GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW15605

Fuel Filler Hose for Diesel and Biodiesel Fuels

1 Scope

1.1 Material Description. This standard covers the material requirements of fuel filler and fuel filler vent hoses (coupled or uncoupled), for use with diesel fuel in automotive fuel systems.

Note: Hoses with Butadiene-Acrylonitrile Copolymer (NBR) lining are not to be used for diesel applications containing biodiesel.

Note: Fuel filler hoses for gasoline applications are specified in GMW15349.

For use in non-conductive environments, all layers of the hose must be non-conductive, and the requirement for non-conductivity must be noted on the part print. For those hoses that need to be conductive, they must meet the conductivity requirements of this specification. MATSPC approval entries for non-conductive hoses must note the non-conductivity of the hose in the approval entry.

The material content of the hose and stiffness of the hose are defined by the Construction and Reinforcement designations for the hose. The Construction and Reinforcement designations for the hose together define the "Type" for the hose. Hoses are suitable for applications subjected to maximum continuous operation temperatures of 100 °C with intermittent operation at temperatures up to 125 °C maximum, with the exception of Construction 4 when used with Biodiesel A which has maximum continuous and excursion temperature limits of 80 °C and 100 °C, respectively.

1.1.1 Construction. Materials covered by this standard are divided into several sets of constructions, reinforcement and fluid compatibility categories. The hose is defined as "GMW15605 Type XYZ," where "X" refers to the reinforcement of the hose, "Y" refers to the construction type of the hose, and "Z" refers to the biodiesel fuel for which the hose has been determined to be compatible.

1.1.1.1 Reinforcement: The reinforcement of the hose describes the type of fiber used in the hose. Reinforcement to the tube of the hose may be applied by braiding, knitting or circular weaving. The reinforcement, for Reinforcements A and B, is placed between the laminated tube and the cover of the hose.

1.1.1.1.1 Reinforcement A: This reinforcement type consists of aramid fiber.

1.1.1.1.2 Reinforcement B: This reinforcement type consists of rayon fiber.

1.1.1.1.3 Reinforcement C: This reinforcement type consists of no fiber or other material added to the hose constructions described in 1.1.1.2.

1.1.1.2 Construction: The "Construction Type" of hose defines the material content and construction of the hose. The following materials are used in the various constructions:

- Tetrafluoroethylene Hexafluoropropylene (THV)
- Epichlorohydrin/ethylene Oxide (ECO) Copolymer
- Fluoroelastomer (FKM)
- Hydrogenated Butadiene-Acrylonitrile Copolymer (HNBR)
- Chlorinated Polyethylene (CPE or CM)
- Chlorosulfonated Polyethylene (CSM)
- Polyvinylchloride Copolymer (PVC)
- Fluorocarbon Thermoplastic Vulcanizate (FTPV)
- Ethylene Tetrafluoroethylene (ETFE)

The thickness of the barrier layer shall be sufficient to ensure resistance to biodiesel fuels.

© Copyright 2015 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 GMW15605 2015

Intermediate layers within the described hose construction may be needed dependent on the hose construction.

The descriptions of the constructions of the hose are summarized in Appendix A, Table A1, together with the suffix codes used to describe each type of reinforcement used, hose construction, and biodiesel fuel compatibility.

The descriptions of the constructions of hose used for this application are as follows:

1.1.1.2.1 Construction Type 1: This hose shall consist of a smooth bore tube of laminated construction consisting of an inner tube of THV, intermediate layer (if necessary) and cover to meet the temperature requirements. The minimum thickness of the barrier (THV) shall be 0.17 mm. Hose can be reinforced, see respective types (1.1.1.1).

1.1.1.2.2 Construction Type 2: This hose shall consist of a smooth bore tube of laminated construction consisting of an inner tube of Fluoroelastomer (FKM), intermediate layer (if necessary) and cover to meet the temperature requirements. The minimum thickness of the FKM shall be 0.60 mm. Hose can be reinforced, see respective types (1.1.1.1).

1.1.1.2.3 Construction Type 3: This hose shall consist of a smooth bore tube of laminated construction consisting of an inner tube of FTPV, intermediate layer (if necessary) and cover to meet the temperature requirements. The minimum thickness of the barrier (FTPV) shall be 0.17 mm. Hose can be reinforced, see respective types (1.1.1.1).

1.1.1.2.4 Construction Type 4: This hose shall consist of a smooth bore tube of laminated construction consisting of an inner tube of HNBR, intermediate layer (if necessary) and cover to meet the temperature requirements. The minimum thickness of the barrier (HNBR) shall be 0.60 mm. Hose can be reinforced, see respective types (1.1.1.1).

1.1.1.2.5 Construction Type 5: This hose shall consist of a smooth bore tube of ETFE, intermediate layer (if necessary) and cover to meet the temperature requirements. The minimum thickness of the barrier (ETFE) shall be 0.17 mm

1.1.1.2.6 Construction Type 6: This hose shall consist of a smooth bore laminated tube of FTPV and ETFE, with an intermediate layer of CM, and a cover of CM. The minimum thickness of the barrier (FTPV/ETFE) shall be 0.18 mm. Hose can be reinforced, see respective types (1.1.1.1).

1.1.1.3 Biodiesel Fuel Compatibility: The hose is placed into one (1) of two (2) categories defining the hose compatibility with two (2) standard biodiesel fuels. Biodiesel fuels contained herein are Rapeseed Methyl Ester (RME)-based and Soybean Methyl Ester (SME)-based.

