



Electronic Throttle Control Pedal Returnability 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. The purpose of this standard is to validate Electronic Throttle Control (ETC) Accelerator Pedal Mechanisms (APM) to Component Technical Specifications (CTS) return response requirements at various temperatures and with return energy source disconnections. This procedure can be used to support component compliance to FMVSS 124, CMVSS 124, and KMVSS 87 although GM CTS requirements are stricter than the referenced vehicle standards.

1.2 Applicability. This standard is applicable to all GMNA built vehicles and for Korean Market vehicles. This standard is a Regulatory Requirement in the areas mentioned.

2 References

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

2.1 External Standards/Specifications.

CMVSS 124 FMVSS 124 KMVSS 87

2.2 GM Standards/Specifications.

GMW14551 GMW14872

2.3 Additional References.

GM Electronic Throttle Control (ETC) Accelerator Pedal Component Technical Specifications (CTS) Template
Program Specific ETC Accelerator CTS

3 Resources

3.1 Facilities. This procedure is to be performed by ETC pedal suppliers at their 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 Humidity chamber that can soak components specified at 100% humidity and 52 °C for at least 24 h continuously.

3.2.2 Temperature chamber that can maintain components specified at the following temperatures:

- -40 °C +0 °C, -3 °C
- -18 °C +0 °C, -3 °C
- 20 °C ± 6 °C
- 52 °C +3 °C, -0 °C

3.2.3 Voltmeter certified to supply a constant 5.0 V ± 0.3 V when subjected to 0 mA to 20 mA current draw, pedal signal supply.

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3.2.4 Voltmeter that can supply 12.0 V or 5.0 V $\pm$ 1.0 V with 0 mA to 50 mA current draw, pedal release trigger supply.

3.2.5 Electronic device that is certified to record voltage within 0.01 V, and time at least every 10 ms with a minimum of 10 ms accuracy:

- Three (3) 0 V to 5 V inputs, or
- Two (2) 0 V to 5 V inputs and one 0 V to 12 V input,

Electronic device must have easy start stop recording capability, and be able to record at least 2 h of such data.

3.2.6 Kick stick that can apply accelerator pedals to specified 100%, 75%, 50%, or 10%, actual sensor output minus idle output, divided by full travel output delta, within $\pm$ 2% displacement positions. After position is obtained, kick stick should provide an instantaneous release of the pedal and side step the pedal. The kick stick is to have a trigger switch consisting of either a micro-switch or electrical conducting provisions (wires and contact strip), that will allow it to complete a circuit with provisions on the pad and contact strip. When the kick stick is slid off the side of the pedal it shall instantaneously close or open, causing a significant electrical circuit voltage change in the pedal release trigger circuit. This voltage change is to be recorded as data, thus indicating the precise instance when the pedal is released.

3.3 Test Vehicle/Test Piece.

3.3.1 The number of parts tested shall be: at least five times the number of severances listed on Data Sheet A1 or requested per 4.1.1 and be of the most production representative program specific pedals available. Four (4) of each severance shall be un-cycled and one (1) shall have completed GMW14551. Therefore, if three (3) severances are listed, 15 parts total should be tested: four (4) un-cycled for each energy source listed, and one (1) that has completed GMW14551 for each energy source listed. Return energy sources (springs) should be severed at a point that would simulate most probable field failures.

3.4 Test Time.

Calendar time:	5 days to 7 days
Test time:	2 h to 3 h
Coordination time:	(24 h to 36 h soak time)

3.5 Test Required Information. Requirement information from the program specific CTS.

3.6 Personnel/Skills.

3.6.1 Test Engineer. Project management skills, mechanical skills, basic electrical skills, and ETC accelerator control system familiarity.

3.6.2 Engineering Technician. Mechanical skills, basic electrical skills, ETC accelerator control system familiarity, computer skills, knowledge of environmental chamber, and of instrumentation used.

4 Procedure

4.1 Preparation.

4.1.1 Identify all accelerator pedal return energy sources, springs, including within the sensor. Sensor springs must be considered even if they contribute minimal lever return force. This is due to drive mechanism lash/compliance. Some designs may not fully return to idle sensor output, if one of the sensor return springs is severed. Identify potential severances and disconnections. Record all information in Appendix A, Data Sheet A1.

4.1.2 Mount the parts to be evaluated on a fixture with the pedal housing in design position (i.e., same housing angle as intended in vehicle).

4.1.3 Install instrumentation.

4.1.3.1 For all measuring devices used for recording data while performing this test, record instrument description, instrument identification number, instrument calibration date, and the next instrument calibration due date on Appendix A, Data Sheet A2.

4.1.3.2 Connect at least one (1) pedal and kick stick to the data acquisition device and verify that it is recording proper outputs versus time.

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4.2 Conditions.

4.2.1 Environmental Conditions. See 4.3.1.

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 Test.

4.3.1.1 New core designs, or designs with metal material or coating changes are to be exposed to GMW14872 Functional Corrosion. Portions of the APM above the lower dash panel are considered interior mid mount and the portion of the APM below the lower dash panel are considered low mount for interior under dash components.

