

## Turbo Charger Hoses with High Temperature Resistance

### 1 Scope

This specification covers the materials and performance of turbo charger hoses either in four (4) layer extruded constructions or in wrapped elastomeric constructions for higher temperature resistance.

**1.1 Material Description.** Materials covered by this specification are divided into the following types: "continuous and excursion". Temperature limits are defined by the Vehicle Technical Specifications (VTS).

**1.1.1 Type A:** Fluoroelastomer (FKM) lining, peroxide cured with Silicone Elastomer (VMQ) intermediate layer and cover for +180 °C continuous and +200 °C excursion.

**1.1.2 Type B:** FKM lining, bisphenolic cure system with higher elongation, with VMQ intermediate layer and cover for +200 °C continuous and +225 °C excursion.

**1.1.3 Type C:** FKM lining, peroxide cured with VMQ intermediate layer and cover for +200 °C continuous and +225 °C excursion.

**1.1.4 Type D:** Fluorosilicone elastomer (FVMQ) lining with VMQ intermediate layer and cover for +180 °C continuous and +200 °C excursion.

**1.1.5 Type E:** Drawing defined (e.g., using SAE J200 or ASTM D2000 line callout).

**1.1.6 Type F:** FKM lining, peroxide cured with better dynamic properties, intermediate layer and cover of VMQ for +200 °C continuous and +225 °C excursion. This material is resistant to exhaust gas and can be used for turbo charger systems with Exhaust Gas Recirculation.

**1.1.7 Type G:** FVMQ or FKM lining with wrapped construction of reinforcement embedded in VMQ for +200 °C continuous and +225 °C excursion. Lining shall be specified selecting one (1) of Type B to Type F.

**1.1.8 Type H:** FKM lining, peroxide cured with better dynamic properties for +225 °C continuous and +250 °C excursion; intermediate layer and cover of VMQ for +210 °C continuous and +250 °C excursion. This material is resistant to exhaust gas and can be used for turbo charger systems with Exhaust Gas Recirculation. For this specification, if no type is defined, the type required by default is Type A.

All extruded hoses shall have textile reinforcement between the intermediate and cover layers that is suitable to fulfill the requirements of the material and durability tests.

**1.2 Symbols.** Not applicable.

**1.3 Applicability.** Turbo Charger Hoses.

### 2 References

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

#### 2.1 External Standards/Specifications.

ASTM D2000	ISO 37	ISO 815	ISO 1817
ISO 34-1	ISO 48	ISO 815-1	ISO 23529
ISO 36	ISO 188	ISO 1431-1	SAE J200

#### 2.2 GM Standards/Specifications.

GMW3059	GMW16153	GMW17245
GMW14270	GMW16955	

### 2.3 Additional References.

Vehicle Technical Specification (VTS)

## 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. Report both individual and averaged values.

**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  $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  and with the same test methods. Unless otherwise stated, ambient temperature test conditions shall be held to  $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Unless otherwise stated, all other temperatures except  $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  shall be held to  $\pm 3\text{ }^{\circ}\text{C}$ .

**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 procedure. The minimum time between vulcanization and testing of elastomers shall be 72 h.

**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 or Product Validation Testing.** Material and performance properties are summarized in Table 1, Table 2, Table 3, and Table 4. For full approval of a hose, compliance to the requirements of Table 1, Table 2, Table 3, and Table 4 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 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, Table 2, Table 3 and Table 4 except Long Term Aging Resistance, Ozone Resistance, and Durability Tests.

