



Thermoplastic Tubing for Hot Diesel Fuel Lines

1 Introduction

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 Purpose. This standard covers the requirements for thermoplastic tubing supplied to finished dimensions and sizes in accordance with the relevant engineering drawing used exclusively for the lines of the diesel fuel system.

1.2 Applicability. Thermoplastic tubing supplied to finished dimensions and sizes in accordance with the relevant engineering drawing used exclusively for the lines of the diesel fuel system.

This standard shall not be used for lines of the gasoline fuel system.

Direct contact between the fuel pipes and materials containing chlorine, as for example adhesive tapes made of polyvinyl chloride (PVC) is not allowed, because nascent chlorine resulting from high temperature decomposition may cause cracks in the polyamide 12 (PA12) outer layer.

The operating temperature range of the tubing is (-40 to +125) °C with peak temperatures up to +140 °C.

1.3 Remarks.

1.3.1 Application. Corresponding to the application conditions, the following two types are covered:

1.3.1.1 Type A. Flexible hot diesel fuel line.

1.3.1.2 Type B. Rigid hot diesel fuel line.

1.3.2 Tubing Diameter. The following tubing diameter sizes are applicable.

Table 1: Dimensions

Code	Tubing Diameter
8	(8 ± 0.1) mm × (1 ± 0.1) mm
10	(10 ± 0.1) mm × (1 ± 0.1) mm
12	(12 ± 0.15) mm × (1 ± 0.1) mm

2 References

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

2.1 External Standards/Specifications.

DIN 73378	IEC 60684-2	ISO 527-2	ISO 1817
EN 590	ISO 178	ISO 1043-1	ISO 1874-1
EN 14214	ISO 179-1	ISO 1133	ISO 16152
EN 60243-2	ISO 527-1	ISO 1167	SAE J2260

2.2 GM Standards/Specifications.

GMW3059	GMW14700	GMW16177
GMW3356	GMW14914	GMW16331
GMW14681	GMW15416	GMW17332

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities. According to the relevant test method.

3.1.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.2 Equipment. According to the relevant test method.

3.1.3 Test Vehicle/Test Piece. If not otherwise stated, the size, dimensions and number of test pieces shall be as specified in the relevant test methods for the property concerned.

For the tests in paragraphs 4.3.11 thru 4.3.13, the mechanical specified value of yield stress (see paragraph 4.3.1) and strain at break (see paragraph 4.3.2) shall be used as reference.

3.1.4 Test Time. Not applicable.

3.1.5 Test Required Information. Not applicable.

3.1.6 Personnel/Skills. Not applicable.

3.2 Preparation. Not applicable.

3.3 Conditions.

3.3.1 Environmental Conditions. Unless otherwise specified in the relevant tests, tests shall be performed in the as-received condition after storage at $(+23 \pm 5)^\circ\text{C}$ and $(50 \pm 6)\%$ relative humidity for ≥ 48 h without any pre-conditioning.

3.3.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

3.4 Instructions. Not applicable.

3.5 Data. Not applicable.

3.6 Safety. This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.7.1 Test Results. The results of the tests shall be summarized in a test report.

4 Requirements and Procedure

Note: All requirements shall be met by any part of the tubing. Each measurement shall meet the required value. All requirements shall be met by the moulded part.

4.1 General.

4.1.1 Material. The extruded tubing shall be made of one material. This material shall be a PA12 with an additional, particularly effective stabilization to avoid the degradation of the material in hot diesel fuel and in hot air. The material shall also be resistant against ultraviolet (UV) radiation.

- Type A: PA12-HIPHL Type 1 according to DIN 73378 specially stabilized for hot diesel applications.
- Type B: PA12 specially stabilized for hot diesel applications.

4.1.2 Appearance. In the as received condition, the tubes shall be free from manufacturing faults (e.g., blisters, voids, in homogeneities, foreign substances).

4.1.3 Dimensions. Dimensions as specified on the part drawing.

If not otherwise specified on the part drawing, the tolerance for diameter and for the wall thickness shall be according to paragraph 1.3.2.

4.1.4 Color. The coloration of the outer layer of the tubing shall be permanently uniform. If not otherwise specified on the part drawing, the color of the outer layer of the tubing shall be black or brown.

4.1.5 Ultraviolet Stabilization. A sufficient stability against exposure to sunlight (UV radiation) is required.

4.1.6 Operating Characteristics. The continuous temperature range for the use is (-40 to +125) °C with peak temperatures up to +140 °C. The peak temperatures can make up to 100 h in the lifetime of the vehicle.

4.1.7 Part Identification. The tubing shall be marked according to GMW16331.

4.2 Characteristics. The characteristic properties of the tubing shall be as specified in Table 2. The required Test Procedures are specified in 4.3.

Table 2: Physical Properties

Property	Type						Unit	Paragraph/Test
	A			B				
	8	10	12	8	10	12		
Yield Stress	≥ 25			≥34			MPa	4.3.1 / ISO 527-1, ISO 527-2
Strain at Break	≥ 150						%	4.3.2 / ISO 527-1, ISO 527-2
Reference Stress								4.3.3 / DIN 73378
at (+23 ± 5) °C	≥ 24			≥ 40			MPa	
at (+140 ± 3) °C	≥ 6			≥ 8			MPa	
Impact Behavior	no break						J	4.3.4 / DIN 73378 ISO 179-1
Burst Pressure								4.3.5 / ISO 1167
at (+23 ± 5) °C	≥ 60	≥ 47	≥ 38	≥ 100	≥ 78	≥ 64	bar	
at (+140 ± 3) °C	≥ 15	≥ 12	≥ 10	≥ 20	≥ 16	≥ 13	bar	
Flexural Test								4.3.6 / ISO 178
Maximum Flexural Force F _{max}	≤ 35	≤ 50	≤ 70	≤ 85	≤ 103	≤ 135	N	
Deflection at F _{max}	≥ 12	≥ 8	≥ 8	≥ 6	≥ 5	≥ 4	mm	
Flexural Force F at 3.5 mm Deflection	≤ 17	≤ 30	≤ 43	≤ 55	≤ 80	≤ 110	N	
Minimum Bend Radius ^{Note 1}	≤ 35	≤ 57	≤ 68	≤ 40	≤ 60	≤ 93	mm	4.3.7 / SAE J2260
Melt Volume-Flow Rate								4.3.8 / ISO 1133
MVR 250/10 in as received condition	≤ 25			≤ 15			cm ³ / 10 minutes	
MVR 250/10 after ageing	≤ 0.5						cm ³ / 10 minutes	
Extractables	12 to 14			≤ 3			% by mass	4.3.9 / ISO 16152