



Small Diameter Fuel Vapor and Oil Hoses

1 Scope

This standard covers the material requirements of hoses for use with gasoline, oil, and related evaporative and vacuum systems. These hoses are not recommended for applications involving liquid fuel. Hoses are intended to withstand continuous service temperatures from -40 °C to 125 °C. The material content of the hose is defined by the construction class designation for the hose. These hoses are not recommended for usage with diesel fuel systems or for applications where low fuel permeation is a requirement.

1.1 Material Description. Each hose type shall be defined by construction. The designation for the hose is defined as GMW17507 Type Y, where Y defines the construction of the hose per 3.2.1, and Table 1.

1.1.1 Construction Type A. Hoses are defined as consisting of a smoothbore tube of Nitrile Butadiene Rubber (NBR) copolymer compound and a cover of Chlorosulfonated Polyethylene (CSM) or Chlorinated Polyethylene (CPE) compound.

1.1.2 Construction Type B. Hoses are defined as consisting of a smoothbore tube of Nitrile Butadiene Rubber (NBR) copolymer compound reinforced with polyester fiber yarn or cord applied by braiding, knitting or circular weaving or of two ply counter directional helical winding, and a cover of CSM or CPE compound.

1.1.3 Construction Type C. Hoses are defined as consisting of a single wall of non-blooming Ethylene Epichlorohydrin oxide (ECO) copolymer.

1.1.4 Construction Type D. Hoses are defined as consisting of a smoothbore tube and cover of non-blooming Epichlorohydrin Homopolymer (EC) reinforced with polyester fiber yarn or cord applied by braiding, knitting or circular weaving or of two (2) ply counter directional helical winding.

1.2 Symbols. Not applicable.

1.3 Applicability. Fuel and oil resistant hoses with lower permeation and temperature requirements.

1.4 Remarks. Oil hoses for higher temperature applications are specified in GMW16171; fuel hoses with good permeation properties and higher temperature capability are specified in GMW16709; Blow-By and vacuum hoses for higher temperature exposure are specified in GMW17391.

2 References

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

2.1 External Standards/Specifications.

ASTM D380	ISO 34-1	ISO 48	ISO 1817
ASTM D412	ISO 36	ISO 188	ISO 23529
ASTM D413	ISO 37	ISO 1431-1	

2.2 GM Standards/Specifications.

GMW3059	GMW14292	GMW15423	GMW16955
GMW14270	GMW14680	GMW16171	GMW17391
GMW14291	GMW14914	GMW16709	

3 Requirements

3.1 Resources.

3.1.1 Test Samples. Unless otherwise specified, the shape, size, and number of test pieces shall be in accordance with the relevant test methods. Minimum of three (3) test samples (hoses) are required for inspection testing. Report both individual and averaged values. Unless otherwise specified, samples are finished parts or to be taken from finished parts. Where the dimensions of the finished parts do not allow preparing of test pieces, tests are to be performed on sheet material of the same production batch. Tests must be carried out to confirm same state of cure between sheet material and finished parts. 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.

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

3.1.2.1 Environmental Conditions. The minimum time between vulcanization and testing of elastomers shall be 72 h. The test pieces shall be maintained at a temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for at least 8 h prior to test and shall be free from strain during this period. Ambient temperature test conditions shall be held to $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. All other temperatures shall be held to a $\pm 3\text{ }^{\circ}\text{C}$ and all pressures to $-0\text{ kPa} + 690\text{ kPa}$ unless otherwise noted.

3.1.3 Equipment. Conforming to the relevant test methods.

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 standard shall be determined correctly with respect to its physical definition.

3.1.6 Facilities. Conforming to the relevant test methods.

3.1.7 Deviations. Deviations from the requirements of this specification shall have been agreed upon by the GM Materials Engineer generating the engineering source approval. Such deviations shall be specified on component drawings, test certificates, reports, etc.

3.2 Hose Construction.

3.2.1 Construction. The construction of the hoses defines the material content and construction of the hoses. The following materials are used in the various constructions.

- Nitrile Butadiene Rubber (NBR)
- Epichlorohydrin Homopolymer (non-blooming) (EC)
- Ethylene/Epichlorohydrin Oxide Copolymer (non-blooming) (ECO)
- Chlorosulfonated Polyethylene (CSM)
- Chlorinated Polyethylene (CPE/CM)

Hose requiring reinforcement shall be reinforced between tube and cover with polyester fiber yarn or cord applied by braiding, knitting or circular weaving or of two (2) ply counter directional helical winding, unless otherwise noted. Hose covers made of CSM or CPE/CM may be perforated to facilitate degassing during manufacturing operations. Hose shall be black.

