICATION.** The molding compound shall be identified by the specification code, the manufacturer's identification code and lot number, along with any division requirements.

**8 INSPECTION AND REJECTION.** The purchaser reserves the right to sample incoming shipments even though it is the responsibility of the supplier to meet the requirements stated without dependence upon the purchaser's inspection. The supplier (whether prime contractor or subcontractor) will forfeit qualification if a change is made in material, processing methods, testing methods, or location of manufacture without prior written request to and subsequent approval from the purchaser.

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**9 GENERAL INFORMATION.** This standard was originated by the Plastics Committee in June 1999 and published in October 1999.

TABLE 1 - COMPOUND PROPERTIES (NATURAL, GRAY AND BLACK)

| Properties                        | Test Values  | Test Methods                                                                                                                                  |
|-----------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Glass Fiber Reinforcement         | 30 - 38%     | TGA GM9077P or ASTM D2584/ISO 1172                                                                                                            |
| Moisture Absorption               | 0.23% max    | ISO 62 (80) Method 1                                                                                                                          |
| Specific Gravity                  | 1.68 - 1.92  | ISO 1183 Method A(87)                                                                                                                         |
| Flexural Modulus @ +22°C          |              | ISO 178 (93) Method 1. Three point loading.                                                                                                   |
| Secant 0.5 mm deflection          | 9400 MPa min | 1.3 mm/minute, 70 mm length,                                                                                                                  |
| Secant 2.5 mm deflection          | 6000 MPa min | 10 mm wide, thickness 2.5-3.0 mm, 60 mm span, secant calculations @ 0.5 and 2.5 mm deflection.                                                |
| Flexural Modulus @ +150°C         |              | ISO 178 Method 1                                                                                                                              |
| Secant 0.5 mm deflection          | 5200 MPa min | Three point loading.                                                                                                                          |
| Secant 2.5 mm deflection          | 4400 MPa min | 1.3 mm/minute, 70 mm length, 10 mm wide, thickness 2.5-3.0 mm, 60 mm span                                                                     |
| Flexural Strength @ +22°C         | 145 MPa min  | ISO 178 (93), Method 1. Three point loading. 1.3 mm/minute, 70 mm length, 10mm wide, thickness 2.5-3.0 mm, 60 mm span                         |
| Flexural Strength @ +150°C        | 75 MPa min   | ISO 178 Method 1. Three point loading. 1.3 mm/minute, 70 mm length, 10mm wide, thickness 2.5-3.0 mm, 60 mm span                               |
| Tensile Strength @ Break @ +22°C  | 55 MPa min   | ISO 527                                                                                                                                       |
| Tensile Strength @ Break @ +150°C | 40 MPa min   | ISO 527                                                                                                                                       |
| Tensile Modulus @ +22°C           | 7300 MPa min | ISO 527                                                                                                                                       |
| Tensile Modulus @ +150°C          | 4200 MPa min | ISO 527                                                                                                                                       |
| High Speed Instrumented Impact    |              | ISO 6603-2. Speed of testing, 2.2 m/s                                                                                                         |
| Maximum Load                      | 1.8 kN min   |                                                                                                                                               |
| Deflection to max Load            | 5.1 mm max   |                                                                                                                                               |
| Energy to max Load                | 4.9 J min    |                                                                                                                                               |
| Total Energy                      | 9.9 J min    |                                                                                                                                               |
| Glass Transition Temperature      | 180°C min    | ISO 6721. Peak in tan $\delta$ . Temperature scan from -20 to 200°C @ 5°C/min. Three point bending a frequency of 1 Hz. Flex modulus @ 150°C. |
| Thermal Conductivity              | 0.5 W/m.K    | ASTM C177 or ISO 8302.                                                                                                                        |