3.3 All materials supplied to this standard must comply with GMW3059, Restricted and Reportable Substances, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

**Table 1: Material and Performance Properties - Requirements to the Lining**

Property	Test Procedure	Unit	Value
<b>Hardness</b>			
Type A, Type C, Type F, Type H	ISO 48 Method M	IRHD	75 -5 + 10
Type B	ISO 48 Method M	IRHD	70 ± 5
Type D	ISO 48 Method M	IRHD	60 -5 + 10
Type E	As specified on drawing/math data file		As specified on drawing
<b>Elongation at Break</b>			
Type A, Type C, Type D	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	200 minimum
Type B, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	400 minimum
Type E	As specified on drawing/math data file	%	As specified on drawing
<b>Tensile Strength</b>			
Type A, Type C, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	10 minimum
Type B	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	8 minimum
Type D	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	6 minimum
Type E	As specified on drawing/math data file	MPa	As specified on drawing
<b>Tear Strength</b>			
Type A, Type C,	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	2 minimum
Type B	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	5 minimum
Type D	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	1.5 minimum
Type E	As specified on drawing/math data file		As specified on drawing
Type F, Type H	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	8 minimum
<b>Age Resistance (Heat Aging)</b>			
Type A, Type C	ISO 188 Method B, 168 h -2 h at +200 °C ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % N/mm	-2 to +5 maximum -40 maximum -20 maximum 2 minimum

Property	Test Procedure	Unit	Value
Type A	ISO 188 Method B, 1008 h -2 h at +175 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	± 5 maximum 200 minimum 8 minimum
Type B	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD% % MPa N/mm	-2 to +5 maximum 200 minimum 8 minimum 4 minimum
Type B	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % %	± 10 maximum 150 minimum 8 MPa minimum
<b>Age Resistance (Heat Aging), continued</b>			
Type C	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD% % MPa N/mm	-2 to +5 maximum 200 minimum 12 minimum 2 minimum
Type C	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	± 5 maximum 200 minimum 8 minimum
Type D	ISO 188 Method B, 168 h -2 h at +200 °C ± 3 °C Change in Hardness Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength Tear Strength	Shore A % % % MPa N/mm	-2 to +10 maximum -40 maximum 200 minimum -30 maximum 6 minimum 2 minimum
Type D	ISO 188 Method B, 1008 h -2 h at +175 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	-2 to +10 maximum 150 minimum 6 minimum
Type E	As specified on drawing/math data file		As specified on drawing
Type F	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD% % MPa N/mm	+10 maximum 250 minimum 10 minimum 4 minimum
Type F	ISO 188 Method B, 72 h -2 h at +250 °C ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD% % % N/mm	+12 maximum -40 maximum -20 maximum 4 minimum

Property	Test Procedure	Unit	Value
Type F	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD% % MPa	+10 maximum 300 minimum 10 minimum
Type H	ISO 188 Method B, 168 h -2 h at +250 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD% % MPa N/mm	+12 maximum 250 minimum 10 minimum 4 minimum
Type H	ISO 188 Method B, 72 -2 h at +275 ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % % N/mm	+12 maximum -40 maximum -40 maximum 4 minimum
Type H	ISO 188 Method B, 1008 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD% % MPa	+10 maximum 300 minimum 10 minimum
<b>Oil Resistance</b>			
Type A, Type C	ISO 1817 to heat aged engine oil to GMW17245; 168 h -2 h; at +175 °C ± 3 °C Change in Hardness Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength Change in Volume Tear Strength	IRHD % % % MPa % N/mm	± 10 maximum -50 maximum 150 minimum -25 maximum 7 minimum -2 to +12 maximum 2 minimum
Type B	ISO 1817 to heat aged engine oil to GMW17245; 168 h -2 h; at +175 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Change in Volume Tear Strength	IRHD % MPa % N/mm	2 to +10 maximum 150 minimum 7 minimum -2 to +12 maximum 5 minimum
Type D	ISO 1817 to heat aged engine oil to GMW17245; 168 h -2 h; at +175 °C ± 3 °C Change in Hardness Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength Change in Volume Tear Strength	Shore A % % % MPa % N/mm	± 10 maximum -50 maximum 150 minimum -50 maximum 5 minimum -2 to +12 maximum 2 minimum
Type E	As specified on drawing/math data file		As specified on drawing

