



Validation Testing for Coolant Hose Coupled Joint Interfaces

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. This specification defines the Design Validation (DV), Production Validation (PV) and Steady State Part Monitoring (SSPM) requirements for coolant hose interfaces, including mid-assembly connections (T joint, Y joint, etc.) The designs validated under this specification may or may not be included in GMW17144: "Hose to Spigot Connection: System of Spring Band Clamp, Hose and Spigot", which is the global metric coolant connection standard for hoses and fittings. GM Engineering may require any connection not defined in GMW17144 be subjected to this specification, prior to acceptance. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

1.2 Applicability. This specification and the test described applies for all the connections used on coolant applications, this includes but is not limited to, hose and clamps, hose and quick connectors and/or hose with overmold features. This procedure must be executed regardless of the type of interface used in the assembly.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM A254	ASTM D380	SAE J1344
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2.2 GM Standards/Specifications.

GMW3059	GMW8758	GMW14872	GMW15760
GMW3116	GMW14573	GMW15272	GMW15920
GMW3286	GMW14785	GMW15758	GMW17144
GMW3420			

2.3 Additional References.

- 9985809, dexcool® Extended Life Engine Coolant

3 Requirements

3.1 System/Subsystem/Component/Part Definition. Not applicable.

3.1.1 Appearance. Not applicable.

3.1.2 Content. Not applicable.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content. Not applicable.

3.1.3 Ambient Environment. Not applicable.

3.1.4 Interfaces. Not applicable.

3.1.5 Usage Definition. Not applicable.

3.2 Product Characteristics. All crimps, over-molds (plastic molded rings acting as crimps), and non-standard clamp joints shall be described as coupled assemblies, for the remainder of this document.

3.2.1 Performance Requirements.

3.2.1.1 Fixed-Value Performance Testing Requirements. GM Engineering to agree to samples before testing begins. For sample requirements and quantities, see 3.7.

3.2.1.1.1 Leak Test.

3.2.1.1.1.1 Coupled Assemblies. There shall be no indication of air leakage at the coupling or in the hose member when the assembly is subjected to a minimum of 350 kPa of air pressure when tested per 4.3.1.1.

3.2.1.1.1.2 Quick-Connector Assemblies. There shall be no indication of air leakage from the connector assembly, or from the hose member, after allowance for temperature compression at a minimum of 500 kPa for quick-connectors < 20 mm sealing surface diameter, and 400 kPa for quick-connectors > 20 mm sealing surface diameter when tested per 4.3.1.2. Temperature compression is defined as the compression set of the rubber compounds for either the hose construction or the O-rings in the quick-connect which create the sealing. This means that the crimped hose assemblies and the internal seals of the quick-connect can experience compression set in the compound but there can be no leakage attributed to this condition. The rubber compound and the coupling or sealing must allow for the compression set and still perform to the standard without leaking.

3.2.1.1.2 Cold Leak Test. Sample must weigh within 3.0 g of original weight when tested per 4.3.1.2.

3.2.1.1.3 Tensile Test. The load at failure either by separation of the hose specimen from the end fittings, or by a rupture of the hose structure, shall not be < 668 N when samples at nominal hose compression are tested per 4.3.1.3.

3.2.1.1.4 Blowoff. There shall be no indication of leakage at the coupled assembly, quick-connect or in the bulk hose, during the 180 s hold period when samples at nominal hose compression are tested per 4.3.1.4. The final blowoff pressure shall exceed 550 kPa for coupled assemblies and 700 kPa for quick-connectors.

3.2.1.1.5 Blowoff After Heat Aging. There shall be no indication of leakage at the coupled assembly, quick-connect or in the bulk hose, during the 180 s hold period when samples at nominal hose compression are tested per 4.3.1.5. The final blowoff pressure shall exceed 550 kPa for coupled assemblies and 700 kPa for quick-connectors.

3.2.1.1.6 Vacuum Test. The assembly must hold the vacuum within 3% during the 10 minute hold period when samples at nominal hose compression are tested per 4.3.1.6.

3.2.1.1.7 Insertion Force Test (Quick-Connect). The maximum insertion load shall not be > 89 N when samples are tested per 4.3.1.7.

3.2.1.1.8 Pull-Out Force Test (Quick-Connect). The quick-connector pull-out load must exceed 668 N when samples at nominal hose compression are tested per 4.3.1.8.