Table 1: Construction and Usage

Lining	Reinforcement	Cover	Usage ^{Note 1}	Coding
NBR	-	CSM or CPE/CM	G, O, E, V	A
NBR	Polyester Fiber ^{Note 2}	CSM or CPE/CM	G, O, E, V	B
ECO	-	-	E, V ^{Note 3}	C
EC	Polyester Fiber	EC	G, E ^{Note 4}	D

Note 1: E = Evaporative Emissions System, G = Gasoline Application, O = Oil Application, V = Vacuum System

Note 2: For hose sizes 12.70 mm through 19.05 mm, use of aramid fiber as reinforcement is permitted for Type B hoses.

Note 3: This material (Type C hose) is not suitable for applications in which it could be exposed to oxidized fuel or oxidized fuel mixtures (i.e., map sensor tubing).

Note 4: This material (Type D hose) is not recommended for use as an oil or fuel carrier in recirculating fuel systems having an in-tank electric fuel pump, or for applications in which it could be exposed to oxidized fuel or oxidized fuel mixtures.

3.2.2 Fuel Compatibility. The fuel compatibility of the hoses is given in Table 1 under the Usage column.

3.2.3 Dimensions and Tolerances. Hoses furnished to this specification shall conform to the dimensions and tolerances shown in Table 2 for hoses of construction Type A, Type B, and Type D; or Table 3 for hoses of construction Type C for the size (nominal inside diameter) specified by the purchaser. For hoses requiring a cover, the hose cover wall thickness shall be between 25% and 40% of total wall thickness.

Concentricity based on total indicator reading between inside bore of hose and outer surface of hose shall not exceed the values given below:

- Sizes 6.35 mm and under: 0.8 mm.
- Sizes over 6.35 mm and up to 12.70 mm: 1.0 mm.
- Sizes over 12.70 mm: 1.3 mm.

Table 2: Dimensions and Tolerances (Type A, Type B, and Type D Hoses)

Table 2A – Metric Units					Table 2B – Customary Units					
Size Millimeters (mm)	Inside Diameter (mm)		Outside Diameter (mm)			Size (Inches)	Inside Diameter (inches)		Outside Diameter (inches)	
	Max	Min	Max	Min			Max	Min	Max	Min
3.97	4.37	3.57	9.71	8.55		5/32	.172	.140	.383	.337
4.76	5.16	4.36	10.90	9.74		3/16	.204	.172	.429	.383
5.56	5.96	5.16	11.69	10.53		7/32	.235	.203	.461	.415
6.35	6.75	5.95	13.28	12.12		1/4	.266	.234	.523	.477
7.14	7.54	6.74	14.07	12.91		9/32	.297	.265	.554	.508
7.94	8.34	7.54	14.87	13.71		5/16	.328	.296	.585	.539
8.73	9.13	8.33	15.66	14.50		11/32	.360	.328	.617	.571
9.53	9.93	9.13	16.46	15.30		3/8	.391	.359	.648	.602
11.11	11.69	10.53	19.05	17.47		7/16	.461	.415	.750	.688
12.70	13.28	12.12	20.63	19.05		1/2	.523	.477	.812	.750
15.88	16.67	15.09	24.60	23.02		5/8	.656	.594	.969	.907
19.05	19.84	18.26	29.37	27.79		3/4	.781	.719	1.156	1.094

Max = Maximum, Min = Minimum

Table 3: Dimensions and Tolerances (Type C Hoses)

Table 3A – Metric Units					Table 3B – Customary Units					
Size Millimeters (mm)	Inside Diameter (mm)		Outside Diameter (mm)			Size (Inches)	Inside Diameter (Inches)		Outside Diameter (Inches)	
	Max	Min	Max	Min			Max	Min	Max	Min
2.78	3.18	2.36	6.86	5.48		7/64	.125	.093	.270	.230
3.97	4.37	3.57	8.43	7.42		5/32	.172	.140	.332	.292
4.76	5.16	4.36	9.25	8.23		3/16	.204	.172	.364	.324
5.56	5.96	5.16	10.03	9.02		7/32	.235	.203	.395	.355
6.35	6.75	5.95	13.28	12.12		1/4	.266	.234	.523	.477

