



Hose for Particulate Filter Applications

1 Scope

This specification covers single wall rubber tubing for Hose Exhaust Pressure Difference Sensor applications. Parts are intended to withstand continuous service temperatures as defined for the respective class and type, see Table 1. The rubber materials described by this specification are suitable for the transport of air contaminated with fuel or other hydrocarbon vapor/condensate.

1.1 Material Description.

Table 1: Material and Temperature Range

Class	Type	Material (Single Layer Tube)	Continuous Temperature ^{Note 1}	Excursion Temperature ^{Note 2}
A	1	Ethylene acrylate copolymer (AEM)	-30 °C to +160 °C	+175 °C
A	2	Ethylene acrylate copolymer (AEM)	-40 °C to +160 °C	+175 °C
B	1	Fluorocarbon Rubber (FKM) peroxide cured	-30 °C to +200 °C	+230 °C

Note 1: As defined by Cold Flexibility (Table 3) and Long-Term Heat Aging (Table 2) respectively.

Note 2: The time at temperature test criteria for excursion temperatures is in Table 2. End use applications must be evaluated using other relevant means to determine the true excursion capability.

1.1.1 Tube Marking. The tube shall be legible marked with the following information: Association of Rubber Products Manufacturers (ARPM) identification code and date code. Such marking shall be printed parallel to the axis in block letters not less than 3 mm high and the open space between the specified markings shall not be greater than 25 mm.

1.1.2 The date code shall consist of six digits: The first two digits shall represent the month (01 through 12) of the year, the next two shall represent the day of the month (01 through 31), and the last two shall be the last two digits of the year.

1.2 Symbols. Not applicable.

1.3 Applicability. Elastomeric tubing for Hose Exhaust Pressure Difference Sensor applications exposed to exhaust gas vapor.

2 References

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

2.1 External Standards/Specifications.

ASTM D297	ASTM D573	ISO 48	ISO 1431-1
ASTM D380	ASTM D624	ISO 188	ISO 1817
ASTM D395	ISO 34-1	ISO 815-1	ISO 23529
ASTM D412	ISO 37	ISO 845	

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW16678	GMW17557
GMW3221	GMW16317	GMW17205	GMW17821

2.3 Additional References.

- Association of Rubber Products Manufacturers (ARPM) OS6, 7321 Shadeland Station Way, Suite 285, Indianapolis, Indiana 46256, (www.arpm.com)
- CG5335 Elastomer Finite Element Data Request Form (ID)
- CG5339 Data Reporting Sheet
- Component Statement of Requirements (SOR)
- Component Technical Specification (CTS)
- Safety and Industrial Hygiene (S&IH) Technical Standard (TS), S&IH TS 3.4-160-02

(ID) This document is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

3.1.1 Test Samples. Unless otherwise specified, the shape and size of test pieces shall be in accordance with the relevant test procedure.

3.1.1.1 Samples are finished parts or to be taken from finished parts. Where the dimensions on the finished parts do not allow preparing of test pieces, tests are to be performed on sheet material of same production batch. The same state of cure between slabs or buttons and finished parts must be assured by appropriate tests, which must be described in the test report. The minimum time between vulcanization and testing of elastomers shall be 72 h.

3.1.1.2 If not otherwise stated, mechanical properties in delivery state and after heat or fluid immersion are to be tested at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and with the same test methods. Unless otherwise stated, ambient temperature test conditions shall be held to $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. Unless otherwise stated, all other temperatures except shall be held to $\pm 3\text{ }^{\circ}\text{C}$. Part compression set or micro-hardness measurements shall be run to GMW17821.

3.1.1.3 Elastomer Test Specimen Preparation. Die-cut specimens used to develop Table 2 properties are prepared from ASTM D3182 or ISO 23529 sheet stock molded to the same conditions for actual parts with post cure if applicable. As an option, specimens from non-post cure compounds may be used from production molds. Report cure time and temperature conditions for all molded specimens.

