GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification Elastomers	GMW15348

Power Steering Return and Remote Reservoir Hose

1 Scope

This standard covers the material requirements of hose used in hydraulic steering applications as a flexible connection between the power steering gear and the power steering pump or pump reservoir. It also covers hose assemblies with end fittings or user-applied clamps secured to the hose as required by engineering drawings.

1.1 Material Description. Materials covered by this standard are divided into several sets of constructions and categories. The "Construction" of hose defines both the material content and construction of the hose. The "Category" of the hose defines the fluid with which it has been qualified for service. The hose is, therefore, defined as "GMW15348 Type XYZ," where "X" refers to the construction of the hose, the "Y" refers to the category to which the hose has been qualified for service, and "Z" refers to the pressure rating of the hose. Thus, the material "Type" is defined by a combination of its construction, category, and pressure rating. It is possible for a hose to be approved to more than one type.

1.1.1 Construction: The "Construction" of hose defines the material content and construction of the hose. All hoses shall have a reinforcement of textile braid. Hoses shall be black. The hoses and/or hose assemblies are capable of giving satisfactory service in an automobile from temperatures of -40°C to the continuous and excursion temperatures shown for the respective construction. The descriptions of the constructions of hose used for this application are as follows:

1.1.1.1 Construction A: This hose consists of a smooth bore tube of chlorinated polyethylene (CM) or chlorosulfonated polyethylene (CSM) compound, resistant to Dexron VI, reinforced with textile braid, and a cover of CM or CSM compound. The hose and/or hose assembly is capable of giving satisfactory service at temperatures of -40°C to +125°C with intermittent operation at temperatures up to +135°C maximum.

1.1.1.2 Construction B: This hose consists of a smooth bore tube of hydrogenated acrylonitrile-butadiene (HNBR) compound or ethylene acrylate (AEM) compound, resistant to Dexron VI, reinforced with textile braid, and a cover capable of meeting the requirements in Table 1 and Table 2. The hose and/or hose assembly is capable of giving satisfactory service temperatures of -40°C to +150°C with intermittent operation at temperatures up to +160°C maximum.

1.1.1.3 Construction C: This hose consists of a smooth bore tube of acrylate (ACM) or ethyl acrylate (AEM) compound or equivalent, resistant to Dexron VI, reinforced with textile braid, and a cover capable of meeting the requirements in Table 1 and Table 2. The hose and/or hose assembly is capable of giving satisfactory service at temperatures of -40°C to +160°C with intermittent operation at temperatures up to +175°C maximum.

1.1.2 Categories: The "Category" of hose defines the power steering fluid with which it has been qualified for service. The description of the fluids used with this hose is as follows:

1.1.2.1 Category 1: This category corresponds to service with hydraulic power steering fluid, GM part number 9985010.

1.1.2.2 Category 2: This category corresponds to service with Pentosin power steering fluid, GM part number 9274926 (B 040 2012).

1.1.2.3 Category 3: This category corresponds to service with Dexron VI transmission fluid, GM part number 9986153.

1.1.3 Pressure Rating: The "Pressure Rating" of hose defines the minimum burst pressure of the hose at temperatures from -40 to +20°C per Table 3 of the specification for Return Hose. The maximum operating pressure at a specific temperature for each "Pressure Rating" for Power Steering Return hose corresponds to 25% of the minimum burst pressure at that temperature. Remote Reservoir Hose has only one "Pressure Rating" of "D" corresponding to a minimum burst pressure of 1.2 MPa at +20°C, and a maximum working pressure of 0.05 MPa at +20°C. For Return Hose, the +20°C minimum burst pressures corresponding to the various "Pressure Ratings" are as follows:

1.1.3.1 Pressure Rating A: This “Pressure Rating” corresponds to a minimum +20°C burst of 6.7 MPa.

1.1.3.2 Pressure Rating B: This “Pressure Rating” corresponds to a minimum +20°C burst of 13 MPa.

1.1.3.3 Pressure Rating C: This “Pressure Rating” corresponds to a minimum +20°C burst of 23 MPa.

1.2 Symbols. Not applicable.

1.3 Typical Applications. Hoses used in hydraulic steering applications

1.4 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM D395	ISO 37
ASTM D412	ISO 188
ASTM D413	ISO 815
ASTM D471	ISO 1431-1
ASTM D865	ISO 1817
ISO 36	

2.2 GM Standards/Specifications.

9985010	GMW3059
GM4486P	GMW14291
GMW3001	GMW15422

2.3 Additional References.

Part No. 9274926 (B 040 2012)

Part No. 9986153

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 procedure. Minimum 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 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 ± 5°C and with the same test methods. Unless otherwise stated, ambient temperature test conditions shall be held to +23 ± 5°C. Unless otherwise stated, all other temperatures except +23 ± 5°C shall be held to ±3 C.

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

3.1.3 Equipment. Conforming to the relevant test procedures.

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 procedures.