Table 3A – Metric Units						Table 3B – Customary Units				
7.14	7.54	6.74	14.07	12.91		9/32	.297	.265	.554	.508
7.94	8.34	7.54	14.87	13.71		5/16	.328	.296	.585	.539
8.73	9.13	8.33	15.66	14.50		11/32	.360	.328	.617	.517
9.53	9.93	9.13	16.46	15.30		3/8	.391	.359	.648	.602
11.11	11.69	10.53	19.05	17.47		7/16	.461	.415	.750	.688
12.70	13.28	12.12	20.63	19.05		1/2	.523	.477	.812	.750
15.88	16.67	15.09	24.60	23.02		5/8	.656	.594	.969	.907
19.05	19.84	18.26	29.37	27.79		3/4	.781	.719	1.156	1.094

Max = Maximum, Min = Minimum

3.3 Test Requirements.

3.3.1 Required Tests. Fuel hose shall be tested to the requirements as specified in Table 4.

Table 4: Test Table

Test	Number of Samples	
	DV ^{Note 1}	PV ^{Note 2}
Material Properties to Table 5 and Table 6	6	

Note 1: DV: Hose Design Validation

Note 2: PV: Hose Process Validation

3.3.2 Engineering Approval Factors. Engineering source approvals generated through testing to prove compliance to this specification are specific for combinations of the following factors (3.3.2.1 through 3.3.2.4).

3.3.2.1 Type. Refer to Table 1.

3.3.2.2 Size of hose.

3.3.2.3 Hose material and construction.

3.3.2.4 Supplier specifications and manufacturing procedures, supplier (both hose and assembly) manufacturing sites.

3.3.3 Design Level Requirements. All hoses manufactured for testing to this specification for engineering source approval purposes shall be completely representative of production level materials, components, processes and tooling. Any deviation from these requirements must be discussed with the GM Materials Engineer generating the approval to the specification prior to the initiation of the test program.

3.4 Material and Performance Requirements. These requirements for testing are specific to this specification for the purpose of hose suppliers to become qualified to supply hose assemblies to GM, and to stay qualified. Sample sizes are described in Table 4 for Design Validation Testing, Process Validation and Audit/Inspection Testing.

3.4.1 Hose Design Validation Testing. Material properties (material/compound approval) are summarized in Table 5, performance requirements (construction approval) in Table 6. For full approval of a hose, compliance to the requirements of Table 5 and Table 6 is needed.

3.4.2 Hose Process Validation Testing. If not defined otherwise, the following testing should be done for production validation testing.

- **Material Properties** (For hose manufacturing site production validation testing.) All tests per Table 5 except Ozone Resistance, Deposits, and all Fuel Resistance tests.
- **Hose Performance Tests** (For hose manufacturing site production validation testing.) All tests per Table 6 except all Fuel Exposure and Fuel Recirculation tests, Dry Heat Resistance.

3.4.3 Audit/Inspection Testing (Hose Process Validation Audit Testing). If not defined otherwise, the following testing should be done for production audit testing.

- **Material Properties.** Tests per Table 5: Elongation at Break, Tensile Strength for all layers, short term aging for cover and adhesion for construction.
- **Hose Performance Tests.** Tests per Table 6: Burst, Fuel Permeability, Push-on/Pull-off.

Table 5: Material Properties Requirements for the Tube and Cover

Properties for the Inner NBR Liner

Property	Test Procedure	Unit	Value
Hardness			
Construction A and Construction B	ISO 48, Method M	IRHD	60 to 80
Elongation at Break			
Construction A and Construction B	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	225 Minimum
Tensile Strength			
Construction A and Construction B	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	MPa	8.3 Minimum
Fuel Resistance Gasoline Compatibility			
Construction A and Construction B Gasoline Application	ISO 1817 to Gasoline test fuels per GMW14914, Table 1 168 h -2 h, at 23 °C $\pm$ 5 °C All tests performed 1 minute after removal from test liquid Change in Hardness Elongation at Break Tensile Strength Change in Mass	IRHD % MPa %	0 to -20 150 Minimum 5 Minimum 0 to +20
Construction A and Construction B Gasoline Application	ISO 1817 to Gasoline test fuels per GMW14914, Table 1 1008 h -2 h, at 60° C $\pm$ 3 °C All tests performed 1 minute after removal from test liquid Change in Hardness Elongation at Break Tensile Strength Change in Mass	IRHD % MPa %	0 to -25 150 Minimum 5 Minimum 0 to +60
Oil Resistance			
Construction A and Construction B Oil Application	ISO 1817 engine oil to GMW16955 Code F; 72 h -2 h; at +100 °C $\pm$ 3 °C Cool specimens at room temperature in oil for 30 minutes $\pm$ 5 minutes prior to testing Change in Tensile Strength Change in Elongation Change in Volume	% % %	-30 Maximum -30 Maximum 0 to 15
Deposits			
Construction A and Construction B Gasoline Application	GMW14292		No Deposits