4.3.1.2 Humidity Soak. Parts to be evaluated should be exposed to 100% humidity at 50 °C ± 3 °C for at least 24 h without being cycled. Do not stroke parts until evaluated for returnability is evaluated per 4.3.1.4

4.3.1.3 Parts shall be soaked at the temperature that they are to be tested at, per Appendix A, Data Sheets A4 and A5, for at least 12 h prior to test. The -40 °C test sequence shall be first, then -18 °C, 20 °C, and 52 °C tests. The pedals shall not be disturbed from their rest idle position prior to the first test recording specified in Appendix A, Data Sheets A4 and A5.

Note: If all samples meet CTS requirements for -18 °C (100 ms) during 40 °C testing, then -18 °C testing need not be performed.

4.3.1.4 Begin electronically recording all pedal outputs, trigger switch status, and time at least every 10 ms. Displace the pedal to the first condition specified in Appendix A, Data Sheet A4, 10% displacement position, using the kick stick with trigger switch. Percent displacement position can be calculated as:

$$(S1_{Actual} - S1_{Idle}) / (S1_{Full Travel} - S1_{Idle})$$

Hold at this initial position for at least 5 s. Then slide the kick stick off the pedal to instantaneously release the pedal and trigger switch. Continue to record specified parameters, all pedal outputs, trigger switch status, and time, until the pedal output stabilizes at an at rest position, at least 5 s from release.

4.3.1.5 Continue to repeat 4.3.1.3 for all initial positions, for all pedals, until all test conditions specified in Appendix A, Data Sheets A4 and A5 for the particular temperature condition have been completed. Record before idle output, initial and settled response times, bounce, and after idle output specified on Appendix A, Data Sheets A4 and A5, either during execution of the test, or using electronically recorded pedal sensor output, and kick stick status, versus time data (see Table 1).

Table 1: Test Temperature Sequence and Data Sheet Reference

Data Sheet	Test Temperature (°C)	Samples (Mandatory)	Samples (as Required)
A4	-40	1 through 10	11 and beyond
A4	-18 (if required)	1 through 10	11 and beyond
A5	20	1 through 10	11 and beyond
A5	52	1 through 10	11 and beyond

4.3.1.6 Determine the longest response time from all the samples and conditions tested and whether it is within CTS requirements for APM Initial Response Time (IRT) and Settled Response Time (SRT).

5 Data

5.1 Calculations. Percent displacement equals actual sensor output minus idle output, divided by full travel output minus idle output.

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5.2 Interpretation of Results. IRT, SRT, bounce, and all changes between, before and after idle output shall be less or equal to program specific CTS requirements. If not, a GM responsible engineer shall be informed within 48 h. See 7.1 for definitions of initial and settled response times.

5.3 Test Documentation. Appendix A, Data Sheets A1, thru A5 shall be completed and a copy provided in the program Production Part Approval Process (PPAP) submission, validation report, and when requested by a GM representative. The supplier shall work with the GM Responsible Engineer to comprehend these requirements.

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.

After Idle Output: Sensor output with the accelerator lever and pad released and fully settled as indicated after each pedal test cycle.

Average Normalized Pedal Output: The average of all sensor outputs scaled to sensor one (1) output at any position. For GM common, full/half specification outputs with two (2) sensors:

- 20%/10% V reference at idle.
- 84%/42% V reference at full travel.
- Sensor 2 output must be multiplied by two then it can be averaged with sensor 1.

Before Idle Output: Sensor output with the accelerator lever and pad released and fully settled as indicated before each pedal test cycle.

Energy Return Source Devices: Devices used to return the accelerator pedal and sensor to the idle sensor position (usually springs).

Full Travel Output Delta: Actual full travel output minus idle output.

Initial Response Time: The elapsed time from release of force of the APM pedal pad, as indicated by change in kick stick trigger switch status, to the time at which average normalized pedal outputs first return to before idle output within the Within Ignition Cycle Idle Output Tolerance, i.e., within 1% total, per CTS specifications (reference 100 ms for temperatures $> 18^{\circ}\text{C}$, and 150 ms for temperatures $\leq -18^{\circ}\text{C}$).

Instantaneous Release of the Actuating Force: Instantaneous removal, usually off the side of the pedal pad, of a device, usually stick or wooden rod, used to push the pedal to a specified initial position. Release of the actuating force shall be detected by the change of a micro-switch, or contact strip, mounted between the driver operated control device and the actuating force.

Settled Response Time: The elapsed time from release of force of the APM pedal pad, as indicated by the change in kick stick trigger switch status, to the time at which average normalized output returns and remains within the **Within Ignition Cycle Idle Output Tolerance** (reference: within 1% total, per CTS specifications, 250 ms for temperatures $> -18^{\circ}\text{C}$ and 350 ms for $\leq -18^{\circ}\text{C}$).

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7.2 Acronyms, Abbreviations, and Symbols.

APM	Accelerator Pedal Mechanism
CTS	Component Technical Specification
ETC	Electronic Throttle Control
GSSLT	Global Subsystem Leadership Team
IRT	Initial Response Time
PPAP	Production Part Approval Process
SRT	Settled Response Time

8 Coding System

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

Test to GMW15152

9 Release and Revisions

This standard was originated in February 2006. It was first approved by the Global Chassis Team in March 2006. It was first published in March 2006.

Issue	Publication Date	Description (Organization)
1	MAR 2006	Initial publication.
2	JAN 2012	Revise to current template. (Pedal GSSLT)
3	FEB 2018	Revise to current template. (Chassis Brake Global Subsystem Leadership Team (GSSLT))

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