1.1.1.3.1 Biodiesel Fuel A Compatible. This hose is considered compatible with fuel consisting of 20% or more of biodiesel content and containing SME-based biodiesel and is also considered compatible with biodiesel consisting of 10% or less of biodiesel content and containing less than 2% of SME-based biodiesel.

1.1.1.3.2 Biodiesel Fuel B Compatible. This hose is only considered compatible with fuel consisting of 10% or less of biodiesel content and containing less than 2% of SME-based biodiesel.

1.2 Symbols. Not applicable.

1.3 Applicability. This standard covers the material requirements of fuel filler and fuel filler vent hoses (coupled or uncoupled), for use with diesel fuel in automotive fuel systems.

1.4 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM D412	ASTM D4678	ISO 37	ISO 1431-1
ASTM D413	ISO 34-1	ISO 48	ISO 1817
ASTM D471	ISO 36	ISO 188	ISO 23529

2.2 GM Standards/Specifications.

GMW3059	GMW14681	GMW15423	GMW16955
GMW14291	GMW14914		

© Copyright 2015 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 GMW15605 2015

3 Requirements

3.1 Requirements on Test Specimens. Not applicable.

3.2 Test Preparation and Evaluation.

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

3.2.2 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 its physical definition.

3.2.3 Facilities. Conforming to the relevant Test Procedures.

3.2.4 Equipment. Conforming to the relevant Test Procedures.

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

Samples are finished parts or are 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.

3.2.6 Test Time. Not applicable.

3.2.7 Test Required Information. Not applicable.

3.2.8 Personnel/Skills. Conform to company and/or laboratory requirements. Technician training records must be available upon request.

3.3 Preparation. See material and performance requirements in 3.9.

3.4 Conditions. See material and performance requirements in 3.9.

3.4.1 Environmental Conditions. See material and performance requirements in 3.9.

3.4.2 Test Conditions. See material and performance requirements in 3.9.

3.5 Instructions. See material and performance requirements in 3.9.

3.6 Data. See material and performance requirements in 3.9.

3.7 Safety. This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3.8 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.

3.8.1 Test Results. See material and performance requirements in 3.9.

3.8.2 Deviations from Test Standard. Deviations from the requirement of this standard shall have been agreed upon. Such deviations shall be specified on component drawings, test certificates, reports, etc.

© Copyright 2015 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 GMW15605 2015

3.9 Material and Performance Requirements.

3.9.1 Design Validation Testing. Material properties (material/compound approval) are summarized in Table 1 thru Table 9 and performance requirements (construction approval) in Table 10. For full approval of a hose, compliance to the requirements of Tables 1 thru 9 (as applicable) and Table 10 is needed.

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

3.9.2.1 All tests per Table 1 thru Table 9, except Fuel Resistance of lining and Cover Age Resistance (1008 h exposure).

3.9.2.2 Extractable Tests and Dry Heat Resistance per Table 10.

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

3.9.3.1 All tests per Table 1 thru Table 9, except Fuel Resistance of lining and Cover Age Resistance (1008 h exposure).

Table 1: Material Properties for the Inner THV Liner [Note]

Property	Test Procedure	Unit	Value
Elongation at Break			
Construction 1	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	250 minimum
Tensile Strength			
Construction 1	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	12 minimum
Fuel Resistance Biodiesel Fuel B Compatible			
Construction 1	ISO 1817, Diesel fuel to GMW14914, but with 10% by volume (RME:SME = 4:1) +70 °C ± 3 °C, 1008 h -2 h in pressure vessel. Change of test fuel every Monday and Friday. Change of elongation at break Change of tensile strength Change in volume	 % % %	 -10 maximum -20 maximum ± 5 maximum
Fuel Resistance Biodiesel Fuel A Compatible			
Construction 1	ISO 1817, Diesel fuel to GMW14914 +80 °C ± 3 °C, 168 h -2 h. Elongation at break Tensile strength Change in Mass	 % MPa %	 250 minimum 12 minimum ± 1 maximum
Construction 1	ISO 1817, Diesel fuel to GMW14914 +80 °C ± 3 °C, 1008 h -2 h. Elongation at break Tensile strength Change in Mass	 % MPa %	 250 minimum 12 minimum ± 1 maximum

Note: Test on extruded inner layer of the same manufacturing process.

© Copyright 2015 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 GMW15605 2015

Table 2: Material Properties for the FKM Liner [Note]

Property	Test Procedure	Unit	Value
Elongation at Break			
Construction 2	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	250 minimum
Tensile Strength			
Construction 2	ASTM D412 or ISO 37, Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	7 minimum
Fuel Resistance Biodiesel Fuel B Compatible			
Construction 2	ISO 1817, Diesel fuel to GMW14914, but with 10% by volume (RME:SME=4:1) +70 °C ± 3 °C, 1008 h -2 h in pressure vessel. Change of test fuel every Monday and Friday. Change of elongation at break Change of tensile strength Change in volume	 % % %	 -20 maximum -10 maximum ± 10 maximum
Fuel Resistance Biodiesel Fuel A Compatible			
Construction 2	ISO 1817, Diesel fuel to GMW14914 +80 °C ± 3 °C, 168 h -2 h. Elongation at break Tensile strength Change in Mass	 % MPa %	 200 minimum 7minimum 0 to +5 maximum
Construction 2	ISO 1817, Diesel fuel to GMW14914 +80 °C ± 3 °C, 1008 h -2 h. Elongation at break Tensile strength Change in Mass	 % MPa %	 150 minimum 7 minimum 0 to +5 maximum

Note: Test on sheet material of the same manufacturing batch.

© Copyright 2015 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 GMW15605 2015