



Viscous Fan Clutch

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 standard shall define the Design Validation (DV), Production Validation (PV), Post-validation Audit (PVA), In-Process (IP) testing, measurement conditions, performance requirements and the minimum durability specification requirements of an engine driven fan clutch assembly under controlled conditions with various input drive shaft speeds and operating conditions. This procedure evaluates fan clutch performance without actual vehicle testing.

1.2 Applicability. This test applies to engine driven fan clutch assemblies for use in GM vehicles. The operating conditions referred to are defined for typical gasoline powered vehicles. For applications designed for diesel-powered vehicles, the operating conditions should be reviewed and may be adjusted to reflect the typically slower fan operating speeds.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

SAE J1344

2.2 GM Standards/Specifications.

GMW3059	GMW8758	GMW14573	GMW15920
GMW3116	GMW14156 (ID)	GMW14872	GMW16331
GMW3600	GMW14157 (ID)	GMW15758	

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

- CG2057 Radiator Statement of Requirements (SOR) Appendix G3 Validation Cross Reference Index (VCRI) Template. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- CG2059 Viscous Fan Clutch Viscous Fan Clutch SOR Appendix G3 VCRI Template. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- Component Technical Specification (CTS)
- SOR Appendix C2, G2, and/or G3
- Vehicle Technical Specification (VTS)

3 Requirements

3.1 System/Subsystem/Component/Part Definition. All requirements of this specification shall be met in order to demonstrate compliance with Design Validation (DV), Product Validation (PV), Product Validation Audit (PVA) evaluations, and IP Testing.

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3.1.1 Appearance. All appearance variations shall be cosmetic-only in nature and shall not result in the non-conformance of the part to the requirements in this standard.

3.1.2 Content. Not applicable.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content. The fan clutch receives mechanical energy from the engine's water pump pulley. This energy is transmitted through a fluid to spin a fan blade. Thermal energy from the CRFM unit passes over the fan clutch, which moderates the rate at which the mechanical energy is transmitted to the fan blade.

3.1.3 Ambient Environment. Unless otherwise specified, the standard ambient testing temperature environment is defined as 23 °C ± 5 °C.

3.1.4 Interfaces. All subcomponents and interfaces that build up the fan clutch including the upper assembly level (if required) must be documented in a block diagram supporting the Design Failure Mode and Effects Analysis (DFMEA), Process Failure Mode and Effects Analysis (PFMEA) and Design Review Based on Failure Mode (DRBFM) as required.

3.1.5 Usage Definition. The passing of these test procedures permit the use of the part globally. If more than one material supplier, or more than one toolset produce the same part in different regions, then a separate round of validation testing shall occur. The supplier shall coordinate this activity with GM Engineering to determine the level of testing required and any other opportunity to combine testing.

3.1.6 Test Vehicle/Test Piece. The testing setup shall be approved by the GM Validation Engineer. The specified sample quantity shall be agreed prior to testing in the Advanced Design Verification Plan and Report (ADVP&R) plan. All subsystem components required for validation shall be provided by GM.

3.1.7 Test Time. Total testing time shall be considered when planning delivery of parts to meet GM key dates contained in the GM Global Vehicle Development Process (GVDP) schedule. It is highly recommended to leave a buffer of at least four weeks between test completion and the GM milestone when planning, due to an unexpected failure where re-validation would be required. Following is an estimated plan of how long it takes to validate and test one fan clutch product or part number. Times may vary based on test cell availability and capacity.

Calendar time: 90 d

Test time: 1704 h

Coordination time: 475 h

3.1.8 Test Required Information. The performance measurements and durability test results are to be summarized and reported to GM on the supplier ADVP&R plan, CG2059 (the supplier shall work with the GM Validation Engineer to comprehend this requirement). Full test reports shall be available for viewing by GM personnel per GMW15920.

3.1.9 Personnel/Skills. The personnel and skill requirements are the responsibility of the supplier.

3.2 Product Characteristics.

3.2.1 Performance Requirements.

3.2.1.1 Fixed-value Performance Testing Requirements.

3.2.1.1.1 Hot Pump Out. Hot Pump out performance should be plotted and presented in the same format as shown in the CTS. Reference CG2059 (ADVP&R) for the table template. Pump out should be based on Appendix C2 Statement of Requirements (SOR) Document, when tested per 4.3.1.1.

3.2.1.1.2 Cold Pump Out. Cold Pump out performance should be plotted and presented in the same format as shown in the CTS. Reference CG2059 (ADVP&R) for the table template. Pump out should be based on Appendix C2 SOR Document, when tested per 4.3.1.2.

3.2.1.1.3 Disengaged Clutch Performance. Performance should be based on Appendix C2 SOR Document, when tested per 4.3.2.1.

3.2.1.1.4 Engaged Clutch Performance. Performance should be based on Appendix C2 SOR Document, when tested per 4.3.2.2.

3.2.1.1.5 Clutch Ramp Performance. Clutch ramp performance must be within acceptable range established and shown in the CTS. Performance should be based on Appendix C2 SOR Document, when tested per 4.3.2.3.

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3.2.1.1.6 Stall Performance. Stall performance must be within acceptable range established and shown in the CTS. Performance should be based on Appendix C2 SOR Document, when tested per 4.3.2.4.

3.2.1.1.7 Corrosion Test. Performance should be based on Appendix C2 SOR Document, when tested per 4.3.4.

3.2.1.2 Durability Testing Requirements. Fan clutch assembly performance after durability testing must be within limits that are defined in the CTS. Check maximum performance degradation at 600 h, 900 h, and EOT. If the value is not set in the CTS, the maximum performance degradation allowed for fan clutch speed is 2.5% for Electro Viscous (EV) fan clutch and 8% for Mechanical Clutch when tested per 4.3.3. This is a Reliability Test. The Reliability Evaluation Point (REP) for each of the samples is 1000 h.

