



Engine Movements

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. To identify critical converging movements for intact engine and engine mounts.

1.2 Applicability. All passenger cars.

1.3 Remarks. Measurement of the movements of the engine with hang on parts in six (6) degrees of freedom (DOF).

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3238	GMW15553	GMW15708	GMW15728
GMW15444	GMW15554	GMW15709	GMW16933
GMW15445	GMW15556	GMW15715	GMW16980

2.3 Additional References.

- AICON 3D Systems GmbH, Braunschweig, Germany (www.aicon3d.com)
- MTS Systems Corporation, Eden Prairie, Minnesota (www.mts.com)

2.3.1 Driving Instructions.

DL.CN.BFC-1	DR.CA.1321	DR.GD.PX	DR.MB.R.6.1
DL.CN.CSC	DR.CA.1322	DR.GD.PY	DR.MB.R.11
DL.CN.FBC	DR.CA.1323	DR.GD.PZ	DR.MB.R.13.1
DL.CN.HTC	DR.CA.1326	DR.GD.TS	DR.MB.R.13.2
DL.CN.JTC	DR.CA.1327	DR.GD.TZ	DR.MB.R.14.1
DL.CN.MPC	DR.DH.ABS/TCS-Gravel	DR.GD.ZB	DR.MB.R.14.2
DL.CN.PBC	DR.DH.Bsnubs	DR.GD.ZY	DR.MB.R.15.2
DL.CN.PHC	DR.DH.HDT	DR.LL.43G0	DR.MB.R.19
DL.CN.SB	DR.DH.Hill	DR.LL.4PER	DR.MB.R.24
DL.CN.SWC	DR.DH.JT	DR.LL.7A	DR.MB.R.25
DL.CN.THCH	DR.DH.PB	DR.LL.7AS	DR.MB.R.34
DL.MF.DP	DR.DH.PH-1&2	DR.LL.7FBS	DR.MB.R.42
DL.MF.EB	DR.DH.Roll	DR.LL.7GGD	DR.MB.R.56
DL.MF.JT	DR.DH.SpBmp	DR.LL.7GMC	DR.MB.R.57
DL.MF.WE	DR.DH.TH	DR.LL.7JT	DR.MF.AS
DL.MF.WF	DR.DH.TTG	DR.LL.7TS	DR.MF.AZ

DL.MF.WH	DR.GD.AS	DR.LL.8PT	DR.MF.FB
DL.MF.WS	DR.GD.AZ	DR.LL.8SB	DR.MF.IT
DR.CA.1061	DR.GD.DP	DR.LL.8TC	DR.MF.PB
DR.CA.1064	DR.GD.FB	DR.LL.BB40	DR.MF.PX
DR.CA.1075	DR.GD.IT	DR.LL.HDT	DR.MF.PY
DR.CA.1076	DR.GD.JT	DR.MB.R.2	DR.MF.PZ
DR.CA.1300	DR.GD.PB	DR.MB.R.4	DR.MF.TS
DR.CA.1316	DR.GD.PS	DR.MB.R.5	DR.MF.TZ

3 Resources

3.1 Facilities. General Motors Proving Grounds:

- Cruz Alta Proving Ground (GM do Brasil)
- Cheongna Test Site (GM Korea)
- Dudenhofen Proving Ground (GM Europe)
- Guangde Proving Ground (GM China, PATAC)
- Lang Proving Ground (GM Holden)
- Milford Proving Ground (GM North America)
- Millbrook Proving Ground (England)

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. Some method of accurate speed indication should be provided to the driver for the execution of the driving events. Some type of acceleration/deceleration rate indicator should also be provided to the driver.

3.2.1 AICON EngineWatch Measuring System or an equivalent measuring device.

3.2.2 Appropriate recording device.

3.2.3 Vehicle Coordinate Measuring Machine (CMM) or similar equipment.

3.2.4 Scale.

3.2.5. Photographic equipment (for documentation purposes).

3.3 Test Vehicle/Test Piece. In order to achieve greater engine movements, tests shall be performed using vehicles with manual transmission (enables direct acceleration). Vehicles with automatic transmission can be used for measurements when this configuration has specific critical conditions that need to be analyzed.

3.4 Test Time. See Appendices A through G.

3.5 Test Required Information. Test relevant information like vehicle payload, tire pressure and trim height.

3.6 Personnel/Skills. The events that comprise this test are intended to be performed by personnel specifically trained in the proper execution of the driving instructions. Refer to the appropriate proving ground driving instruction documents and related risk assessments.

Different driver license requirements, knowledge of test content, and mandatory health checks for involved personnel have to be considered.

4 Procedure

4.1 Preparation. Measurement of adjustments and settings may be made as deemed necessary to document the condition of the vehicle. These measurements must be made without significantly affecting the adjustment or setting being considered. The intent of these measurements is to document the condition of the vehicle without changing the state of the original assembly.

4.1.1 Release Status. Check the following parts to the state of release:

- Powertrain Mounts (check for cracks), stators

- Engine installation position
- Engine suspensions according to the state of release

Test according to the availability of parts for non-series vehicles.

If assemblies are expected to come into contact with each other during the tests using released set of powertrain mounts, check for temporary alignment that guarantees no contact of components. The free movement of parts in relation to each other shall be guaranteed under all customer driving conditions.

4.1.2 Body Measurement. Before measurement the relative position of the body to the engine has to be recorded. For this purpose the Center Manufacturing Points (CMPT), the centerline windshield, the center points of the tower mounts and appropriate points at the engine should be recorded in absolute coordinates on a vehicle CMM.

