



Gaseous Fuel Engine Management Subsystem Durability and Mounting Integrity Test

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 procedure determines the functional durability and mounting integrity of the Gaseous Fuel (GF) Engine Management Subsystem (EMS) when subjected to worst case mechanical input representative of actual engine operation over its target life.

1.2 Applicability. This procedure is applicable to all engine mounted components in Compressed Natural Gas (CNG) or Liquefied Petroleum Gas (LPG) Gaseous Fuel EMS designs.

1.3 Remarks. This procedure documents the process for developing and validating engine mounted gaseous fuel systems designed for passenger car and light duty truck applications.

This procedure may not comprehend all gaseous fuel system design configurations. The intent and processes described can be applied to any design.

Many GF vehicles have the CNG or LPG system installed after the normal GM production process. Engine durability tests are typically not conducted with the GF EMS selected for GM approved conversions. This test procedure serves to validate the GF EMS mounting durability and integrity without conducting lengthy engine durability tests.

2 References

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

2.1 External Standards/Specifications.

ISO 1550-2 SAE J1349
ISO 1585

2.2 GM Standards/Specifications.

None

2.3 Additional References.

GMPT1105: GM Test 1T and 1SS (Power)

3 Resources

3.1 Facilities. A mechanical test laboratory equipped with an electrodynamic shaker system.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

- Single axis electrodynamic shaker system.
- Digital data acquisition system.
- Triaxial accelerometers and signal conditioners.
- Pressure transducers and signal conditioners.
- Source of pressurized nitrogen.

Note: All instrumentation must be calibrated. Record instrumentation details and the date of calibration in the test records unless the information is otherwise preserved in the testing facility records.

3.3 Test Vehicle/Test Piece. The test specimen consists of all engine mounted Gaseous Fuel EMS components that directly control and/or contain the flow of fuel from the interface with the chassis gaseous fuel storage system to the induction system of the engine, i.e., from the under hood low pressure shut-off valve to the gaseous fuel injector/hose fitting/nozzle in the intake manifold inclusive.

The Gaseous Fuel EMS components can be grouped for test based on attachment location where the vibration inputs are determined to be common. For example, the EMS could be divided into groups:

- Pressure Regulator or Vaporizer and Shut-off Valve (if engine mounted).
- Gaseous fuel rail assembly (rail, injectors and sensors), injector fuel lines and intake manifold fittings/adaptor for gaseous injectors/lines.

Each test group must include all the production intent mounting brackets and fastener hardware.

3.4 Test Time. Test time can vary based on the grouping of test components. The range of times is based on a variety of tests run using an Electrodynamic Shaker System (ESS).

Engine Load Data Acquisition (ELDA)	
time:	3 days to 5 days
Fixture build time:	3 days to 5 days
Test time:	50 hours to 150 hours
Coordination hours:	2 hours

3.5 Test Required Information. The input parameters for the EMS durability and mounting integrity test are determined from data collected during engine dynamometer tests. The engine represents the intended service environment for the EMS components.

Accelerometers are applied to each EMS component assembly with mounting bracket in locations preferably determined by Finite Element Analysis modeling.

Engine tests are conducted according to ISO 1585, SAE J1349, or GMPT1105. The accelerometers are used to collect data for the ELDA process. Data is collected at all engine speeds from idle to maximum.

EMS component part numbers and design levels must be provided. Fastener torque specifications must be provided, along with assembly sequences that may apply to properly assemble the test specimen.

3.6 Personnel/Skills. For acquiring the required test information, technicians and instrumentation specialists experienced with engines, dynamometers, powertrain control systems, instrumentation, data acquisition and analysis are required.

For the EMS durability and mounting integrity test, mechanics, instrumentation technicians and engineering test personnel experienced with electrodynamic shaker systems, data acquisition and analysis are required.

4 Procedure

4.1 Preparation.

4.1.1 Data Preparation. The first step is to establish the test conditions based on ELDA measurements collected during the engine dynamometer tests. The ELDA data must be analyzed to determine the maximum acceleration, resonant frequency and direction for each EMS component.

4.1.2 Fixture Design. Design and build the specimen fixture(s) for ESS tests. The test specimen should include the production intent

mounting hardware and representative interfacing components.

The test fixture design should include the actual engine component interfaces wherever possible, e.g., cylinder heads, rocker covers, intake manifold.

4.1.3 Initial Component Performance. Before test, each component of the EMS must be measured for baseline performance. Devices that regulate or meter fuel must be:

- Flow checked, e.g., Injector Flow versus Base Pulse Width (BPW).
- Checked for internal leakage.
- Checked for external leakage.

Devices that contain or transport fuel must be checked for general leakage. Refer to ISO 1550-2, for procedural guidelines.

Brackets and supports must be visually examined and qualified as being production representative.

4.1.4 Test Site Preparation. Install the EMS test specimen. All components should be installed to the test fixture using design intent fasteners and torque specifications with an index mark to allow monitoring of torque retention.

The test specimen must be oriented in the fixture so that the ESS table input is parallel to the direction of the peak resonant load path.

Install accelerometers to the same components in the same locations as used for the engine dynamometer test. The input axis of the transducer must be parallel to the input axis of the electrodynamic shaker.

Tune the ESS output such that the measured accelerations match the maximum level determined in 4.1.1. The test frequency should be selected to excite the specimen at its resonant operating condition to optimize input force levels.

Pressurize the EMS fuel components with nitrogen to normal operating levels. Sample block diagrams corresponding to the groups noted in 3.3 are presented in Appendix A, Figures A1 and A2.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified by the requesting engineer, the environmental conditions for this test are the ambient temperature, humidity and atmospheric pressure at the test facility.

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