



Brake, Accelerator, Clutch Pedal and Module Strength 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 applies to passenger cars and light and medium duty truck adjustable and fixed Brake/Accelerator/Clutch Pedal Modules.

1.2 Applicability. Laboratory strength and durability test for Brake/Accelerator/Clutch Pedal Modules.

1.3 Remarks. To evaluate strength and durability characteristics of Brake/Accelerator/Clutch Pedals and Modules when subjected to various apply direction and lateral loadings, and durability cycling. This procedure is not intended to be the primary durability test for Electronic Throttle Control (ETC) accelerator pedals and clutch pedal over center springs since accelerated test methods (high loads) used in this procedure are not applicable to accelerating high travel usage for these components and, thus, GMW14551 and GMW15150 are still needed to validate the accelerator and clutch pedals.

This test is based on the following Product Usage, Measurements and Application (PUMA) reports:

- K-10 Truck Customer Measurement Program Final Report.
- C30 4L80E 7.4L Truck Customer Vehicle Usage Measurement Program Final Report.
- T Utility Customer Vehicle Usage Measurement Program Final Report.
- W Car Customer Vehicle Usage Measurement Program Final Report.
- L18 Big Block Engine.
- AVIS Customer Vehicle Measurement Program Final Report.
- Full-size Utility Customer Vehicle Measurement Program Interim Report.
- J-Car China Customer Usage Final Report, North American Ambient Weather Study.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14551 GMW15150

2.3 Additional References.

- Component Technical Specification (CTS)
- Subsystem Technical Specification (SSTS)
- AVIS Customer Vehicle Measurement Program Final Report
- C30 4L80E 7.4L Truck Customer Vehicle Usage Measurement Program Final Report
- Full-size Utility Customer Vehicle Measurement Program Interim Report
- J-Car China Customer Usage Final Report

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- K-10 Truck Customer Measurement Program Final Report
- L18 Big Block Engine
- North American Ambient Weather Study
- T Utility Customer Vehicle Usage Measurement Program Final Report
- W Car Customer Vehicle Usage Measurement Program Final Report

3 Resources

3.1 Facilities. Test laboratory with bed plates and environmental chamber at pedal supplier, General Motors, or test contractor site.

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 Deflection Testing Equipment.

3.2.1.1 Fixture for restraining brake pedal without travel at the pivot point and the master cylinder attachment point, simulating actual vehicle environment, while up to 4000 N load is applied as shown in Appendix A, Figure A1.

3.2.1.2 Device for applying and measuring 0 N to 220 N (0 lb to 50 lb) to the pedal pad laterally right to left and left to right.

3.2.1.3 Device for measuring lateral deflection at the load application point.

3.2.1.4 Device for applying 0 N to 4000 N (0 lb to 900 lb) apply direction pedal force.

3.2.1.5 Device for measuring apply direction deflections at the load application point.

3.2.2 Durability Testing Equipment.

3.2.2.1 As specified and approved by the GM program release engineer, a durability test fixture utilizing an actual vehicle front of dash, or mod plate, or same gage steel metal fixturing which simulates vehicle attachment interface stiffness.

3.2.2.2 Device for applying and measuring 0 N to 5 N (0 lb to 1 lb) to the pedal pad laterally right to left and left to right.

3.2.2.3 Device for measuring lateral deflection at the load application point.

3.2.2.4 Device for applying and durability cycling 0 N to 1200 N (0 lb to 270 lb) apply direction pedal force. For adjustable pedal, durability load cycling shall occur with one-fourth ($\frac{1}{4}$) of samples at full forward position, one-fourth ($\frac{1}{4}$) of samples at 33% position between forward and rearward, one-fourth ($\frac{1}{4}$) of samples at 66% position between forward and rearward, and one-fourth ($\frac{1}{4}$) at full rearward. At intervals specified in section 4, adjustable pedals must be free to be adjusted.

3.2.2.5 Device for measuring apply direction deflections at the load application point.

3.2.2.6 Durability brake apply system/push rod load simulating device that mimics actual brake apply system push rod loads. Setup should simulate design intent push rod angles throughout the operating test range and shall be free to rotate up, down and laterally such as not to provide artificial angular support that would not be provided by an actual master cylinder/booster on an actual front of dash or mod plate. (Actual brake hydraulic system can be used.)

