



Transmission and Engine Oil Cooler Plumbing System

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The specification describes the quality, reliability, durability and performance requirements for Transmission Oil Cooler (TOC) and Engine Oil Cooler (EOC) plumbing systems for use in GM vehicles. All requirements of this specification shall be met in order to demonstrate design and production validation, as well as in process compliance.

1.2 Applicability. This standard covers qualification tests for plumbing systems used with cooling line oils designated as Type E; Engine oils and Type T; Transmission oils used in automotive applications (as detailed in 4.1.1.4.1).

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM B210	ASTM D380	SAE J1344	SAE J1739
ASTM B221			

2.2 GM Standards/Specifications.

9986153	GMW15608	GMW16171	GMW17136
GMW3059	GMW15786	GMW16304	
GMW14327	GMW15827	GMW16444	
GMW14872	GMW15964	GMW17010	

2.3 Additional References.

- GM Production Part Approval Process (PPAP).
- GM1738 Packaging and Identification Requirements for Production Parts.
- GM1820 Pre-Prototype and Prototype Sample Approval.
- Statement of Requirement (SOR).

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance.

3.1.1.1 Finish. Appearance and finish of parts shall be free of weld and/or braze splatter, flash, ridges, roughness and of tool lubricants and other contamination.

3.1.2 Content. Not applicable.

3.1.3 Ambient Environment. The hose and coupling shall be capable of withstanding temperature variations from -40 °C to 150 °C with an excursion temperature exposure of 165 °C and severe exposure to a corrosive environment. Excursion temperature exposure is a peak.

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3.1.4 Interfaces. Not applicable.

3.1.5 Usage Definition. The transmission or engine oil cooler line will be exposed to under-hood and underbody environments. Hose material and tubing must be compatible with Dexron® VI (GMW16444) and other GM Specific Program approved transmission fluids, GM and SAE International standard engine oils (e.g., SAE 5W30), and any other under-hood fluid (windshield washer fluid, brake fluid, etc.) Transmission or Engine Fluid shall be approved by Validation Engineer and Design Responsible Engineer (DRE) before Analysis/Development/Validation Plan and Report (ADVP&R) submission.

3.2 Product Characteristics.

3.2.1 Performance Requirements. Not applicable.

3.2.2 Physical Characteristics. Not applicable.

3.2.3 Reliability.

3.2.3.1 Reliability Evaluation Point. The Reliability Evaluation Point (REP) shall be one (1) life of severe customer usage at the vehicle level.

3.2.3.2 Reliability Requirements. Components must demonstrate the required reliability of 99% at a 50% confidence (R99C50) and slope of 2, at the REP for the transmission oil cooler line or engine oil cooler line. Reliability evaluation profiles shall be consistent with the customer usage profile and environmental exposure at the REP as specified in the ambient environment and usage sections of this technical specification. Test to failure methodology is preferred.

3.2.4 Serviceability. Refer to 4.3.4.

3.2.5 User System/Subsystem/Component/Part Interface. Not applicable.

3.3 Design and Construction.

3.3.1 Materials, Processes and Parts Selection Guidelines.

3.3.1.1 Material Guidelines.

3.3.1.1.1 Hose. Hoses shall be in accordance with GMW16304 and GMW16171.

3.3.1.1.2 Tube. Tube shall be in accordance with aluminum tubing AA3003-H14 per ASTM B210 or ASTM B221.

3.3.1.1.3 Connectors. Connector designs shall be at the discretion of the supplier but subject to the performance guidelines contained in this specification.

3.3.1.1.4 Hose to tube Couplings. Coupling designs shall be at the discretion of the supplier but subject to the performance guidelines contained in this specification.

3.3.1.1.5 Hose to Tube Couplings. Use validation requirements in GMW15964.

3.3.1.1.6 Shipping Caps or Covers. All hose assemblies shall have shipping caps or shipping bags, as specified by the detail drawing which maintain a fully installed position, until the hose assembly is installed into a final system assembly. The shipping caps must conform to GMW15786. During removal, there must be no degradation of features as represented by the detail drawings. This would include but not be limited to, dislodging of the sealing mechanism (if required) and/or damage to the threads or sealing areas.