Property	Test Procedure	Unit	Value
Type F, Type H	ISO 1817 to heat aged engine oil to GMW17245; 168 h -2 h; at +175 °C ± 3 °C Change in Hardness Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength Change in Volume Tear Strength	IRHD % % % MPa % N/mm	± 5 maximum -60 maximum 200 minimum -50 maximum 8 minimum -2 to +12 maximum 3.5 minimum
<b>Resistance to Exhaust Gas Recirculation Fluid</b>			
Type F, Type H	ISO 1817 to EGR fluid (see Appendix A, Table A1) 336 h -2 h; at +100 °C ± 3 °C Change in Hardness Change in Volume Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength after additional drying at +80 °C ± 3 °C for 22 h -2 h Change in Hardness Change in Volume Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength	Shore A % % % % MPa Shore A % % % % MPa	-10 maximum +35 maximum -35 maximum 180 minimum -30 maximum 9 minimum +10 maximum -10 maximum -35 maximum 150 minimum -45 maximum 8 minimum
<b>Resistance to Exhaust Gas Recirculation Fluid, continued</b>			
Type F, Type H	ISO 1817 to EGR fluid (see Appendix A, Table A1) 1008 h -2 h; at +60 °C ± 3 °C Change in Hardness Change in Volume Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength after additional drying at +80 °C ± 3 °C for 22 h -2 h Change in Hardness Change in Volume Change in Elongation at Break Elongation at Break Change in Tensile Strength Tensile Strength	Shore A % % % % MPa Shore A % % % % MPa	-10 maximum +15 maximum -35 maximum 180 minimum -45 maximum 9 minimum +10 maximum -10 maximum -35 maximum 150 minimum -30 maximum 8 minimum

EGR = Exhaust Gas Recirculation

IRHD = International Rubber Hardness Degree

Table 2: Material and Performance Properties - Requirements to the Intermediate Layer

Property	Test Procedure	Unit	Value
<b>Hardness</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 48 Method M	IRHD	55 to 75
Type E	As specified on drawing/math data file		As specified on drawing
<b>Elongation at Break</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	300 minimum
Type E	As specified on drawing/math data file	%	As specified on drawing
<b>Tensile Strength</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	MPa	8 minimum
Type E	As specified on drawing/math data file	MPa	As specified on drawing
<b>Tear Strength</b>			
Type A, Type B, Type C, Type D	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	2 minimum
Type F, Type H	Tear strength to ISO 34-1 Method A (trouser test piece)	N/mm	5 minimum
Type E	As specified on drawing/math data file		As specified on drawing

Property	Test Procedure	Unit	Value
<b>Age Resistance (Heat Aging)</b>			
Type A, Type C, Type D	ISO 188 Method B, 168 h -2 h at +200 °C ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % N/mm	-5 to +10 maximum -40 maximum -30 maximum 2 minimum
Type A, Type D	ISO 188 Method B, 1008 h -2 h at +175 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 150 minimum 5 minimum
Type B	ISO 188 Method B, 168 -2 h at +200 ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength	IRHD % %	-5 to +10 maximum -50 maximum -30 maximum
Type F	ISO 188 Method B, 168 -2 h at +200 ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % N/mm	+10 maximum -40 maximum -30 maximum 3 minimum
Type B, Type F	ISO 188 Method B, 168 -2 h at +225 ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD % MPa N/mm	+10 maximum 200 minimum 5 minimum 2 minimum
Type B	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % %	+10 maximum 200 minimum 6 minimum
Type F	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % %	+10 maximum 200 minimum 4 minimum
Type C	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD % MPa N/mm	+10 maximum 200 minimum 5 minimum 2 minimum
Type C	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 200 minimum 6 minimum
Type H	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % N/mm	+10 maximum -50 maximum -50 maximum 2 minimum

Property	Test Procedure	Unit	Value
Type H	ISO 188 Method B, 168 h -2 h at +250 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+15 maximum 170 minimum 4 minimum
Type H	ISO 188 Method B, 1008 h -2 h at +210 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 200 minimum 4 minimum
<b>Age Resistance (Heat Aging), continued</b>			
Type E	As specified on drawing/math data file		As specified on drawing
<b>Oil Resistance</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 1817 engine oil to GMW16955 Code F 72 h -2 h; at +150 °C ± 3 °C Change in Volume	%	± 30 maximum
Type E	As specified on drawing/math data file		As specified on drawing