3.1.2 Conditioning. Conditioning shall be as specified in the relevant test method.

3.1.3 Equipment. Conforming to the relevant test method.

3.1.3.1 Test fixture Kink Resistance. Test fixture shall consist of a flat plate approximately 25 mm thick with holes not to exceed hose outer diameter (OD) by more than 1.6 mm and separated by the center distances specified in Table 4.

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

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

3.1.6 Facilities. Conforming to the relevant test method.

3.1.7 Deviations. Deviations from the requirements of this specification shall have been agreed upon between supplier and end user. Such deviations shall be specified on component drawings, test certificates, reports, etc.

3.2 Dimensions and Tolerances. Tube dimensions and tolerances shall be as specified by the purchaser.

3.3 Material and Performance Requirements.

3.3.1 Design or Product Validation Testing. Material and performance properties are summarized in Table 2. For full approval of a tube compound, compliance to the requirements of Table 2 and Table 3 is needed. Three (3) to five (5) samples of material of at least three (3) production lots from each mixing location, shall be tested to each of the requirements for Design or Product Validation Testing. A GM data reporting sheet is

available for this standard and will be used to submit all test results. The supplier shall work with Global Propulsion Systems Engine Materials Engineering to comprehend the requirements of template document CG5339.

3.3.2 Product Validation Testing. If not defined otherwise, the following testing should be done for production audit testing.

- All tests per Table 2.
- Table 3 Tests: Burst Test.

3.3.3 Audit/Inspection Testing. If not defined otherwise, the following testing should be done for production audit testing.

- All tests per Table 2, except Long Term Age Resistance and Ozone.
- Table 3 Tests: Burst Test.

3.3.4 Compound Characterization for Finite Element Modeling. All elastomeric compound qualifying to this standard must also be entered into the hyper-elastic GM Materials Approved Source List for finite element modeling unless otherwise specified by the Component Statement of Requirements (SOR) or Component Technical Specification (CTS). Axel Products, Incorporated is GM's sole global contract test facility as the equipment and test methods used are unique and confidential. A finite element development form is submitted with each elastomeric compound. Table 1 in CG5335 shows where in the part and compound development process the data is characterized for hyper-elastic modeling.

3.3.5 Global or Cross Regional Compounds. Compound formulations produced in more than one (1) mix facility but sharing a common compound identification, shall be subject to review. The level of testing and approval may be by polymer source and/or mix site depending on the variation permitted in ingredient selection and process conditions. Approvers are responsible for tracking production compound history and managing local variation as part of the formal approval process. Approval and material database records will capture the relevant mix locations.

3.3.6 Contingency. As part of the approval process, each compound supplier shall have a designated alternative mix operation. Compound from that location(s) shall be evaluated to 3.3.1.

3.3.7 Supplemental Tests – Resistance to Exhaust Gas Vapor. Elastomers for tubing exposed to exhaust gas vapor must be tested and meet all the requirements of Table 2 (naturally aspirated and turbo gas engines) or (turbo diesel only). Pressure vessel testing is required for the Table 2 test conditions. No change in test fluid is required for the tests. Those laboratories with a GMW16678 setup, may use it (replace the 35 kPa (5 psig) valve with a 690 kPa (100 psig) valve) because constant test fluid stirring is part of the equipment. To maintain consistent results over time, always use the same volume of test fluid to specimen volume.

3.3.8 Document References and Changes. Use the latest published version at the time of submission for first approval. The following subsection addresses whether or not an approved material still meets the standard when one (1) or more of the procedures referenced in the standard changes after it was first approved.

3.3.8.1 Role and Responsibility for Notification. After first approval, if the referenced standard changes, GM expects the tiered supplier (1, 2, 3, etc.) to monitor industry standard documents for changes and evaluate the impact of the change to determine if it affects required limits. GM is responsible for timely notification to suppliers of its own test standards referenced in this document.