3.3.1.1.7 Protection Sleeves. The protection sleeves material and performance requirements for expandable braided flexible sleeves, heat shrinkable woven sleeves and self-closing sleeves for abrasion resistant shall be in accordance with GMW14327. The cross-linked flexible polyolefin heat shrinkable sleeve shall be in accordance with GMW17136. The thermal resistant sleeves shall be in accordance with GMW15608.

3.3.2 Design Guidelines and Constraints. Not applicable.

3.3.3 Identification and Marking. All assemblies must show indemnification of supplier. All plastic parts shall be identified for recycling per SAE J1344.

3.4 Documentation.

3.4.1 Failure Mode and Effects Analysis (FMEA) (SAE J1739). Design and process FMEA shall be submitted to the GM Release Engineer on request and shall be maintained as part of the vendor records of the Design Validation (DV) and Product Validation (PV). The FMEAs shall be updated each time a change occurs.

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4 Validation

4.1 General. The requirements shall be satisfied as partial fulfillment of the requirements for prototype and production submission. In addition, plumbing systems must perform satisfactorily in vehicle system validation.

4.1.1 Design Validation (DV). Design Validation is defined as the set of requirements to be used to validate a new design. New design is defined as a design using different materials, processes or dimensions that, in the GM Release Engineer's opinion, is a departure from previous practice. This new design need not be manufactured from production tools and processes, but should be representative from a design function standpoint. Submission of test results should be done through both a Design Validation Plan and Report (DVP&R) or through the GM1820 process for pre-prototype material approval. The ADVP&R template to be used for validation will be defined in the Validation Cross Reference Index (VCRI) in the Statement of Requirements (SOR) Appendix. See Validation Engineer if there are any questions related to the ADVP&R plan.

4.1.1.1 Hose to Tube Couplings. Use Validation Requirements in GMW15964.

4.1.1.2 Tube to Tube/Tube to Cooler/Tube to Transmission/Engine Connections.

4.1.1.2.1 Test Sample Construction. Unless otherwise specified by the responsible GM Release Engineer, test samples shall be built as follows:

4.1.1.2.1.1 Vibration Test, Pressure, Displacement and Temperature (PDT), and Heat Aging Tests.

4.1.1.2.1.2 Pressure, displacement and temperature, and heat aging test connector samples should be tested with a coupled hose assembly having a straight hose length of 500 mm $\pm$ 10 mm (19.7 in $\pm$ 0.394 in) and a straight tube length of 100 mm $\pm$ 10 mm (3.94 in $\pm$ 0.394 in).

4.1.1.2.1.3 Vibration test samples shall be built according to the production released math data.

4.1.1.2.2 All Other Tests.

4.1.1.2.2.1 Connector samples should be tested with a 300 mm $\pm$ 10 mm (11.8 in $\pm$ 0.394 in) long straight tube assembly.

4.1.1.3 All DV tests require twelve samples. Half of all samples for each test must be supplied at minimum clearance condition and half must be supplied at maximum clearance condition. Maximum clearance condition shall reflect maximum allowed clearance between the male and female portions of the connector. If a seal is used, it shall have the minimum allowed compression or interference. Minimum clearance condition shall reflect the minimum allowed clearance between the male and female portions of the connector. If a seal is used, it shall have the maximum allowed compression or interference. The male and female portions of the connector may be manufactured (within production representative methods) to compensate for the worst case condition produced by the various components. Design tolerance stack information must be provided to confirm each component's dimensions with regard to the appropriate material condition. Additionally, each specimen must be serialized and accompanied by corresponding serialized data showing it conforms to its material condition.

4.1.1.4 Tensile Strength. This test is intended to insure that the joint retention structure will withstand a given threshold tensile force. Ten (10) tube and connector assemblies shall be tested.

4.1.1.4.1 Acceptance Determination. The load at failure either by separation of the specimen from the end fittings or by ruptures of the hose structure shall be no less than those in Table 1 when tested per 4.3.1.

