Engine Coolant Hose

1 Scope

These engine coolant hoses or assemblies incorporating these coolant hoses are intended to withstand the effects of circulating solutions containing corrosion inhibitors and glycols and operating under various pressure conditions at continuous operating temperatures from 40 °C to maximum temperatures ranging from 120 °C to150 °C, dependent on type.

The tube and cover stocks of these hoses shall be made from ethylene propylene diene monomer (EPDM) compounded and reinforced with appropriate yarn (as described in 1.1) to meet the requirements of this specification. The radial thickness of the lining shall be at least 50% of the total wall thickness. Cover may be perforated to facilitate degassing during manufacturing operations. Hose shall be black. Alternate reinforcement may be permitted with Engineering Source Approval, and this alternate reinforcement will be referenced as the approved reinforcement for that specific hose approval in MATSPC. Use of high tensile modulus, low elongation polyaramid materials (i.e., Technora, Kevlar, and Twaron) may not be suitable for heater hose part numbers which are formed with small bend radii and used for dynamic applications. For additional information or aid in selection of proper reinforcement materials for specific part numbers, contact the regional Materials Engineer. No Rubber Manufactures Association (RMA) defined colored tracer or other identifying thread shall be added to the reinforcement specified for the construction of the hose.

1.1 Material Description. Materials covered by this specification are divided into several types, defining the material content, construction, and performance limits of each specific type of hose. **Types D, F, and G are considered preferred types which should be used for all production hose releases unless there is a specialized application requiring a unique hose construction. If there is a unique hose application for which one of the other types might be considered or required, contact the GM Materials Engineer to discuss the appropriate hose type that should be used.**

Refer to Appendix D, Table D1 and Table D2 for requirements to Type A, Type B, and Type C for legacy and service usage.

1.1.1 Type D. EPDM coolant hose, sulphur cured utilizing aramid reinforcement, capable of operating to a maximum continuous temperature limit of +130 °C, and formulated to contain zero (0) weight percent thiuram, and a maximum of 0.04 weight percent thiocarbamates in the EPDM rubber stock for both hose tube and cover.

1.1.2 Type E. EPDM coolant hose, peroxide cured utilizing aramid reinforcement, capable of operating to a maximum continuous temperature limit of +150 °C. A Dicumyl peroxide cure system may not be used for this hose.

1.1.3 Type F: EPDM coolant hose, peroxide cured utilizing aramid reinforcement, capable of operating to a maximum continuous temperature limit of +150 °C, but having greater expansion under pressure than Type E. A Dicumyl peroxide cure system may not be used for this hose.

1.1.4 Type G: EPDM coolant hose, peroxide cured utilizing aramid reinforcement, capable of operating to a maximum continuous temperature limit of +150 °C. A Dicumyl peroxide cure system may not be used for this hose.

1.1.5 Type H: EPDM coolant hose, peroxide cured utilizing Polyethylene Terephthalate (PET) reinforcement, capable of operating to a maximum continuous temperature limit of +120 °C. A Dicumyl peroxide cure system may not be used for this hose.

1.2 Symbols. Not applicable.

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1.3 Typical Applications. This specification covers the material requirements of ethylene propylene diene monomer (EPDM) engine coolant hose, both large diameter (radiator hose) and small diameter (heater hose). In addition, this specification covers the material requirements for engine coolant hose which is incorporated into crimped metal pipe and hose assemblies, or which is incorporated into molded branched hose assemblies. The performance requirements for engine coolant hose and assemblies incorporating engine coolant hose are defined by additional performance specifications**.**

2 References

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

2.1 External Standards/Specifications.

ASTM D380	ASTM D471	ISO 37	ISO 1431-1
ASTM D395	ASTM D573	ISO 48	ISO 1817
ASTM D412	ASTM D2240	ISO 188	ISO 7619-1
ASTM D413	ISO 36	ISO 815	ISO 23529

2.2 GM Standards/Specifications.

GM9902P	GMW14329	GMW16317
GMW3059	GMW14679	GMW16955

2.3 Additional References.

TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

3.1 Resources.

3.1.1 Test Samples. Unless otherwise specified, the shape and size of test pieces shall be in accordance with the relevant Test Method. Minimum six (6) test samples (hoses) are required for initial sample testing. Minimum three (3) test samples (hoses) are required for inspection testing.

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.

If not otherwise stated, mechanical properties in delivery state and after heat or fluid immersion, are to be tested at +23 °C ± 5 °C and with the same test methods. Unless otherwise stated, ambient temperature test conditions shall be held to +23 °C ± 5 °C. Unless otherwise stated, all other temperatures except +23 °C ± 5 °C shall be held to ±3 °C.