Table 3: Material and Performance Properties - Requirements to the Cover

Property	Test Procedure	Unit	Value
<b>Hardness</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 48 Method M	IRHD	60 to 80
Type E	As specified on drawing/math data file		As specified on drawing
<b>Elongation at Break</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	%	300 minimum
Type E	As specified on drawing/math data file	%	As specified on drawing
<b>Tensile Strength</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 37, Type 2 or Type 4 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	8 minimum
Type E	As specified on drawing/math data file	MPa	As specified on drawing
<b>Tear Strength</b>			
Type A, D	Tear strength to ISO 34-1 Method A (trouser test piece )	N/mm	2 minimum
Type B, Type C, Type F, Type H	Tear strength to ISO 34-1 Method A (trouser test piece )	N/mm	5 minimum
Type E	As specified on drawing/math data file	MPa	As specified on drawing
<b>Age Resistance (Heat Aging)</b>			
Type A, Type B, Type C, Type D	ISO 188 Method B, 168 h -2 h at +200 °C ± 3 °C Change in Hardness Change in Elongation at Break Change in Tensile Strength Tear Strength	IRHD % % N/mm	-5 to +10 maximum -50 maximum -50 maximum 2 minimum

Property	Test Procedure	Unit	Value
Type A, Type D	ISO 188 Method B, 1008 h -2 h at +175 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 200 minimum 6 minimum
Type B	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD % MPa N/mm	+10 maximum 250 minimum 6 minimum 2 minimum
<b>Age Resistance (Heat Aging), continued</b>			
Type B, Type C, Type F	ISO 188 Method B, 1008 h -2 h at +200 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 200 minimum 5 minimum
Type C, Type F	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD % MPa N/mm	+15 maximum 200 minimum 5 minimum 2 minimum
Type E	As specified on drawing/math data file		As specified on drawing
Type H	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength Tear Strength	IRHD % MPa N/mm	+10 maximum 200 minimum 4 minimum 2 minimum
Type H	ISO 188 Method B, 168 h -2 h at +250 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+15 maximum 150 minimum 4 minimum
Type H	ISO 188 Method B, 1008 h -2 h at +210 °C ± 3 °C Change in Hardness Elongation at Break Tensile Strength	IRHD % MPa	+10 maximum 150 minimum 4 minimum
<b>Oil Resistance</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 1817 engine oil to GMW16955 Code F; 72 h -2 h; at +150 °C ± 3 °C Change in Volume	%	± 30 maximum
Type E	As specified on drawing/math data file		As specified on drawing
<b>Ozone Resistance</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 1431-1, 50 ppm, 20%, 40 °C ± 2 °C, 72 h -2 h visual examination (no magnification)		No cracks
Type E	As specified on drawing/math data file		As specified on drawing