3.2.1.1.9 Cleanliness Test. There shall be no visual evidence of corrosion of either internal or external metal surfaces when hoses at nominal hose compression are tested per 4.3.1.9. No greater than 0.25 g/m² of internal surface area of contaminants is permitted.

3.2.1.1.10 Cyclical Corrosion Test. Sample must show no greater than 10% base metal corrosion when tested per 4.3.1.10. The assembly must meet all of the requirements of the Leak Test (3.2.1.1.1) and the Blowoff Test (3.2.1.1.4) after the cyclical corrosion test has been performed. All test samples from this test must be forwarded to GM Global HVACPTC Engineering for evaluation at the end of the test.

3.2.1.1.11 Salt Spray Test. After 168 h of the Salt Spray Test, assembly shall not exhibit evidence of any red rust on ferrous parts when tested per 4.3.1.11.

3.2.1.1.12 Maximum Crimp Compression Condition (Coupling). No hose rubber or reinforcement damage generated by the crimping operation is permissible in the samples when tested per 4.3.1.12.

3.2.1.1.13 Over-Crimp to Maximum Crimping (Coupling). Hose samples shall be tested per 4.3.1.13. Samples with maximum crimp, but without showing damage, shall be tested per and must meet the acceptance requirements of the Cold Leak Test (see 3.2.1.1.2). Production controls and product design must be such that over-crimp to damage is not possible in production.

3.2.1.1.14 Error-Proofing Pull-Tab Test (Quick-Connect Assemblies).

3.2.1.1.14.1 Partially Assembled Connectors. The pull-tab shall break through the finger pull area prior to releasing from the connector when tested per 4.3.1.14. All pull-tab material shall remain with the connector. The force required to break the tab shall be a minimum of 12 N.

3.2.1.1.14.2 Fully Assembled Connectors. The pull-tab shall not break during the removal process. The maximum force required to remove the pull-tab shall not exceed 2.5 N when tested per 4.3.1.14.2.

3.2.1.1.15 Anti-Rotation Feature Torque Resistance (Quick-Connect Assemblies). There shall be no loss of the anti-rotation feature, or any other damage that would cause loss of quick-connect function when tested per 4.3.1.15.

3.2.1.2 Endurance Testing Requirements. GM Engineering to agree to samples before testing should begin. For sample requirements and quantities see 3.7.

3.2.1.2.1 Pressure/Vibration/Temperature Test. Samples must meet the acceptance requirements of GMW14785. Samples must meet the acceptance requirements of the Cold Leak Test (See 3.2.1.1.2), following test completion. For sample quantity guidelines see 3.7.

3.2.1.2.2 Pressure/Temperature Test. Assemblies shall be tested per 4.3.2.2 - Pressure/Temperature Test, no leakage is allowed during the test procedure. Assemblies must pass the requirements of the Cold Leak Test (see 3.2.1.1.2), following test completion.

3.2.1.2.3 Coolant Circulating Test. Assemblies shall be tested per 4.3.2.3 - Coolant Circulating Test. Assemblies must pass the requirements of the 3.2.1.1.4 Blowoff Test, following test completion.

3.2.2 Physical Characteristics. Not applicable.

3.2.2.1 Dimensions and Capacity. Not applicable.

3.2.2.2 Mass Properties. Not applicable.

3.2.3 Reliability.

3.2.3.1 Reliability Evaluation Point. This specification, as written, provides a test exposure representing a Reliability Evaluation Point (REP) required by GM.

3.2.3.2 Reliability Requirements. This specification, as written, supports the demonstration of the required reliability of 99% or greater at a 50% confidence (R99C50), at the REP for the coolant hose assembly. The supplier shall utilize "vehicle equivalent" laboratory test setups to simulate "in-vehicle" orientations. If the orientation may be different from one vehicle to another, use the orientation which will provide the worst case loads for all physical level reliability demonstration testing.

The reliability demonstration is provided by the Design Validation (DV) Endurance Tests specified in 3.7.1.3.

Note: Test to Failure (TTF) is always the preferred method. Failure is defined as, but not limited to, the loss of function, unacceptable performance degradation and nonconformance of the component as stated in this specification.

Note: The required number of test samples may be negotiable if it is not practical to run, for example, 23 samples. Negotiation of sample size shall consider test equipment limitations, physical size of test samples, test duration, etc. However, reduction of the sample size may require inclusion/use of longer test durations or other test methods such as Highly Accelerated Stress Screening (HASS), Highly Accelerated Stress Testing (HAST), Calibrated Accelerated Life Testing (CALT), Highly Accelerated Life Testing (HALT), etc. Weibull slope values available from previous failure testing may be considered as a way to reduce the sample size and/or test duration.