4.1.3 Reference Point. As reference point for the AICON Measuring System the true engine Center of Gravity (COG) has to be used.

4.1.4 Measuring System. Record the movements of the engine and hang-on parts simultaneously, for all six (6) DOF.

Note: The engine and the hang-on parts are considered to be rigid bodies.

4.2 Conditions.

4.2.1 Environmental Conditions. This test should be performed in dry weather conditions (preferable).

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.

4.2.2.1 Road Surface. The surface shall conform to the corresponding test tracks of an appropriate proving ground. The road surface shall be dry, in order to achieve maximum movements.

4.2.2.2 Vehicle Load. The vehicle shall be on Structural Vehicle Weight (SVW) ballast. Some maneuvers can be performed in Gross Vehicle Weight (GVW) ballast if this condition generates higher engine movements. Vehicle ballast must be done according to procedure GMW15445.

4.3 Instructions. Refer to the Appendix for the appropriate GM Proving Ground (Appendices A through G).

4.3.1 General. These safety related components shall be checked for each drive condition.

- Brake system (ensuring depression, sealed oil system)
- Steering (locking, stiff steering)
- Cooling system (air and water tightness)
- Gas regulation (unintentional increased engine speed, return to idle speed, distortion of the power transmission elements)
- Engine and Transmission calibration should be latest available release

4.3.2 Procedure. The following drive tests shall be performed and recorded separately. The repetitions of tests are listed in the Global Track Lists (see 4.3.2.1.2).

4.3.2.1 Assessments during the Drive.

4.3.2.1.1 Driving on the durability test track according to the Global Track List. Reference Appendix H, Table H1 for Naming and Driving Instructions.

4.3.2.1.2 Global Track List (Reference Appendices A through G).

Comparable test results should be achieved by application of test vehicles on the following proving grounds according to the attached route descriptions (see Appendices A through G):

- **Cruz Alta Proving Ground (GM do Brasil)**, route description see Table A1, Appendix A
- **Cheongna Test Site (GM Korea)**, route description see Table B1, Appendix B
- **Dudenhofen Proving Ground (GM Europe)**, route description see Table C1, Appendix C
- **Guangde Proving Ground (GM China, PATAC)**, route description see Table D1, Appendix D
- **Lang Proving Ground (GM Holden)**, route description see Table E1, Appendix E
- **Milford Proving Ground (GM North America)**, route description see Table F1, Appendix F

- **Millbrook Proving Ground (England)**, route description see Table G1, Appendix G

4.4 Driver Responsibilities. The driver is to provide the first indication that the vehicle requires attention. During the execution of the test, the driver is to observe vehicle behavior as would a customer and inform the responsible individuals through written comment whenever a malfunction occurs or unusual behavior is experienced.

The driver should, in essence, play the role of the customer and should initiate checkout for potential repair of the vehicle. The driver should be informed of this responsibility and should be instructed to keep accurate, thorough records on the vehicle. The driver is an important source of vehicle performance information for the test coordinator with whom there should be active communication.

The proper execution of this durability test is highly dependent on close driver adherence to the events and the instructions contained therein. This is because accurate correlation with field experience can only be achieved by means of tailored combinations of vehicle speed, road surface, and driving maneuvers.

5 Data

5.1 Calculations. The data shall be recorded as time signal for the reference point as mentioned in 4.1.3. The data exchange format should be agreed with customer.

Only Movement Data exchange format is AICON standard.

In combination with regular Road Load Data Acquisition (RLDA) channels, the standard road load data exchange format within GM is MTS Systems Corporation Remote Parameter Control (RPC) III.

5.2 Interpretation of Results. Complaints which are not directly associated with the test contract shall be passed on in writing to the appropriate groups as agreed, together with details of the test conditions.

5.3 Test Documentation. Add the completed data sheets with reference to this test procedure to a test report.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

In general, a risk assessment needs to be performed for every driving instruction prior to executing this standard. (**Note:** National law needs to be considered while performing a risk assessment.) The required rating of risk by exposure probability and possible violation will be done in a separate document. Every identified risk must be named inside the risk assessment for the relevant driving instruction in order to announce that risk to employees. Within the risk assessment, the vehicle equipment and different vehicle build stages have to be considered. After performing a risk assessment, non-acceptable risk needs to be mitigated by appropriate countermeasures. Here technical measures are preferred because these are independent from attendant circumstances. In case technical measures are not appropriate, organizational and/or personal measures will apply. This includes training, wearing of Personal Protection Equipment, or arrangement of idle time.

6.1 Safety Precautions.

6.1.1 Instrumentation and other test equipment must be securely mounted in accordance with proving grounds traffic safety guidelines for mounting and usage of in-vehicle instrumentation.

6.1.2 All running lights and vehicle safety features must be operational according to proving grounds rules for running lights and power windows. Exterior lights must not be obscured by styling add-ons, covers or camouflage packages. The horn may be disabled because of steer angle transducer installation.

6.1.3 A helmet is required in accordance with the regulations of the test facility. The vehicle should never be operated in a manner where the vehicle leaves the roadway or goes onto the shoulder for any reason.

6.1.4 Check for proper attachment of the steering wheel to the gear via the intermediate shaft. If it feels loose or abnormal, do not run the test until the parts are properly assembled according to the intended design.

6.1.5 Check to be certain that all wheel lugs are present and have the specified torque. Loose or missing wheel fasteners are to be replaced, installed or tightened before the test may begin.

6.1.6 The driver's seatbelt must be worn at all times during the test. Passengers accompanying the test operator must also be safely belted in the vehicle, preferably in the right rear seat.