Table 4: Material and Performance Properties - Requirements to the Assembly

Property	Test Method	Unit	Value
<b>Adhesion Strength</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 36 strip test piece lining to intermediate layer intermediate layer to cover	N/mm N/mm	1.2 minimum 2.5 minimum
Type E	As specified on drawing/math data file		As specified on drawing
Type G	ISO 36 strip test piece lining to wrapped layer between wrapped layers	N/mm N/mm	1.0 minimum 1.5 minimum
<b>Age Resistance (Heat Aging)</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 188 Method B, 336 h -2 h at +200 °C ± 3 °C Adhesion Strength lining to intermediate layer adherence of the layers	N/mm	0.25 minimum no delaminating
Type E	As specified on drawing/math data file		As specified on drawing
Type G	ISO 188 Method B, 168 h -2 h at +225 °C ± 3 °C Adhesion Strength lining to wrapped layer between wrapped layers adherence of the layers	N/mm N/mm	1.0 minimum 1.0 minimum no delaminating
Type G	ISO 188 Method B, 1008 °C -2 h at +200 °C ± 3 °C Adhesion Strength lining to wrapped layer between wrapped layers adherence of the layers	N/mm N/mm	1.0 minimum 1.0 minimum no delaminating
<b>Oil Resistance</b>			
Type G	A section of the hose (at least 100 mm free length) is plugged at one end. Fill hose to approximately 50% of volume with engine oil to GMW16955 Code F and plug other end. Store in +150 °C for 336 h in that way that the seam of the lining (in case of wrapped lining) is exposed with oil. Adhesion Strength lining to wrapped layer between wrapped layers Visual Examination	N/mm N/mm	1.0 minimum 1.0 minimum no separation at the seam
<b>Compression Set</b>			
Test pieces are to be taken from calibrated ends, if available			
Type A, Type D,	ISO 815 test piece Type B <sup>Note 1</sup> , wall thickness is test piece thickness; +175 °C ± 3 °C, 24 h, 25% compressed	%	45 maximum
Type B, Type C, Type F	ISO 815 test piece Type B <sup>Note 1</sup> , wall thickness is test piece thickness; +200 °C ± 3 °C, 24 h, 25% compressed	%	80 maximum
Type E	As specified on drawing/math data file		As specified on drawing
Type G	ISO 815 test piece Type B <sup>Note 1</sup> , wall thickness is test piece thickness; +175 °C ± 3 °C, 24 h, 25% compressed	%	55 maximum

Property	Test Method	Unit	Value
Type H	ISO 815 test piece Type B <sup>Note 1</sup> , wall thickness is test piece thickness; +200 °C ± 3 °C, 24 h, 25% compressed Hose must not slip off during pressure vibration temperature (PVT) test to GMW16153.	%	85 maximum
<b>Cold Resistance</b>			
Type A, Type B, Type C, Type D, Type F, Type H	ISO 23529, -30 °C ± 3 °C; 22 h + 1 h Test piece 10 mm × 100 mm Bending test radius = 12.5 mm		No cracks
Type E	As specified on drawing/math data file		As specified on drawing
<b>Durability Tests</b>			
If the hose has to compensate a relative movement, test to GMW16153 and requirements on drawing.			
If the hose does not have to compensate a relative movement, test per GMW16153 and requirements on drawing, except movement simulation.			

**Note 1:** The reference to ISO 815 indicates the test piece diameter and refers to the calculation of the results. But test pieces must be taken from finished hose in product thickness.

## 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. The hoses must have properly manufactured ends; free threads of textile reinforcement may not exceed 1.5 mm maximum.

## 5 Rules and Regulations

**5.1 Legal Regulations.** All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

**5.2 Language.** In the event of conflict between the English and domestic language, the English language shall take precedence.

**5.3 Inspection and Rejection.** Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.

A new approval must be received for any changes, e.g., properties, manufacturing process, location of manufacture, etc. If not otherwise agreed, all testing and documentation normally required for initial release must be completed.

It is the responsibility of the supplier to inform the customer in a timely manner, without solicitation, and to include documentation of all modifications of materials and/or processes and to apply for a new release.

**5.4 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS).** For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements.

## 6 Approved Sources

Materials supplied to this specification must be approved by General Motors.

A list of approved materials can be found in the GM Materials Approved Source List. This GM Material File is provided to third parties to reduce redundant testing of materials. If approved material already listed is used, the part supplier can use GM Material File reference for Production Part Approval Process (PPAP) material approval. If the decision is made to use a not yet approved material, contact Materials- Elastomers Global Subsystem Leadership Team for details on the approval process. The material approval process must be completed prior to PPAP start date of the part supplied to General Motors.

Engineering qualifications of an approved source are required for this standard. Only sources listed in the GM Materials File (i.e., GM SupplyPower) under this standard number have been qualified by engineering as meeting the requirements of this standard. To access this list, reference GMW14270 for latest location.

