



Evaluation of Keyed Ignition Robustness to Road Inertial Inputs

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 evaluate vehicle robustness to unintended ignition switch rotation due to inertial loads during severe road inputs.

1.2 Applicability. This procedure is applicable to all passenger cars, multi-purpose vehicles and light trucks with keyed ignitions.

1.3 Remarks. Currently this standard is run at Milford, Dudenhofen, and Guangde proving grounds. The development of this test standard for the Cruz Alta Proving Ground is under consideration.

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

2.3 Additional References.

- CG190 GM Evaluation Report
- Test request (from the GM Design Responsible Engineer)

3 Resources

3.1 Facilities. General Motors proving grounds:

- a. Milford Proving Ground (GM North America)
 1. Pot Hole Facility
 2. Belgian Block Road
 3. Ride and Handling Loop
 4. Cubilete
- b. Cruz Alta Proving Ground (GM Brazil)
- c. Dudenhofen Proving Ground (GM Europe)
 1. Pot Hole Facility
 2. Torture Tracks G
 3. Comfort and Noise Track
- d. Guangde Proving Ground (GM Korea and Pan Asian Technical Automotive Center)
 1. Pot Hole Facility
 2. Belgian Block Loop
 3. Pleasant Valley Chatter Bumps

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4. Durability Loop
5. Ride Loop
6. Cubilete

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 Key Rings and Weight. 50 mm inner diameter key rings and individual keys to add weight.

3.2.2 Torque Meter. A torque meter capable of rotating an ignition key. The torque meter full scale should be approximately 134 N·cm (12 lbf·in) with a resolution of 0.1 N·cm (0.01 lbf·in).

3.2.3 Inclinator. An inclinometer with resolution of one (1) degree.

3.2.4 Calipers. Calipers with resolution of 1 mm.

Note: If the equipment in 3.2.1 through 3.2.4 is not preserved, record calibration information on Data Sheet A1 in Appendix A.

3.3 Test Vehicle/Test Piece. The vehicle chosen for the evaluation should be production representative with respect to:

- Tires and suspension.
- Ignition key assembly, including ignition key head geometry, number and size of key rings attached to the ignition key, and attached tags or electronics. **Note:** If multiple ignition key head shapes and or slot/hole sizes are planned for production, the test shall be run for each variant. If multiple ignition key blade lengths are planned for production (such that the ignition key head sits in different positions relative to interior trim), the test shall be run for each blade length.
- Ignition switch, lock cylinder, lock cylinder housing.
- Steering column range of tilt and telescope adjustments (if ignition switch located on steering column).
- Column shifter, column shroud, instrument panel trim, or any interior items in proximity to the keyed ignition that could interact with the test articles outlined in 3.2.1.

3.4 Test Time.

Calendar time: 1 day

Test hours: 4 hours

Coordination hours: 4 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Access to and driving privileges on the GM proving ground used for the evaluation.

4 Procedure

4.1 Preparation. Fill out the information in Data Sheet A2 and Data Sheet A3 in Appendix A.

4.1.1 Key, Key Rings, and Key Tag or Electronics. Obtain the production representative ignition key assembly as defined in 3.3. Consult the appropriate proving ground driving instructions, Appendix B, Appendix C, and Appendix D, for the mass required on each schedule.

If the required mass is ≤ 0.4 kg (≤ 0.88 lb), add keys to a single 50 mm inner diameter ring until the mass is achieved. For a required mass exceeding > 0.4 kg (> 0.88 lb), add keys to a single 50 mm inner diameter ring until 0.4 kg (0.88 lb), is achieved, and then add keys to a second 50 mm ring until the combined mass of the two (2) rings achieves the required mass.

The masses are to be attached to the ignition key assembly during the test as illustrated by Example 1, Example 2 or Example 3 in Figure 1. If the ignition key assembly, as defined in 3.3, is to be sold without any rings attached to the ignition key, then substitute a 25 mm inner diameter ring as shown in Example 2 or Example 3 of Figure 1.

