



Electronic Throttle Control Pedal Lab Durability 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 is to evaluate the durability characteristics of the Electronic Throttle Control (ETC) Accelerator Pedal Mechanism (APM) as a component.

1.2 Applicability. All passenger vehicles, light and medium duty trucks with ETC.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15008

2.3 Additional References.

- Component Technical Specification (CTS)
- Data Check List available from the GM Pedal Engineer
- Data Sheets available from the GM Pedal Engineer
- National Instruments Corporation, Austin, Texas (www.ni.com/labview)

3 Resources

3.1 Facilities. GM, supplier, or contracted test facilities.

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.

3.2.1 Test Machines.

3.2.1.1 Humidity chamber capable of exposing APMs to 100% humidity at laboratory ambient temperature for 48 h (continuous).

3.2.1.2 Permanent or temporary fabricated environmental chamber capable of maintaining APMs at any specified uniform temperature between -40 °C to 85 °C ± 5 °C. This chamber must allow application of simulated foot operated loads and resulting pedal motion.

3.2.1.3 A dry contaminant spray system capable of automatically or manually dispensing a specified quantity or duration of dry contaminant mixture specified in 3.3.1 to portions of the APM. Unless otherwise specified by GM Engineering, the spray shall be aimed at the pedal pivot, sensor and other vulnerable areas to simulate likely contamination entering the APM.

3.2.1.4 Programmable controller and data logger capable of monitoring the APMs and controlling the load actuator during the three (3) modes for cycling the APM, 3.2.1.4.1 through 3.2.1.4.3 (Reference National Instruments Corporation, LabVIEW System Design Software).

3.2.1.4.1 Actuate from idle to $95\% \pm 2\%$ of full travel for 999 cycles at a cycle rate of 1 Hz to 2 Hz, then apply and hold for at least 0.5 s, normal 100% full travel load plus twice the load tolerance specified by the Component Technical Specification (CTS) for the 1000th cycle as specified in Appendix A Test Schedules (Tables A1 through A5).

3.2.1.4.2 Actuate from idle to full travel with load increased to $334 \text{ N} \pm 20 \text{ N}$ as specified by the Appendix A Test Schedules (Tables A1 through A5) at a cycle rate of 1 Hz to 2 Hz. After the APM has reached the travel or load specified, the actuator must pull back and let the pedal retract by means of its own return mechanism.

3.2.1.4.3 Drive cycle per Appendix G (Reference Figure G1).

3.2.1.4.4 Controller shall provide supply voltage(s) of $5.0 \text{ V} \pm 0.1 \text{ V}$ to each sensor, ground voltage of $0.0 \text{ V} \pm 0.1 \text{ V}$ to each sensor, and control the test environment as specified. The test controller/data recorder shall also be capable of monitoring sensor outputs, applied forces, temperature, humidity, other parameters as specified by GM Engineering, and perform continuous near real time sensor diagnostic checks as required per 3.5.1 and GM Engineering. See Appendix C for the minimum sensor parameters to be continuously monitored during test.

3.2.1.5 Test fixture that can accurately position a portion of an actual or simulated Front of Dash (FOD) including deflections, load actuators, environmental chamber and full travel floor stop (if part of the design). GM shall decide if a simulated or actual floor pad, carpeting, floor mat, insulation, pedal stop, and/or other interior vehicle components shall be used in the test based on if or how the design that is being tested, interfaces with these components. Pedal packaging information math data shall be provided by GM.

3.2.1.6 Load actuator capable of applying loads specified in 3.2.1.4. Loads shall be applied to the accelerator pedal pad as specified by GM Engineering.

Note: (Reference) 203 mm from the heel point as shown on the design layout (ball of foot position for the 50% male) and the angle of application, shall be 15 degrees left to right in the horizontal plane (Figure 1) for 50% of parts tested each phase, 0 degrees for at least 25% parts tested in each phase, and 15 degrees right to left in the horizontal plane, for up to 25% of parts tested each phase.