3.1.2 Conditioning. Conditioning shall be as specified in the relevant Test Method. The minimum time between vulcanization and testing of elastomers shall be 72 h.

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 specification 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. Such deviations shall be specified on component drawings, test certificates, reports, etc.

3.2 Material and Performance Requirements.

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3.2.1 Design Validation Testing. Material Properties (material/compound approval) are summarized in Table 1. Performance Properties (construction approval) are summarized in Table 2. For full approval of hose compliance to the requirements, Table 1 and Table 2 are needed. For Test Plan for Design Validation, see Appendix A, Table A1.

3.2.2 Product Validation Testing. If not defined otherwise, the following testing should be done for production audit testing. (See also Appendix B, Table B 1.

- All tests per Table 1 except Long Term Immersion, Ozone Resistance, and Resistance to Electrochemical Degradation, Bloom and Paint Compatibility.
- Burst Strength, Pressure Impulse and Fatigue Test per Table 2.

3.2.3 Audit/Inspection Testing. If not defined otherwise, the following testing should be done for production audit testing. (See also Appendix C, Table C1.)

- All tests per Table 1 except Long Term Immersion, Ozone Resistance, and Resistance to Electrochemical Degradation, Bloom and Paint Compatibility.
- Burst Strength and Pressure Impulse per Table 2.

Table 1: Material Properties

As Received Properties for Tube and Cover

Property	Test Method	Unit	Value
Hardness Note 1			
Types A, B; C, D, E, G, and H	ASTM D2240, 6 mm specimens, made by plying together samples of the elastomeric compound Read scale within 1 s or ISO 7619-1, 6 mm specimens, made by plying together samples of the elastomeric compound Read scale within 3 s	Shore A	55 to 75
Type F	ASTM D2240, 6 mm specimens, made by plying together samples of the elastomeric compound Read scale within 1 s or ISO 7619-1, 6 mm specimens, made by plying together samples of the elastomeric compound Read scale within 3 s	Shore A	52 to 72
Elongation at Break			
All Types	ASTM D412 or ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	250 minimum
Tensile Strength			
Types A, C, D, and E	ASTM D412 or ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	Mpa	7.6 minimum
Type B; G and H			7.0 minimum
Type F			6.5 minimum
Modulus at 50% Elongation			
Types A, C, D, and E	ASTM D412 or ISO 37, Type 2 or 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	As specified on drawing
Type B; G and H			As specified on drawing
Type F			2.1 maximum

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Property	Test Method	Unit	Value
Modulus at 100% Elongation			
Types A, C, D, and E	ASTM D412 or ISO 37, Type 2 or Type 4 dumbbell 200 mm/minute ± 20 mm/minute	MPa	As specified on drawing
Type B; G and H			As specified on drawing
Type F			3.8 MPa maximum
Modulus at 200% Elongation			
Types A, C, D, E and F	ASTM D412 or ISO 37, Type 2 or Type 4 dumbbell 200 mm/minute ± 20 mm/minute	MPa	3.0 minimum (tube), 4.5 minimum (cover)
Type B; G and H		MPa	As specified on drawing

Requirements to the Cover

Property	Test Method	Unit	Value
Age Resistance (Heat Aging)			
Types A, C, and D	ASTM D573, 168 h at 150 °C Change of hardness Change of elongation at break or Elongation at break Change of tensile strength	 Shore A % % %	 0 to +18 -65 maximum 120 minimum -35 maximum
Type B	ISO 188 Method B, 72 h -2 h at +125 °C ± 3 °C Change of hardness Change of elongation at break Change of tensile strength	 Shore A % %	 0 to +15 -50 maximum -20 maximum
Type E	ASTM D573, 168 h at 165 °C Change of hardness Change of elongation at break Change of tensile strength	 Shore A % %	 0 to +15 -55 maximum -30 maximum
Type F	ASTM D573, 168 h at 165 °C Change of hardness Change of elongation at break Change of tensile strength	 Shore A % %	 0 to +20 -55 maximum -35 maximum
Types G and H	ISO 188 Method B, 168 h -2 h at +150 °C ± 3 °C Change of hardness Change of elongation at break Change of tensile strength	 Shore A % %	 0 to +15 -65 maximum -35 maximum
Ozone Resistance			
Types A, C, D, E and F	ISO 1431-1, 100 pphm, 13 mm straight sample, elongated 20% for test, 40 °C ± 2 °C, 336 h -2 h Visual Examination, 2x magnification		No cracks
Type B; G and H	ISO 1431-1, 50 pphm, straight sample 20% strain 40 °C ± 2 °C, 72 h -2 h Visual Examination, 7x magnification		No cracks