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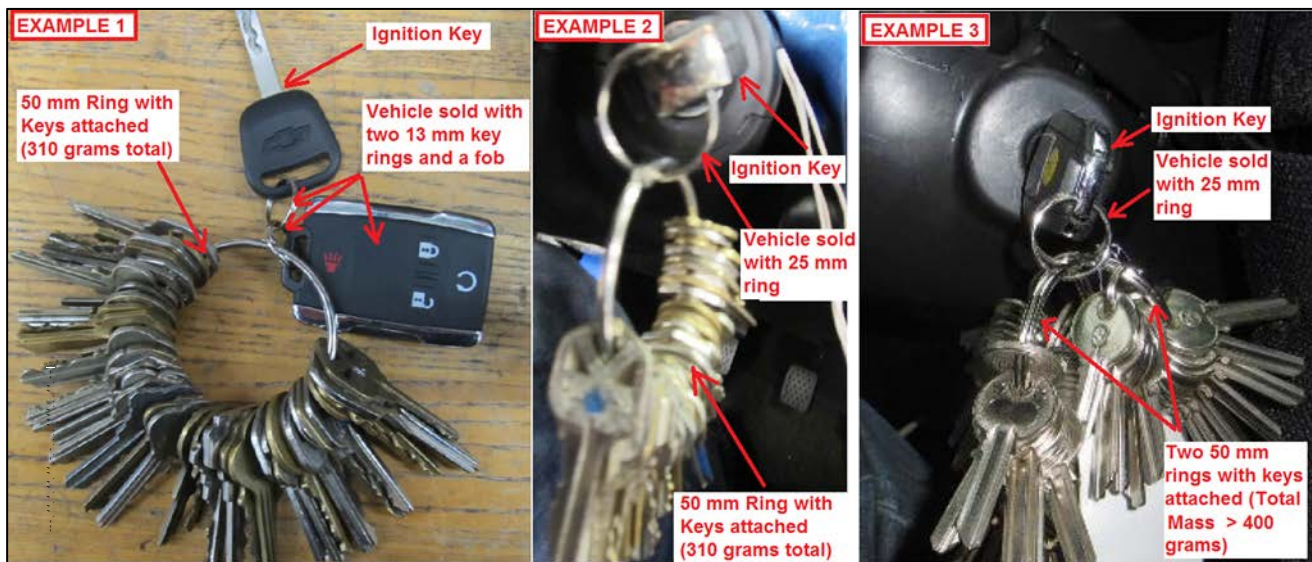


Figure 1: Examples of Weight Key Chains

4.1.2 Tires and Pressures. Review the tire pressure placard, usually on the driver door below the latch, and set the pressures accordingly.

4.1.3 Suspension. Review the suspension options for the test vehicle. If the vehicle has any driver selectable suspension modes, run the test with the stiffest mode.

4.1.4 Steering Column Drive Condition. For ignition switches located in the steering column, adjust the column as follows:

- Full telescope out (if telescope adjustment available).
- Inspect ignition key angle in RUN position and identify if angle is positive or negative. Zero (0) reference is 12:00 noon with clockwise rotation being positive values. See Figure 2. Adjust steering column to full up position if angle is positive, or to full down if angle is negative.

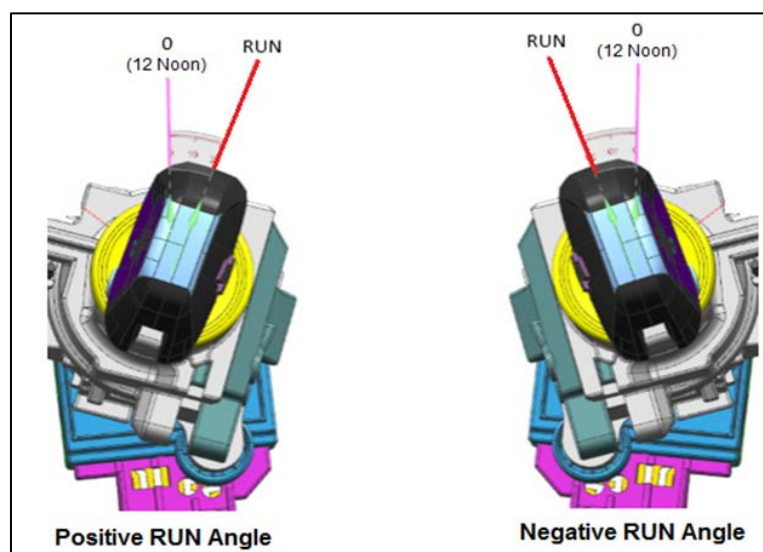


Figure 2: Ignition Key Angle

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4.1.5 Photographs. Document using Data Sheet A3 in Appendix A:

- Ignition key and rings attached to the ignition key used in testing.
- Tags or electronics attached to the ignition key used in testing.