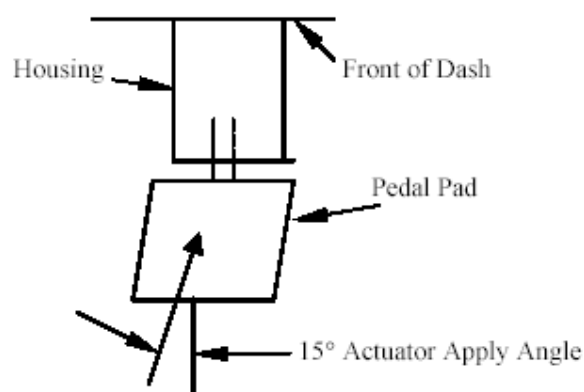


Figure 1: Plan View – Pedal Apply Angle

3.2.2 Instrumentation.

3.2.2.1 Test controller/data recorder capable of controlling and recording environments, forces, displacements and voltages as specified within.

3.2.2.2 Force plot load transducers capable of measuring $0 \text{ N} \pm 0.5 \text{ N}$ to $50 \text{ N} \pm 0.5 \text{ N}$.

3.2.2.3 Cycling load transducers capable of measuring $0 \text{ N} \pm 3 \text{ N}$ to $450 \text{ N} \pm 3 \text{ N}$.

3.2.2.4 Electronic temperature and humidity sensors.

3.2.2.5 Heating and cooling sources (i.e., heat gun, nitrogen, Carbon Dioxide (CO_2)).

3.3 Test Vehicle/Test Piece. Number of samples to be tested per CTS.

3.3.1 Contaminant mixture consisting of the following:

- 0.14 kg (5 oz) Coarse Air Cleaner Test Dust
- 0.14 kg (5 oz) 400 grit Alumdum
- 0.07 kg (2.5 oz) 150 grit Alumdum
- 0.14 kg (5 oz) Rock Salt

3.3.2 Miscellaneous Equipment. Wire harnesses with appropriate connectors for links between connectors and controllers.

3.4 Test Time.

Calendar time: 45 days to 75 days

Test hours: 30 hours to 60 hours

Coordination hours: 32 hours (4 days)

3.5 Test Required Information.

3.5.1 Validation Performance Requirements. Each sensor must be continuously monitored during all testing as specified in this section. Also, before, during and after testing, each sample must conform to requirements stated in the CTS which may include, but is not limited to: return response, apply load, return load, hysteresis, travel, sensor outputs, etc. See Appendices B and C for minimum parameters to be recorded. The sensor parameters shall be checked at least every 1 ms and, in order for proper correlation computations while the pedal is moving, sensor output shall be sampled within 40 μ s of each other. All errors detected shall be recorded and reported to GM Engineering at regular intervals and in the final test report. A fault or failure is considered to have occurred if during testing, four (4) errors were detected on each of four (4) continuous scans, or 20 errors during any 1 s interval. If a fault is detected, the data logger shall record 10 s of all monitored parameter data before and after the fault, the sample shall stop testing, and GM Engineering contacted within 48 h. Data collection manner shall be reviewed and agreed on by GM and the test facility prior to start of test.

3.5.2 Reliability and Durability Goals as Defined by the CTS shall be Achieved.

3.5.3 Test Reports. Interim and final test reports shall contain actual values, plots of parameters specified in the Data Check List, and total number of errors recorded and when for each sample. Interim and final test reports shall also contain an example of at least 1 s of typical performing data of sensor outputs.

3.6 Personnel/Skills. Technician shall be competent and experienced at performing component tests on electronic systems with applied environments.

4 Procedure

4.1 Preparation.

4.1.1 Inspect all test hardware for damage. If any hardware is damaged, report damage to test engineer. Do not install on test.

4.1.2 Install test hardware on test buck or equivalent per applicable design layout and Master Process Document (MPD) to simulate in-vehicle position.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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.

4.3 Instructions.

4.3.1 Perform Schedule I, II, III, and IV per Appendix A (Tables A1 through A4).

4.3.2 Repeat Schedule IV per Appendix A (Table A4) until reliability goals stated in CTS are achieved.

4.3.3 Perform Schedule V, per Appendix A (Table A5).

4.3.4 Inspect APMs for cracks, distress, squeaks, rattles, and sticking, before, during, and after:

- Cycling

- Force and sensor plots
- Slow/fast/side load returnability evaluations at environmental extremes

4.3.5 Guidelines. After-test APMs can be evaluated on applicable vehicles, or an ETC system simulator for ETC system validation.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. Report using the Data Sheets available from the GM Pedal Engineer.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

APM	Accelerator Pedal Mechanism
CO2	Carbon Dioxide
CTS	Component Technical Specification
ETC	Electronic Throttle Control
FOD	Front of Dash
GSSLT	Global Subsystem Leadership Team
MPD	Master Process Document
PPS	Pedal Position Sensor
SOT	Start of Test

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW14551

9 Release and Revisions

This standard was originated in October 2005. It was first approved by Global Chassis Powertrain Integration Center Team in March 2006. It was first published in June 2006.