3.2.2.7 Durability clutch apply system/push rod load simulating device that linearly increases load 0 N to 334 N times the pedal ratio, for pedal travels of 0% to 100% of full in car travel, then allows minimal push rod movement at higher loads. Setup should simulate design intent push rod angles throughout the operating test range and shall be free to rotate up, down and laterally such as not to provide artificial support that would not be provided by an actual master cylinder/booster. (Actual clutch hydraulic system can be used.)

3.2.2.8 Durability test fixture for mounting accelerator pedal support bracket that can handle repeated applications 0 N to 334 N (0 lb to 75 lb) input force at the pedal pad.

3.2.2.9 Cycle controller and counters for each pedal and, if required, adjustment mechanism.

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Note: All instrumentation is to be calibrated as required; record instrumentation details and date of calibration on Appendix B, Data Sheet B1 unless the information is otherwise preserved in the testing facility records.

3.3 Test Vehicle/Test Piece. Minimum of four (4) each, pedals and brackets for load tests, and four (4) for durability. See program specific Component Technical Specification (CTS) sample size and reliability requirements.

If specified in the CTS or by the GM responsible engineer, plastic components of the pedal system, prior to deflection testing, shall be heat aged by soaking at 100 °C for 500 h. If polyamide is used, after heat aging, re-soak for 24 h intervals in a humidity cabinet at 40 °C with 90% Relative Humidity (RH) to 95% RH until 2% weight percent moisture is achieved.

3.4 Test Time.

Calendar time: 12 days to 22 days

Test time: 80 h to 160 h

Coordination time: 16 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. At least one (1) technician trained to perform this standard.

4 Procedure

4.1 Preparation.

4.1.1 Installation Position. For brake and clutch pedal pads, load shall be applied to the vertical and lateral center of the pedal pads except for elongated brake pads where loads shall be applied at 0.2 of the width of the pad on side furthest from the lever. For an example, a 100 mm wide pad with the lever attached at 30 mm from one edge, force shall be applied at 20 mm from the opposite edge. See Appendix A, Figure A2.

For accelerator pedal strength, loads shall be applied at 30 mm from the bottom of the pad except at the bottom for reverse loads. For durability cycling, load shall be applied to the defined 50th percentile male ball of foot (BOF).

4.1.2 Component Switches and/or Sensors. All switches and/or sensors shall be checked before and after all tests against CTS electrical requirements. Any requirement non-conformities shall be reported to the GM pedal design engineer.

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 Load Strength.

4.3.1.1 Accelerator Pedal Load Performance by Itself (Not Mounted to Mounting or Module Bracket).

Mount pedal to fixture without separate mounting or module bracket. Record initial sensor outputs. Apply 75 N in the apply direction, 30 mm from the bottom of the pad. Record displacement and sensor outputs. Remove load. Record set and sensor outputs. This is to assure sensor is unlikely to be over-travel during handling.

4.3.1.2 Accelerator Pedal Performance with CTS Specified Full Travel Forces. Record initial sensor outputs. Apply CTS specified full travel force, F2, minus tolerance (reference 32 N). Record displacement and sensor outputs. Increase load to F2 plus tolerance. Record displacement and sensor outputs. Remove load. Record set and sensor outputs.

4.3.2 Lateral Load Strength.

4.3.2.1 Lateral Load Strength Test. Position brake pedals to simulate the maximum use position (25 mm travel).

4.3.2.2 Apply a lateral force of 220 N to the right side of the pedal pad. Measure and record lateral deflection and permanent set.

4.3.2.3 Repeat for clutch pedals at the fully returned position.

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4.3.2.4 Repeat for accelerator pedals, however, force to be 178 N and record both idle outputs before, during, and after application of the force.

4.3.2.5 Repeat again for accelerator pedals however, apply force to the left side of the pedal pad.

4.3.2.6 Repeat again for accelerator pedals, however, apply force to return direction (opposite of the apply direction) at the bottom edge of the pedal pad.