4.1.6 Measurements. Document using Data Sheet A2 and Data Sheet A3 in Appendix A, using the equipment defined in 3.2 the following minimum required measurements:

- Ignition key RUN angle after making the necessary steering column adjustments in 4.1.4.
- Ignition key slot (or hole) width.
- Five (5) RUN to ACCESSORY torque measurements performed at a slow rate ($< 5 \text{ N}\cdot\text{cm/s}$).

Note: These parameters have a large influence on the test results and therefore are essential to document.

4.2 Conditions. The seating position of the driver should not allow the knee or any part of the body to interact with the weighted mass attached to the ignition key during the tests.

4.2.1 Environmental Conditions. Driving tests should be postponed in the event weather conditions prevent safe execution of the schedules, or alternatively if the traction or profile of the test road surface is changed such that the test vehicle response becomes altered.

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. After all preparations outlined in 4.1 are complete, perform the drive schedules with the correct masses attached to the ignition key as specified in Appendix B, Appendix C, and Appendix D and document the results in Data Sheet A4 in Appendix A. To ensure the ignition switch is fully seated in the RUN position at the beginning of each schedule, the ignition key is to be cycled to the OFF position and then back to RUN at the beginning of each schedule per the driving instructions in Appendix B, Appendix C, and Appendix D. See Example 1, Example 2 or Example 3 in Figure 1 for proper attachments of weighted masses.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Vehicles that do not exhibit unintended ignition switch rotation are considered robust. For vehicles that do not pass all schedules, i.e., experience unintended key rotation on one (1) or more schedules, changes to the keyed ignition system should be made to increase robustness, e.g., the ignition key angle in RUN (controlled by the lock cylinder) can be made more vertical, the ignition key head slot/hole width can be narrowed to reduce the rotational leverage the weighted mass has on the ignition key, or the rotational resistance of the ignition switch can be increased. Results may be compared to the vehicle technical specifications requirements (if applicable), results from other vehicles, or to test results from methods outlined in the Test Request.

5.3 Test Documentation. Publish these test results according to the supplier or GM departmental protocol using the GM Evaluation Report, CG190, template in Global Document Management (GDM) or similar. Completion of instructions and information fields in the data sheets in Appendix A constitutes complete documentation for this GMW procedure.

All unusual observations are to be documented in the Problem Resolution Tracking System (PRTS) or similar system. Contact the GM Requesting Engineer for details on documenting unusual observations.

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

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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.

Note: Passengers are allowed for observation or training purposes.

6.1.7 If a crossbar is used to hold the steering wheel angle transducer base plate, the passenger side airbag is to be disabled or disconnected.

7 Notes

7.1 Glossary.

Ignition Key Angle: Zero reference is 12:00 noon with clockwise rotation being positive values. See Figure 2.

7.2 Acronyms, Abbreviations, and Symbols.

GDM	Global Document Management
PRTS	Problem Resolution Tracking System
VIN	Vehicle Identification Number

8 Coding System

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

Test to GMW17290

9 Release and Revisions

This standard was originated in November 2014. It was first approved by Vehicle Systems Engineering in February 2015. It was first published in February 2015.

Issue	Publication Date	Description (Organization)
1	FEB 2015	Initial publication.
2	SEP 2016	Added clarity to data sheets in Appendix A and Appendix B and Milford Proving Ground driving procedure. Added driving procedures in Appendix C and Appendix D for Guangde and Dudenhofen Proving Ground. (Systems Engineering)

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Data Sheet A1: Calibration of Instrumentation ^{Note 1}

Note 1: See 3.2.
Note 2: Scale used to weigh articles in 3.2.1