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

3.2 Material and Performance Requirements.

3.2.1 Design Validation Testing. Material properties (material/compound approval) are summarized in Table 1; performance requirements (construction approval) in Table 2. For full approval of hose compliance to the requirements of Table 1 and Table 2 is needed.

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

- All tests per Table 1.
- Table 2 tests: Burst Strength, Tensile Test, and accelerated Pressure Impulse Test.

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

- All tests per Table 1, except long term aging.
- Table 2 tests: Burst Strength, Tensile Test.

Table 1: Material Properties

Properties for the Cover

Property	Test Procedure	Unit	Value
Elongation at Break, As-Received			
All Constructions	ASTM D412 or ISO 37, Type 2 or 4 dumb-bell, 200 ± 20 mm/minute	%	100 minimum
Tensile Strength, As-Received			
All Constructions	ASTM D412 or ISO 37, Type 2 or 4 dumb-bell, 200 ±20 mm/minute	MPa	10 minimum
Age Resistance (Heat Aging)			
Construction A	ASTM D865 or ISO 188 Method B, 72 +0/-2 h at 135 ± 3˚C. Change of elongation at break Change of tensile strength	 % %	 -40 maximum -25 maximum
Construction B	ASTM D865 or ISO 188 Method B, 72 +0/-2 h at 160 ± 3 ˚C. Change of elongation at break Change of tensile strength	 % %	 -25 maximum -20 maximum
Construction C	ASTM D865 or ISO 188 Method B, 72 +0/-2 h at 175 ± 3 ˚C. Change of elongation at break Change of tensile strength	 % %	 -25 maximum -20 maximum
Age Resistance (Heat Aging) long term			
Construction A	ASTM D865 or ISO 188 Method B, 1008 +0/-2 h at 125 ± 3 ˚C. Elongation at break Change of elongation at break Tensile strength Change of tensile strength	 % % MPa %	 100 minimum -50 maximum 10 minimum -20 maximum
Construction B	ASTM D865 or ISO 188 Method B, 1008 +0/-2 h at 150 ± 3 ˚C. Elongation at break Change of elongation at break Tensile strength Change of tensile strength	 % % %	 100 minimum -40 maximum. 10 minimum -20 maximum
Construction C	ASTM D865 or ISO 188 Method B, 1008 +0/-2 h at 160 ± 3 ˚C. Elongation at break Change of elongation at break Tensile strength Change of tensile strength	 % % %	 100 minimum -40 maximum 10 minimum -20 maximum

Properties for the Hose Tube Material

Property	Test Procedure	Unit	Value
Elongation at Break, As-Received			
All Constructions	ASTM D412 or ISO 37, Type 2 or 4 dumb-bell, 200 ± 20 mm/minute	%	150 minimum
Tensile Strength, As-Received			
All Constructions	ASTM D412 or ISO 37, Type 2 or 4 dumb-bell, 200 ± 20 mm/minute	MPa	10 minimum
Immersion in Fluid			
Category 1	ASTM D471 or ISO 1817, in power steering fluid (9985010), 72 +0/-2 h at 150 ± 3˚C Change of elongation at break Change of tensile strength Change in volume	 % % %	 -40 maximum -30 maximum +30 maximum
Category 2	ASTM D471 or ISO 1817, in Pentosin (9274926, B040 2012), 72 +0/-2 h at 150 ± 3˚C Change of elongation at break Change of tensile strength Change in volume	 % % %	 -40 maximum -30 maximum +30 maximum
Category 3	ASTM D471 or ISO 1817, in Dexron VI ATF (9986153), 72 +0/-2 h at 150 ± 3˚C Change of elongation at break Change of tensile strength Change in volume	 % % %	 -40 maximum -30 maximum +30 maximum
Immersion in Fluid for hoses to Construction A used with Dexron VI			
Construction A Category 3	ASTM D471 or ISO 1817, with power steering fluid 9986153 Dexron VI Hoses must be filled with 9986153, sealed at both ends and stored at +135 °C for 336 h. The fluid shall be renewed after 48, 96, 168, 216 and 264 h, then the following tests on samples prepared from the immersed lining must be performed: Elongation at break and Change of elongation at break Tensile strength and Change of tensile strength	 % % MPa %	 70 minimum -50 maximum 8 minimum -40 maximum
Construction A Category 3	ASTM D471 or ISO 1817, with power steering fluid 9986153 Dexron VI Hoses must be filled with 9986153, sealed at both ends and stored at +150°C for 168 h. Then the following tests on samples prepared from the immersed lining must be performed: Elongation at break and Change of elongation at break Tensile strength and Change of tensile strength	 % % MPa %	 70 minimum -50 maximum 8 minimum -40 maximum

