GM WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16501

Elastomeric Vacuum Brake Hose

1 Scope

This specification covers light wall vacuum brake hoses for use in power braking systems of vehicles.

1.1 Material Description. Materials covered by this specification are divided into two (2) Types. It is possible for a hose to be approved to more than one (1) Type.

- Type A1 hose is suitable for use to temperatures of +125 °C continuous exposure, and +150 °C excursion exposure.
- Type A2 hose is suitable for use to temperatures of +125 °C continuous exposure, and +150 °C excursion exposure but higher compression set values than Type A1.
- Type B1 hose is suitable for use to temperatures of +150 °C continuous exposure and +175 °C excursion exposure.
- Type B2 hose is suitable for use to temperatures of +150 °C continuous exposure and +175 °C excursion exposure with higher changes in properties than Type B1.

1.1.1 Construction. The hose shall consist of a smooth tube of Ethylene Propylene Diene Monomer (EPDM) elastomer reinforced with a ply or plies of braided, knit, spiral, or woven polyester or other vendee approved fabric and furnished with a cover of EPDM elastomer. Hoses shall be black unless otherwise specified. Hose shall conform to the dimensions and tolerances listed in Appendix A; Table A1. The hose shall be legibly marked with the following information:

- Symbol DOT.
- Nominal inside diameter (expressed as fraction of inch).
- Hose manufacturer's code identification.
- Date code; the symbol VL; and the GM specification number (GMW16501).

Such markings shall be printed parallel to the axis in white or blue block letters not <3 mm high and shall be repeated at intervals of 150 mm maximum. The symbol DOT constitutes certification by the hose manufacturer that the hose assembly conforms to Federal Motor Vehicle Safety Standard (FMVSS 106). The date code shall consist of six (6) digits: The first two (2) digits shall represent month (01 through 12) of the year, the next two (2) digits shall represent the day of the month (01 through 31); and the last two (2) digits shall be the last two (2) digits of the year. In addition, each hose manufacturer shall incorporate into the construction of the hose, identification yarn as assigned by the Rubber Manufacturers Association (RMA).

1.1.2 Material Identification and Marking. To properly define the hose, the material specification number (GMW16501) is to be referenced. The vacuum hose marking must conform to requirements specified in government regulations, such as FMVSS 106. The vacuum hose must also meet requirements for vacuum brake hose marking specified in GMW16501.

For China usage, the supplier is responsible to contact the China Quality Certificate Center for China Compulsory Certification (CCC) activities, and ensure the vacuum hose/tubes meet the CCC requirements, reference CNCA-C11-12: 2014. All saleable parts shall have CCC markings after proper authorization which includes both a CCC label and the related GB 16897 test standard. A copy of the certificate for the part shall be sent to GM Engineering before Production Part Approval Process (PPAP). This applies to both production parts and parts for service.

© Copyright 2016 General Motors Company All Rights Reserved

Documents
Document Sharing Hub

Copyright General Motors Company
Provided by IHS Markit under license with General Motors Company
Reproduction, distribution or publication of these standards is expressly prohib
Licensee=/, User=,
Not for Resale,
Full document details: GM GMW16501 2016

1.2 Symbols. Not applicable.

1.3 Applicability. Vacuum Brake Hose.

2 References

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

2.1 External Standards/Specifications.

ASTM D412	CNCA-C11-12: 2014	ISO 37	ISO 815-1
ASTM D413	FMVSS 106	ISO 48	ISO 1431-1
ASTM D471	GB 16897	ISO 188	ISO 1817
ASTM D865	ISO 36	ISO 815	ISO 23529

2.2 GM Standards/Specifications.

GMW3059	GMW14914	GMW16955
GMW14270	GMW16502	

2.3 Additional References.

- China Compulsory Certification (CCC)

3 Requirements

3.1 Requirements on Test Specimens.

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

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. When presenting a new quality, sheet material of the same batch for all layers is recommended.

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 °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.

3.1.1.3 Test specimens for compression set shall be taken at the end of the hose where the end clamp is located, especially if the end form is calibrated for tighter dimensional tolerance. Test only for hose surfaces and distances that allow a 13 mm diameter finished test specimens in compliance with ISO 815-1. A sufficient hose area shall exist to permit clamping to flatten the hose for die cutting per ISO 23529 Method A, and to eliminate cupping from cutting. When cupping (the formation of a concave surface) is a problem, the test piece shape is improved by cutting it in two (2) stages: first cut an oversize test piece and then trim it to the exact dimensions with a second cutter. Cut down with the hose cover on top and run compression test in the same orientation. Test a sufficient number of hose end forms from the same lot to satisfy 3.2.1 minimum sample requirements.

3.1.2 Conditioning. Conditioning shall be as specified in the relevant Test Method.

3.1.3 Equipment. Conforming to the relevant Test Method.

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

3.2 Material and Performance Requirements.

© Copyright 2016 General Motors Company All Rights Reserved

Documents
Document Sharing Hub

Copyright General Motors Company
Provided by IHS Markit under license with General Motors Company
Reproduction, distribution or publication of these standards is expressly prohib
Licensee=/, User=,
Not for Resale,
Full document details: GM GMW16501 2016

3.2.1 Design Validation Testing. Material and Performance Requirements are summarized in Table 1 and Table 2. For full approval of a hose, compliance to the requirements of Table 1 and Table 2 is needed. Six (6) samples of material from at least three (3) different hoses shall be tested to each of the requirements for Design or Product Validation Testing.

3.2.2 Product Validation Testing. If not defined otherwise, all tests per Table 1 and Table 2 should be done for production audit testing.

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

- Three (3) samples of material from at least two (2) different hoses shall be tested to each of the requirements for Audit/Inspection Testing.
- All tests per Table 1, except Ozone, and Immersion in Fluid tests.
- Burst Test from Table 2.

Table 1: Material Properties for the Tube and Cover Materials

Property	Test Method	Unit	Value
Hardness, As-Received			
All Types	ISO 48, Method M	IRHD	60 to 75
Elongation at Break, As-Received			
All Types	ASTM D412 or ISO 37, Type 2 dumbbell or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	250 Minimum
Tensile Strength, As Received			
All Types	ASTM D412 or ISO 37, Type 2 dumbbell or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	7 Minimum
Immersion in Fluid, Tube Material Only			
All Types	ASTM D471 or ISO 1817, Immerse in GMW16955 for 70 h at 100 °C ± 2 °C. Change in Volume	%	+120 Maximum
All Types	ASTM D471 or ISO 1817, Immerse in Gasoline Test Fuel to GMW14914 for 48 h ± 2 h at 23 °C ± 5 °C Change of elongation at break Change of tensile strength	% %	-70 Maximum -70 Maximum
Age Resistance (Heat Aging), Tube and Cover Materials			

© Copyright 2016 General Motors Company All Rights Reserved

Documents
Document Sharing Hub
Copyright General Motors Company
Provided by IHS Markit under license with General Motors Company
Reproduction, distribution or publication of these standards is expressly prohib
Licensee=/, User=,
Not for Resale,
Full document details: GM GMW16501 2016