4.3.3 Apply Direction Load Strength.

4.3.3.1 Brake Pedal Apply Direction Load Strength.

4.3.3.1.1 For brake pedals, apply 220 N in the force direction to the point specified in 4.1. Record maximum deflection and Brake Actuating Sensing System (BASS) output. Return the load to zero. Record permanent set.

4.3.3.1.2 Increase the maximum pedal force by 220 N each load cycle until 1100 N is reached. At each load, record total deflection and maximum BASS output. Return load to zero after each step. Record permanent set.

4.3.3.1.3 Starting at 1100 N pedal force, increase the load in 100 N increments until 2700 N is reached, the pedal separates, or some other failure occurs. If the load specified in the Subsystem Technical Specification (SSTS) or CTS exceeds 2700 N, further loads shall be applied in steps of 100 N until the load stated in the specification is met. Hold applied force for a minimum of 10 s at each 100 N increment and note any deflections.

4.3.3.2 Repeat for the clutch pedal except maximum load test is to be as specified in the CTS or if not provided 667 N. Maximum Clutch Actuating Sensing System (CASS) outputs to be recorded during loads.

4.3.3.3 For the accelerator pedal measure apply, and 45 degrees direction load strength, with load applied 30 mm from the bottom of the pad, and outputs before, during, and after loads per CTS overload requirements. If maximum loads not otherwise specified, use 1115 N for apply direction load and 556 N for 45 degrees direction load.

4.3.3.4 For the crash releasing brake and clutch pedals, slow increase load until the pedal yields to the floor but do not exceed 4000 N. Record load that pedal yields to floor and total deflection.

4.3.4 Durability Test.

4.3.4.1 Set up pedals and load appliers per Appendix A, Figures A1 and A2. For adjustable pedal assemblies, the specified pedal cycle position shall be full forward for 25% of modules tested, one-third ($\frac{1}{3}$) adjustment position for 25% of modules tested, two-thirds ($\frac{2}{3}$) adjustment position for 25% of modules tested, and full rearward for 25% of modules tested. Thus for 25% of parts to be tested, the force applying device will be one-third ($\frac{1}{3}$) rearward, and for another 25% it will be another two-thirds ($\frac{2}{3}$) rearward, and for the final 25% it will be set for the full rearward adjustment position. These will always be the load cycling position for these respective pedals. The pedals, at specified intervals, will be adjusted full rearward and forward, but returned to the same position for load cycling. The load applying device fixture must accommodate the pedals being adjusted full rearward.

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5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results.

5.2.1 Test Results.

5.2.1.1 For deflection testing: Deflections and sensor outputs at specified loads. Record on Appendix B, Data Sheets B2, B3 and B4.

5.2.1.2 For durability testing: Report appearance of functional defects or cracks, or any objectionable sound. Also, with pedals mounted to a vehicle intent mounting fixture with all pedal system brackets, measure total movement of the pedal pad when 5 N is applied left to right to the pedal pad along its centerline, then 5 N is applied right to left. Record total movement of the pedal pad after both loads, before and after durability cycling. Record on Appendix B, Data Sheet B5.

5.3 Test Documentation. Anomalies and data sheets are to be provided to the GM program specific design engineer. Samples of components or material released to this specification shall be tested for conformity with the requirements of this specification and approved by the responsible GM department prior to the start of delivery of production level components or materials.

Any change to the component or material, (e.g., design, function, properties, manufacturing process and/or location of manufacture) requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases a shorter test can be agreed to between the responsible GM department and the supplier.

5.3.1 Deviations from Test Procedure. Deviations from the requirements of the test procedures shall be reviewed and considered by the GM responsible Design Release Engineer (DRE). Specification deviations shall be specified on component test reports, drawings, test certificates, and other performance documentation.

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.

Elastic Deflection: Total deflection minus permanent set/deflection.

Permanent Set/Deflection: That portion of the total deflection that remains after the applied load is removed.

Total Deflection: The deflection measured during a specified load.

7.2 Acronyms, Abbreviations, and Symbols.

BASS	Brake Actuation Sensing System
BOF	Ball of Foot
CASS	Clutch Actuating Sensing System
CTS	Component Technical Specification
DRE	Design release Engineer
ETC	Electronic Throttle Control
GSSLT	Global Subsystem Leadership Team
PUMA	Product Usage, Measurements and Application

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