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Requirements to the Lining

Property	Test Method	Unit	Value
Immersion in Coolant			
Types A, C, and D	ASTM D471 in mixture of 55% ethylene glycol type to coolant to GMW16955, Fluid E and 45% water 168 h at boiling temperature Change of hardness Change of elongation at break or Elongation at break Change of tensile strength Change in volume	 Shore A % % % %	 -15 to +15 -30 maximum 250 minimum -15 maximum +20 maximum
Type B; G and H	ISO 1817, in mixture of 50% ethylene glycol to GMW16955, Fluid E and 50% water boiling under reflux, 168 h -2 h Change of hardness Change of elongation at break Change of tensile strength Change in volume	 Shore A % % %	 ±10 -30 maximum -5 maximum -5 to +15
Type E	ASTM D471 in mixture of 55% ethylene glycol type to coolant to GMW16955, Fluid E and 45% water 168 h at boiling temperature Change of hardness Change of elongation at break Change of tensile strength Change in volume	 Shore A % % 	 -15 to +15 -15 maximum -15 maximum +20 maximum
Type F	ASTM D471 in mixture of 55% ethylene glycol type to coolant GMW16955, Fluid E and 45% water 168 h at boiling temperature Change of hardness Change of elongation at break Change of tensile strength Change in volume	 Shore A % % 	 -15 to +15 -20 maximum -15 maximum +20 maximum
Long Time Immersion in Coolant			
Types A, C, and D	ASTM D471 in mixture of 55% ethylene glycol type to coolant to GMW16955, Fluid E and 45% water 1000 h at boiling temperature Change of elongation at break or Elongation at break	 % %	 -40 maximum 225 minimum
Types E and F	ASTM D471 in mixture of 55% ethylene glycol type to coolant to GMW16955, Fluid E and 45% water 1000 h at boiling temperature Change of elongation at break	 %	 -40 maximum

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Property	Test Method	Unit	Value
Long Time Immersion in Coolant (test in pressure vessel)			
Type B Note 2	ISO 1817, in mixture of 50% ethylene glycol to GMW16955, Fluid E, and 50% water test in pressure vessel, 504 h -2 h, at +125 °C ± 3 °C Change of hardness Change of elongation at break Change of tensile strength Change in volume	 Shore A % % %	 ±10 -30 maximum -20 maximum -5 to +15
Type G and H	ISO 1817, in mixture of 50% ethylene glycol to GMW16955, Fluid E and 50% water test in pressure vessel, 504 h -2 h, at +150 °C ± 3 °C Change of hardness Change of elongation at break Change of tensile strength Change in volume	 Shore A % % %	 ±10 -30 maximum -20 maximum -5 to +15

Requirements for the Construction/Constructional Properties

Property	Test Method	Unit	Value
Compression Set			
Types A, C, and D	ASTM D395, Method B, 125 °C, 70 h. Molded buttons with equivalent cure state to production hose	%	85 maximum
Type B	ISO 815 test piece Type B Note 3, wall thickness is test piece thickness; samples to be taken from calibrated ends, (if existing) +125 °C, 24 h, 25% compressed	%	45 maximum
Type E	ASTM D395, Method B, 150 °C, 70 h. Molded buttons with equivalent cure state to production hose.	%	60 maximum
Type F	ASTM D395, Method B, 150 °C, 70 h. Molded buttons with equivalent cure state to production hose	%	80 maximum
Types G and H	ISO 815 test piece Type B Note 3, wall thickness is test piece thickness; samples to be taken from calibrated ends, (if existing) +150 °C, 24 h, 25% compressed	%	45 maximum
Adhesion			
Types A, C, D, E and F	ASTM D413, Machine Method. Adhesion of Cover to Tube and Cover/Tube to Reinforcement	N/mm	1.4 minimum
Type B; G and H	ISO 36 strip test pieces for hoses with inner diameter (ID) above 28 mm or ring shaped test pieces for hoses with ID up to 28 mm	N/mm	2.5 minimum
Cold Flexibility			
All Types	ASTM D380, specimens from straight length hose. Condition -40 °C ± 3 °C; 22 h + 1 h prior to flexing Visual Examination		No cracks
All Types	ISO 23529, -40 °C ± 3 °C; 22 h +1 h strip cut through hose, 5 mm to 10 mm wide, 100 mm long, bent 180° around radius of 12.5 mm Visual Examination		No cracks

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