3.3.8.2 New Data Requirements and Timing Resulting from Specification Content Change. A change herein is defined as procedural and/or a new limit or range requirement. *Data reporting is required only where the change level affects specified limits (however testing still must occur).* The appropriate tier supplier is only required to test to a change(s) that occurred since the supplier's initial full data approval. Data must be submitted to GM Material Engineering within 180 business days of the published revision in GM Global Document Management (GDM) for GM Standards, or the date the document arrives at the external standards contract distributor. Time limits may be extended for regulatory health and safety issues only. No testing is required if the revised document has no changes (revision date only change) or if the changes do not involve fit, form or function as defined in GMW17205.

3.3.8.3 How Document Changes Affect Material Compliance. All product produced after the changes are published in GDM, shall meet the new requirements according to 3.3.8.2. Product approved under the previous edition requirements and already in the delivery pipeline or in inventory will be used until the product is used.

Decisions involving regulatory changes will be handled separately, and existing product may be immediately removed as a result.

3.3.8.4 Any previously approved compound failing to meet the changing requirements will be removed from GM Materials Approved Source List by the Materials Global Elastomers Team.

3.3.9 Tube Interior Cleanliness. The inside of the tube shall be free of any soap, soapstone, talc, or other substance which could interfere with attaining a satisfactory clamping load, which could act as a lubricant resulting in unsatisfactory retention on fittings or other foreign materials, or which could have an adverse effect on the normal function of any portion of the coolant system.

3.3.10 Tube Kink Resistance. Outer diameter (OD) of hose shall collapse no more than 25% when tested according to 3.3.10.1.

3.3.10.1 Cut hose specimen to length specified in Table 4. Condition at room temperature for 2 h. Measure OD at the approximate center of the specimen length. Using the test fixture described in 3.1.3.1, insert one (1) end of the hose into one (1) hole, carefully bend the hose (in the direction of natural curvature) and insert remaining hose end into the other hole. To prevent excessive kinking or collapse, do not over-bend or bend hose with sharp motion. Within 30 seconds, measure OD at the point of greatest collapse.

3.3.10.2 Test fixture shall consist of a flat plate approximately 25 mm thick with holes not to exceed hose OD by more than 1.6 mm and separated by the center distances specified in Table 4.

3.3.11 Ovality. The as received tubing shall not be out-of-round to the extent that a steel test ball equal to the diameter in Table 5 for the nominal Inner Diameter (ID) will not roll freely when tested to 3.3.11.1.

3.3.11.1 Ovality Test. Condition a 275 mm length tube specimen for 2 h at room temperature. With the tube in a straight position (free state and unstressed) insert a steel ball of diameter equal to that shown in Table 5 consistent with the nominal tubing inside diameter. Roll the ball from one end to the other twice.

Table 2: Material Properties

Property	Test Procedure	Unit	Value
Micro-Hardness			
All Classes	ISO 48 Method M or ASTM D1415	IRHD	70 ± 4
Density			
All Classes	ASTM D297, hydrostatic method or ISO 845		As reported ± 0.02
Elongation at Break			
All Classes	ISO 37, dumb-bell Type 2 or Type 4, 200 mm/minute ± 20 mm/minute or ASTM D412, Die C	%	200 minimum
Tensile Strength			
All Class A	ISO 37, Type 2, 200 mm/minute ± 20 mm/minute or ASTM D412, Die C	MPa	10 minimum
Class B	ISO 37, Type 2, 200 mm/minute ± 20 mm/minute or ASTM D412, Die C	MPa	7 minimum
Tear Strength			
All Class A	ISO 34-1, Method A ASTM D624, Die C or ISO 34-1, Method B, Angle Die 500 mm/minute	N/mm kN/m	4.5 minimum 18 minimum
Class B	ISO 34-1, Method A ASTM D624, Die C or ISO 34-1, Method B, Angle Die 500 mm/minute	N/mm kN/m	2.5 minimum 10 minimum