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. The dimensions, mass, and internal volume of the fan clutch assembly shall meet all drawing specifications. This shall be proven statistically with a multi-part layout at DV and PV according to the Analysis/Development/Validation (ADV) plan.

3.2.2.2 Mass Properties. The program mass targets provided in the Component Data Sheet (CDS) must be met and confirmed before testing can begin.

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) of 15 years of corrosion and 240 500 km (150 000 mi) of severe customer usage at the vehicle level. For a REP of 200 000 mi, multiply the test cycles for endurance tests by 1.33.

3.2.3.2 Reliability Requirements. This standard, as written, supports demonstration of the required reliability of 99.0% or greater at a 50% confidence (R99C50) at the REP for the fan clutch assembly when tested in a component test. The supplier shall utilize "vehicle equivalent" laboratory test setups to simulate "in vehicle" orientations. If the orientation may be different from vehicle to vehicle, use the orientation that will provide the worst-case loads, for all physical level reliability demonstration testing.

Reference GMW14156 Test Reliability Requirements Guidelines, and GMW14157 Statistical Confidence Level for Reliability Validation Testing.

The Reliability Demonstration is provided by the Design Validation (DV) Endurance Tests. In contrast to DV, the Endurance Tests specified for Product Validation (PV) are intended to confirm the reliability demonstrated during PV of components manufactured from high volume tooling and at all manufacturing sites.

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 ADV Test Plan for approval.

3.2.4 Serviceability.

All serviceable parts shall be able to be disassembled within the assembly (if required) and returned without showing signs of degradation. GM's requirement is that the part must be able to be disassembled and reassembled at least ten (10) times without damage. The supplier must demonstrate by test, using real or surrogate data, that the design can withstand re-use without breakage. The supplier must choose the right design, torque, and consider all other factors that might influence serviceability. In-vehicle serviceability to be approved by GM Service Engineer prior to first design freeze.

Service parts shall be adequately protected to ensure satisfactory assemblies after a storage period of five years beyond the date of shipment from the manufacturer's plant.

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.

Refer to SOR Appendices. Elastomeric and aluminum materials supplied under this specification must be homogeneous, free of defects and surface contamination such as bloom, talc, mold release agents, and flash. Machine surface finish must be measured on a 30 part layout and be according to drawing specification.

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3.3.1.2 Processes Guidelines. Not applicable.

3.3.1.3 Parts Guidelines. Not applicable.

3.3.1.4 Recycling. Materials shall be recyclable per GMW3116 (Recyclability/Recoverability). Attempts shall be made to minimize the variety of materials used to make recycling more viable. All plastic parts shall be identified for recycling per SAE J1344.

3.3.2 Design Guidelines and Constraints.

3.3.2.1 Drawing Requirements. Fan clutch assemblies supplied under this specification must conform to the detailed drawing approved by Design Release Engineer (DRE).

3.3.3 Identification and Marking. The fan clutch assemblies supplied under this specification shall be visually identified in a manner exclusive and unique to each supplier to permit rapid identification of each respective fan clutch assembly manufacturer by the responsible GM Supplier Quality Engineer. Identification methods must be submitted to and approved by the GM Design Release Engineer. All assemblies must be labeled with the GM part number, date code and tool/cavity number in a visible location to comply with GMW16331, Identification and Branding Requirements on GM Parts. All labels shall conform to GMW14573.

3.3.4 Workmanship. All exterior surfaces shall be clean and free of ridges, sharp edges, roughness and manufacturing lubricants.

KCDS requirements shall be defined on the GM approved engineering drawings. The fan clutch assembly shall have manufacturing capability such that all dimensions are targeted at print nominal dimensions. The supplier shall submit a detailed improvement plan which describes how their manufacturing process for each part/operation shall achieve a process distribution of a value determined by the GM Supplier Quality Engineer.

3.3.5 Interchangeability. Not applicable.

3.3.6 Packaging. See GM1738, Packaging and Identification Requirements for Production Parts.

3.4 Documentation. All documentation for testing shall be approved before final Production Part Approval Process (PPAP) can be approved. For PV, the supplier shall submit a completed and signed off GMW3600 Validation Commodity form in order to finalize that all the requirements for the component(s) have been met. For Radiator see form CG2057 (the supplier shall work with the GM Validation Engineer to comprehend this requirement).

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

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

3.7 System/Subsystem/Component/Part Characteristics. Not applicable.

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

4 Validation

4.1 General.

4.1.1 Validation Phase Definitions. Reference GMW15758 (ADV Process Development and Validation Terminology) for the definitions of Design Validation, Product Validation, and Post Validation Audit.

4.1.2 Test Samples. Reference GMW15758 for explanations of how parts for Design Validation, Product Validation, and Post Validation Audit shall be produced and selected. Test samples' dimensions and materials must be within specification.

4.1.2.1 Performance Evaluation. Parts shall be to design release intent, representing the final fan clutch packaging. This includes: Fan Clutch Assembly, Fan Assembly, Radiator Assembly, Fan Shroud and Baffling.

4.1.2.2 Durability Evaluation. All components should be to design release intent representing the final fan clutch packaging. Also, all components should comprehend manufacturing and performance variation.

4.1.2.2.1 Fan clutch assemblies to be tested that have been measured and marked for out-of-balance.

4.1.2.2.2 A qualified fan blade assembly that has the out-of-balance location clearly marked.

4.1.2.2.3 A fan clutch assembly having known engagement temperatures and speeds.

4.1.2.2.4 A fan and clutch assembly having axial and radial movement measured and documented at the start of test.

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