GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16

High Density Polyethylene - High Molecular Weight, Blow Moldable

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Material Description. This specification describes material types of high molecular weight, high density polyethylene (HDPE), which are used in blow molded form for plastic parts in the fuel system or extruded sheet for thermoforming applications. The described material types shall possess high impact and excellent Environmental Stress Cracking Resistance (ESCR).

1.2 Symbols. The material abbreviation according to ISO 11469 is >PE-HD<.

1.3 Applicability. Blow molded fuel filler pipes, fuel tanks and their components.

1.4 Remarks. The classification into types is according to the different melt flow rates. If no type is specified on the drawing, the default is T1.

- **T1:** Low fractional melt 3.0 to 9.0 for layers used in multilayer and some monolayer fuel tank designs. Resins to Type 1 will only be given full approval in MATSPC after a fuel tank has been validated for a GM program.
- **T2:** Medium fractional melt 7.0 to 11.5 for monolayer fuel tank and windshield washer containers under high stress conditions, injection molded components compatible for welding to fuel tanks, and extruded sheet for thermoforming applications.
- **T3:** High fractional melt 10.0 to 17.0 for injection molded components compatible for welding to fuel tanks.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 306	ISO 1133-2	ISO 1872-2	ISO 16770
ISO 527-1/2	ISO 1183	ISO 11469	

2.2 GM Standards/Specifications.

GMW3013	GMW3059	GMW3221

3 Requirements

3.1 Requirements on Test Specimens. Unless otherwise specified, compression molding of test specimens shall be accomplished per ISO 1872-2. Test methods and specimen dimensions are also to be in accordance with ISO 1872.

All tests shall be performed on unannealed specimens 40 h minimum after molding and immediately following a conditioning period of 24 h in a controlled atmosphere per GMW3221, Code A, unless otherwise specified.

The minimum values specified in Table 1 shall be met by test specimens in natural or black.

3.2 Requirements on Delivery. Important physical, mechanical and thermal properties that characterize the material are summarized in charts.

Note: For each product, the requirements to Table 1 shall be documented by Certification Statement according to GMW3013.

3.3 Chemical Requirements. All parts manufactured from molding compounds shall be resistant to the media they contact at their place of use.

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3.4 Compound Properties. See Table 1. The following are also required for full specification approval and the minimum number of lots per test required is one in natural: Poisson's Ratio, Stress/Strain Curve at +23 °C, Differential Scanning Calorimeter Curve, and Infrared Spectroscopy Curve. See the polyethylene certification template for the test procedures.

3.5 Performance Requirements. Performance requirements shall be specified on part drawings or in component specifications.

Table 1: Compound Properties (Natural and Black)

Property	Standard Note1	Unit	T1 Value	T2 Value	T3 Value
Melt Flow Rate Note 2 MFR 190/21.6	190 C with 21.5 kg weight per ISO 1133-2 Condition G, Procedure A	g/10 minutes	3.0 to 9.0	7.0 to 11.5	10.0 to 17.0
Melt Volume Rate Note 2 MVR 190/21.6	190 C with 21.5 kg weight per ISO 1133-2 Condition G, Procedure B	cm^3/10 minutes	4.0 to 9.0	-	12.0 to 21.0
Density	ISO 1183	g/cm^3	Target Range 0.944 to 0.947	Target Range 0.945 to 0.953	Target Range 0.935 to 0.955
Vicat Softening Temperature	ISO 306	°C	Target ≥120	Target ≥123	Target ≥115
Tensile Modulus	ISO 527-1/2	MPa	850 to 1300	1000 to 1500	≥ 650
Tensile Stress at Yield	ISO 527-1/2	MPa	≥19	≥23	≥17
Tensile Strain at Break	ISO 527-1/2	%	≥400	≥400	≥400
Tensile Strain at Yield	ISO 527-1/2	%	≥7.5	≥9.0	7.0 to 12.0
Full Notch Creep Test Note 3 4.0 MPa, 2% Arkopal N 100, 80 °C	ISO 16770	h	≥50	-	≥25
Environmental Stress Cracking Resistance Note 3	ISO 1872-2, Table 4, Condition B, F50, 10% Igepal Solution	h	>400	-	-
Environmental Stress Cracking Resistance Note 3	ISO 1872-2, Table 4, Condition B, F50, 100% Igepal Solution	h	-	>700	>900

Note 1: Standard test specimen and test setup should follow GMW3013.
Note 2: Either test may be run to determine Melt Flow Rate or Melt Volume Rate.
Note 3: Either test may be run to determine the level of stress cracking resistance.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

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