Table 1: Acceptable Minimum Load by Type

Type	Test Temperature	Minimum Load Acceptance
E	Ambient Room Temperature	2220 N
E	93.5 °C	1000 N
T	Ambient Room Temperature	890 N
T	150 °C	500 N

4.1.1.5 Burst Strength.

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4.1.1.5.1 Acceptance Determination. Minimum burst strength shall be no less than 6895 kPa when tested per 4.3.2.

4.1.1.6 Insertion Force. This test is intended to insure that assembly effort to make the joint does not exceed manufacturing guidelines (validation of quick connect joints).

4.1.1.6.1 Acceptance Determination. The compression load required to secure the joint must not exceed 66.75 N. Refer to 4.3.3.1.

4.1.1.7 Serviceability.

4.1.1.7.1 Each specimen must not leak when subjected to the Leak Test (4.3.10) prior to this test. In between each and after a total of ten (10) service procedures have been performed on the specimens, the specimens must pass the requirements of the Leak Test (4.3.10). Additionally, after the tenth service procedure, the joint must pass the requirements for Burst Strength (4.3.2). Refer to 4.3.4.1.

4.1.1.8 Heat Aging. This test is intended to verify the capability of the joint's elastomeric components to perform in a high ambient temperature environment. Six (6) samples shall be tested.

4.1.1.8.1 The hose and/or quick connect seal shall show no signs of external or internal cracks, charring or disintegration and must not leak when subjected to the Leak Test (4.3.10) both before and after heat aging. Refer to 4.3.5.1.

4.1.1.9 Vibration. Six (6) samples, three (3) minimum material condition and three (3) maximum material condition, shall be mounted in the test fixture such that the vibration shall be imparted to the assembly through the hose end, and six (6), three (3) minimum material condition and three (3) maximum material condition, samples shall be mounted such that the vibration shall be imparted through the tube end.

4.1.1.9.1 Acceptance Determination. There shall be no evidence of leakage prior to or at the completion of the vibration test.

4.1.1.10 Corrosion. The test is intended to insure the corrosion resistance capability of the components of the joint.

4.1.1.10.1 Acceptance Determination. Both before and after being subjected to the corrosion procedures required in 4.3.6, the joint must pass the Leak Test (4.3.10) and Burst test per 4.3.2.

4.1.1.11 Pressure and Temperature Cycling.

4.1.1.11.1 Test Specimens. Twelve hose assemblies shall be tested.

4.1.1.11.2 Acceptance Criteria. There shall be no evidence of leakage when tested per 4.3.10.

4.1.1.12 Pressure, Displacement and Temperature (PDT).

4.1.1.12.1 Test Specimens. Twelve hose assemblies shall be tested.

4.1.1.12.2 Acceptance Criteria. There shall be no evidence of leakage when tested per 4.3.10.

4.1.2 Production Validation (PV). Production Validation is defined as the set of requirements to be used to validate new production parts. A part is considered new when either a dimensional, material or process change has been made and, in the GM Release Engineer's opinion, the change affect the design function. Test parts must be manufactured from production tools and processes and selected at random. Submission of test results should be done through a standard Production Part Approval Process (PPAP).

4.1.2.1 Hose to Tube Couplings. Use Validation Requirements in GMW15964.

4.1.2.2 Tube to Tube or Tube to Cooler/Transmission/Engine Connections.

4.1.2.2.1 Test Sample Construction. Unless otherwise specified by the responsible GM Release Engineer, test samples shall be built as follows.

4.1.2.2.1.1 Pressure, Displacement and Temperature Test.

4.1.2.2.1.1.1 Connector samples should be submitted as part of a coupled hose assembly having a hose length of 500 mm $\pm$ 10 mm (19.7 in $\pm$ 0.394 in) and a straight tube length of 100 mm $\pm$ 10 mm (3.94 in $\pm$ 0.394 in).

4.1.2.2.1.2 All other tests.

4.1.2.2.1.2.1 Connector samples should be submitted as part of a production assembly. This assembly may be modified to permit installation in a test chamber.

4.1.2.3 Tensile Strength.

4.1.2.3.1 Test Specimens. Ten (10) tube and connector assemblies shall be tested.

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