Issue	Publication Date	Description (Organization)
1	JUN 2006	Initial publication.
2	DEC 2011	Revised to current template. (Pedal GSSLT)
3	JAN 2017	Revised to current template (Chassis Pedals Global Subsystem Leadership Team (GSSLT))

Appendix A

Table A1: Schedule I – Thermal Shocks

Force and sensor plots per Appendices B,C, D (Figure D1) and E (Figure E1), and sensor resistance measurements at ambient per Appendix J
Soak at -40 °C for 30 minutes, transition to +80 °C within 30 s, hold for 30 minutes, transition to -40 °C within 30 s. Repeat sequence seven (7) times.

Table A2: Schedule II – Start of Test Side Steps

Cycle Count	Temperature (°C)	Travel (% Pedal Position Sensor (PPS))	Peak Load (N)
10	Laboratory ambient	Release from full travel	As required
Force and sensor plots per Appendices B, C, D (Figure D1), and E (Figure E1), and Sensor resistance measurements at ambient per Appendix J	Laboratory ambient	Idle to full travel	As required

Table A3: Schedule III – 24 h Soak at 80 °C and 95% Humidity

Event	Cycle Count	Temperature (°C)	Travel (%PPS)	Peak Load (N)
24 h soak at 80 °C and 95% to 100% humidity		80 ± 5		
Begin Schedule IV cold soak within 1 h		-40 ± 5		

Table A4: Schedule IV – Cycling

Event	Cycle Count	Temperature (°C)	Travel (%PPS)	Peak Force (N)
2 h soak at -40 °C. Cycle pedal once; pedal shall return on its own to within Ignition Cycle, idle output tolerances within 150 ms. Force and sensor plots per Appendices B, C, D (Figure D1), and E (Figure E1). Sensor resistance measurements at cold per Appendix J. Apply force consistency (stick-slip) evaluation at cold per Appendix F. Noise/Squeak evaluation beginning at cold per Appendix H. Within ignition cycle evaluation at cold per Appendix G. Reference Figure G1.	Start of Test (SOT) 0 to 1000	-40 ± 5	As specified	As required

Event	Cycle Count	Temperature (°C)	Travel (%PPS)	Peak Force (N)
2 h soak at +80 °C. Force and Sensor Plots. Sensor resistance measurements at hot per Appendix J. Apply force consistency (stick-slip) evaluation at hot per Appendix F. Noise/Squeak evaluation beginning at hot per Appendix H. Within ignition cycle evaluation at hot per Appendix G. Reference Figure G1.	Start of Test (SOT) 0 to 1000	80 ± 5	As specified	As required
	Start of Test (SOT) 0 to 1000		Once every 1000 cycles	As required for 95% travel, and CTS specified full travel +2 times tolerance
Force and sensor plots (This evaluation not required after 1 000 000 cycles.)		Lab ambient	As specified	As required
Cycle	1001 to 10 000	Lab ambient	Idle to 95%, full travel once every 1000 cycles	As required for 95% travel, and CTS specified full travel +2 times tolerance
Force and sensor plots (This evaluation not required after 1 000 000 cycles.)		Lab ambient	As specified	As required
Cycle	10 001 to 100 000	Lab ambient	Idle to 95%, full travel once every 1000 cycles	As required for 95% travel, and CTS specified full travel +2 times tolerance
Force and sensor plots (This evaluation not required after 1 000 000 cycles.)		Lab ambient	As specified	As required
Cycle	100 001 to 150 000	-40 ± 5	Idle - 95%, full travel once every 1000 cycles	As required for 95% travel, and CTS specified full travel +2 times tolerance
Force and sensor versus displacement plots at cold, Force consistency evaluation at cold, and noise/squeak evaluation at cold.		-40 ± 5	As specified	As required