3.2.3.3 Accelerated Test Methods. GM encourages the use of appropriate accelerated test methods, wherever possible; for example, the use of accelerated stress testing to reduce test time (GMW8758 - Calibrated Accelerated Life Testing).

Note: GM Validation Engineering shall review and accept reliability demonstration test plans prior to the supplier submitting the Analysis Development Validation (ADV) Test Plan for approval.

3.2.4 Serviceability. Not applicable.

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. Not applicable.

3.3.1.2 Processes Guidelines. Not applicable.

3.3.1.3 Parts Guidelines.

3.3.1.3.1 Coupling Design. The coupling shall be designed and manufactured (for example, over-molded, inserted, swaged, or crimped) so that no internal tube abrasions, cuts or flaws shall result under any condition or combination of assembly component dimensioning or tolerances allowed by supplier production specifications, or under any condition of rubber hose compression allowed by supplier production specifications.

3.3.1.3.2 Sharp Corners. Sharp corners are not permitted where the coupling contacts the tube in order to prevent cutting of the hose when the hose assembly is subjected to internal pressure.

3.3.1.3.3 Tube Insert. The tube insert must not extend past the end of the crimp shell after crimping, and the end of the tube insert must have a radius and be manufactured to eliminate burrs or sharp edges which might cause hose damage under conditions of assembly vibration or pressure impulse.

3.3.1.3.4 Damage. Damage to hose rubber or reinforcement generated by the coupling of the hose is not permissible under any possible production manufacturing conditions or supplier production tolerance stack-up, including variations in hose compression concentricity.

3.3.1.3.5 Tube Collapse. Metal tube insert collapse during crimping is not permissible, except when this collapse is limited, predictable, controllable, and does not increase the potential for assembly leakage or other malfunction. Approval is required from the GM Global HVACPTC Engineer.

3.3.1.3.6 Design Restrictions. Grooves, upsets, or serrations are not permitted on the tube stem Outside Diameter (OD), or on the crimp shell Inside Diameter (ID), except that these grooves, upsets, or serrations do not cause hose cutting or other damage under any condition or combination of assembly component dimensioning or tolerance allowed by supplier production specifications, or under any condition of rubber hose compression allowed by the supplier production specifications.

3.3.1.3.7 Skiving, Adhesives. Skiving of the hose is not permissible. Use of adhesives in the joint is not permissible.

3.3.1.4 Recycling. Materials shall be recyclable per GMW3116. Attempts shall be made to minimize the variety of materials used, to make recycling more viable.

3.3.2 Design Guidelines and Constraints.

3.3.3 Identification and Marking. All assemblies must be labeled with the GM part number, date code and tool/cavity number in a visible location. All labels shall conform to GMW14573.

All plastic parts shall be identified for recycling per SAE J1344.

3.3.4 Workmanship. Not applicable.

3.3.5 Interchangeability. Not applicable.

3.3.6 Packaging. Not applicable.

3.4 Documentation. See GMW15920 - Record Management for Suppliers.

3.5 Support of System/Subsystem/Component/Part After Sale. Not applicable.

3.6 System/Subsystem/Component/Part Operator Training. Not applicable.

3.7 Testing Requirements.

3.7.1 DV Phase (GMW8758 - Design Validation and Production Validation).

Table 1: DV/PV Test Table

Section	Test	Number of Samples for Couplings ^{Note 1}	Number of Samples for Quick-Connect	Test Type
3.2.1.1.1	Leak	See Note 2	See Note 2	Performance
3.2.1.1.2	Cold Leak	24	12	Performance
3.2.1.1.3	Tensile	24	12	Performance
3.2.1.1.4	Blowoff	24	12	Performance
3.2.1.1.5	Blowoff After Heat Aging	24	12	Performance
3.2.1.1.6	Vacuum	24	12	Performance
3.2.1.1.7	Insertion Force	Not applicable	12	Performance
3.2.1.1.8	Pull-Out Force	Not applicable	12	Performance
3.2.1.1.10	Cyclical Corrosion	24 ^{Note 3}	12	Performance
3.2.1.1.11	Salt Spray	24 ^{Note 3}	12	Performance
3.2.1.1.12	Maximum Crimp Compression Condition	16	Not applicable	Performance

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