Properties for the Construction

Property	Test Procedure	Unit	Value
Adhesion			
All Types	ASTM D413, Machine Method, or ISO 36 (ring shaped test pieces). Adhesion of Cover to Tube and Cover/Tube to Reinforcement	N/mm	1.4 minimum
Cold Flexibility			
All Types	Hose samples shall be subjected to a temperature of -40 ± 2˚C for 24 +0/-2 h while in a straight position. After conditioning and without removal from the cold box, the hose shall be bent around a mandrel having a diameter of 8 times the nominal OD of the hose through 180 degrees within 4 s		Hose must not fracture or show any cracks, breaks or checks in the tube or cover.
Ozone Resistance			
All Types	GM4486P or ISO 1431-1 100 pphm, 40 ± 2 ˚C 336 +0/-2 h. Hose bent around a mandrel having a diameter of 8 times the nominal OD of the hose Visual Examination, 2X magnification,		No cracks permitted
Compression Set			
Construction A	ASTM D395, Method B, or ISO 815 test piece Type B 125 ± 3 °C, 24 +0/-2 h. samples taken from calibrated ends, if existing.	%	45 maximum
Construction B	ASTM D395, Method B, or ISO 815 test piece Type B 150 ± 3 °C, 24 +0/-2 h. samples taken from calibrated ends, if existing.	%	45 maximum
Construction C	ASTM D395, Method B, or ISO 815 test piece Type B 160 ± 3 °C, 24 +0/-2 h. samples taken from calibrated ends, if existing.	%	45 maximum

Table 2: Performance Properties

Property	Test Procedure	Unit	Value
Kink (Hose Only)			
All Types	GMW15422, 4.1		Ball traverses length of hose freely
Burst Strength (Hose and Hose Assemblies)			
Return Hoses	GMW15422, 4.2	MPa	Per Table 3
Remote Reservoir	GMW15422, 4.3	MPa	1.2 minimum
Oil Resistance/Accelerated Pressure Impulse Test – Ozone Resistance (Assemblies Only)			
Return Hoses	GMW15422, 4.4		No cracks
Hose Push-On Effort Test (Hose Only)			
All Types	Test to GMW14291	N	133 maximum
Tensile Test (Assemblies Only)			
All Types	GMW15422, 4.5	N	1333 minimum (permanent fitting) 380 minimum (user-applied clamps) 780 minimum (crimped collar fittings)
Accelerated Pressure Impulse Test (Assemblies Only)			
Return Hoses	GMW15422, 4.6. Test to 400 000 cycles		No leak or burst. No cuts, splits, or bulges evident in the hose
Cold Start Test (Assemblies Only)			
Return Hoses	GMW15422, 4.7		No hose split or break
Volumetric Expansion (Hose Only)			
Return Hoses	GMW15422, 4.8	cc/m	5 minimum No increase in the volumetric expansion rate gradient between 0 and 2 MPa as pressure increases
Pressure Impulse, Multiple Temperatures (Hose Only)			
Return Hoses	GMW 15422, 4.9		Per Table 4
Oil Resistance/Ozone Resistance (Hose Only)			
Remote Reservoir	GMW 15422, 4.10		No cracks
Vacuum Collapse (Hose Only)			
Remote Reservoir	GMW 15422, 4.11		Ball traverses length of hose freely

Table 3: Burst Pressure at Temperature

Pressure Rating	Minimum Burst Pressure at Temperature			
	-40°C	**-20°C**	**0°C**	**20°C**
A	18 MPa	13 MPa	10 MPa	6.7 MPa
B	20 MPa	18 MPa	15 MPa	13 MPa
C	35 MPa	30 MPa	29 MPa	23 MPa

Table 4: Pressure Fatigue Cycles

Test Setup Pressure (MPa)	Pressure Fatigue Cycles (n)
83% of minimum burst pressure	100 minimum
74% of minimum burst pressure	1 000 minimum
65% of minimum burst pressure	10 000 minimum
57% of minimum burst pressure	100 000 minimum
48% of minimum burst pressure	1 000 000 minimum

4 Manufacturing Process

The inner surface of the hose shall be free of excess soap, talc or other material which could affect serviceability and usage.

5 Rules and Regulations

5.1 All materials supplied to this standard must comply with the requirements of GMW3001, **Rules and Regulations for Material Specifications.**

5.2 All materials supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts.**

6 Approved Sources

Engineering qualifications of an approved source are required for this standard. Only sources listed in the GM Materials File (i.e., GM Supply Power) under this standard number have been qualified by engineering as meeting the requirements of this standard.

For other GM locations, the responsible engineering group should be contacted to obtain the approved source in that individual country.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms. Abbreviations and Symbols.

ACM Acrylate

AEM Copolymer of ethyl acrylate and ethylene

CM Chlorinated polyethylene

CSM Chlorosulfonated polyethylene

HNBR Hydrogenated acrylonitrile-butadiene

OD Outer diameter

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Material per GMW15348 Type "XYZ", where XYZ = material type as defined in Section 1.1

9 Release and Revisions

9.1 Release. This standard originated in May 2006. It was first approved by the Global Elastomer Team in January 2009. It was first published in February 2009.

It supersedes all regional material specifications for power steering return and suction hoses for use on Global Engineered materials including but not limited to GM6210M, GM6211M, GME 09009, GME 09010 and GME 7063.