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

## 7 Notes

Suppliers can qualify a hose for both Type A and Type C approvals by successfully completing the requirements for Type C approval. Suppliers can qualify a hose for both Type C and Type F approvals by successfully completing the requirements for Type F approval. Suppliers can qualify a hose for Type F and Type H approvals by successfully completing the requirements for Type H approval.

### 7.1 Glossary.

**Calibrated End:** A calibrated end is formed by an extra cap which is pulled over one or two (2) ends of the hose when mounted on mandrel before vulcanization to allow wall thickness with lower dimensional tolerance.

**pH:** pH is a measure of hydrogen ion concentration; a measure of the acidity or alkalinity of a solution. Aqueous solutions at 25 °C with a pH <7 are acidic, while those with a pH >7 are basic or alkaline.

### 7.2 Acronyms, Abbreviations, and Symbols.

<b>ASTM</b>	ASTM International
<b>CAC</b>	Charge Air Cooler
<b>CTS</b>	Component Technical Specification
<b>DRE</b>	Design Release Engineer
<b>EGR</b>	Exhaust Gas Recirculation
<b>FKM</b>	Fluoroelastomer
<b>FVMQ</b>	Fluorosilicone Elastomer
<b>GHS</b>	Globally Harmonized System of Classification and Labeling of Chemicals
<b>IMDS</b>	International Material Data System
<b>IRHD</b>	International Rubber Hardness Degree
<b>ISO</b>	International Organization for Standardization
<b>MSDS</b>	Material Safety Data Sheet
<b>PPAP</b>	Production Part Approval Process
<b>pphm</b>	parts per hundred million
<b>PTFE</b>	Polytetrafluoroethylene
<b>PVT</b>	Pressure Vibration Temperature
<b>SAE</b>	SAE International
<b>SDS</b>	Safety Data Sheet
<b>SSTS</b>	Subsystem Technical Specification
<b>VMQ</b>	Silicone Elastomer
<b>VTS</b>	Vehicle Technical Specification

## 8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:  
Material per GMW15408 Type "X",

### Where:

X = Material Type as defined in 1.1

## 9 Release and Revisions

This standard was originated in August 2006. It was first approved by Global Elastomers Team in November 2006. It was first published in May 2008.

Issue	Publication Date	Description (Organization)
1	MAY 2008	Initial publication.
2	JAN 2014	Updated to current template. (Elastomers Global Subsystem Leadership Team)
3	FEB 2017	Resistance to Exhaust Gas Recirculation fluid and High Heat Hoses for Exhaust Gas Recirculation (EGR) ducts added; typographical errors corrected. (Materials - Elastomers Global Subsystem Leadership Team)

## Appendix A

Table A1: Fluid Composition for Exhaust Gas Recirculation Test - Approximately 1 pH value <sup>Note 1</sup>

Acid Component	Chemical Notation	Content in mg/l
Hydrofluoric Acid	HF	60
Hydrochloric Acid	HCl	40
Sulfuric Acid	H <sub>2</sub> SO <sub>4</sub>	30
Phosphoric (V) Acid	H <sub>3</sub> PO <sub>4</sub>	50
Nitric Acid	HNO <sub>3</sub>	3000
Formic Acid	HCOOH	450
Acetic Acid	CH <sub>3</sub> COOH	500

## Note 1:

- Mix all ingredients in distilled water.
- Only mix the amount of fluid which is needed for tests; check pH-value.
- Use personal protection (laboratory coat, safety glasses, acid resistant gloves) and work under an extractor hood when preparing test fluid.
- Immerse test pieces in a pressure vessel with resistance to the EGR fluid (e.g., stainless steel to EN 10088-2 (CrNiMo steel)), e.g., 1.4404, 1.4571 or Polytetrafluoroethylene (PTFE) and PTFE gasket. Volume ratio test piece to EGR fluid 1:30 to 1:40.
- After immersion, test pieces are removed from the fluid and wiped dry.