



Power Mode Robustness to Driver Knee Contact

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 power mode change due to driver knee contact.

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

1.3 Remarks. This test procedure establishes a common set of tools and methods to be used for evaluating robustness to unintended power mode change due to driver knee contact. Modifications to this procedure may be necessary to comprehend the exact conditions for testing to a particular technical specification, regulation, or best practice. The test request will specify the details needed to meet the testing requirements of a particular technical specification, regulation or best practice. The supplier shall work with the GM Design Responsible Engineer to comprehend the requirements.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Anthropometric Reference Data for Children and Adults: United States, 2003-2006 from the Centers for Disease Control and Prevention (CDC), available at Uniform Resource Locator (URL) <http://wwwn.cdc.gov/nchs/nhanes/bibliography/Pubs.aspx?CatID=45&name=Anthropometry>.
- CG190 GM Evaluation Report
- Test request (from the GM Design Responsible Engineer)

3 Resources

3.1 Facilities. Not applicable.

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. Tape measure/scale, camera, calipers, and inclinometer. Unless otherwise preserved in test facility records, enter equipment information on Data Sheet A1 in Appendix A.

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

- Driver seat and range of adjustments
- Gas/Brake pedals and range of adjustments (if applicable)
- Steering wheel and range of tilt and telescope adjustments

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- Steering column shroud, dash, knee bolster, and all occupant-surrounding trim pieces
- Ignition switch, lock cylinder, lock cylinder housing
- Start switch/button (if applicable)
- Ignition key assembly (including key head geometry, number and size of key rings, and attached tag or electronic transmitter)

3.4 Test Time.

Calendar time: 2 days
 Test hours: 8 hours
 Coordination hours: 8 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. This test procedure requires nine (9) total evaluators that meet specific Human Factors Anthropometric measurements:

- Three (3) evaluators representing 5% female or smaller height with varying weights
- Three (3) evaluators representing 50% male height with varying weights
- Three (3) evaluators representing 95% male or taller height with varying weights

Anthropometric Reference Data for Children and Adults: United States, 2003-2006 from the CDC are listed in Table 1. See URL <http://wwwn.cdc.gov/nchs/nhanes/bibliography/Pubs.aspx?CatID=45&name=Anthropometry>.

Table 1: Evaluator Measurement Percentile Chart

Measurement	5% Female	50% Male	95% Male
Standing Height	151 cm $\pm$ 2 cm	175 cm $\pm$ 3 cm	186 cm $\pm$ 4 cm
Average Weight	51 kg $\pm$ 2 kg	84 kg $\pm$ 4 kg	121 kg $\pm$ 10 kg

4 Procedure

4.1 Preparation.

4.1.1 Evaluators. Each evaluator should wear comfortable clothing which is not restrictive to their motions. Shoe heel height should not exceed 2 cm. Record evaluator information on Data Sheet A2 in Appendix A

4.1.2 Vehicle.

4.1.2.1 Seat, Steering and Pedal Reference Points. Determine zero reference point for seat, steering column, and pedal adjustments. Refer 4.3.2.

4.1.2.2 Ignition Switch Interface. For vehicles with a start switch/button, measure the size and depression distance. Note the power mode strategy (push and hold time or multiple button presses). For vehicles with a keyed ignition, measure the key angle with an inclinometer in the run position with the column at nominal tilt position (key angle zero reference is 12:00 noon with clockwise being positive values). Measure the key head width, key head slot width, key ring inner and outer diameters, transmitter geometry, and transmitter ring inner and outer diameters (if two rings are present). Prepare the ignition key for the evaluators with proper assembly of rings and fob. Record ignition switch interface information on Data Sheet A2 in Appendix A.

4.2 Conditions.

4.2.1 Environmental Conditions. Comfort for the evaluators and the person recording the data should be taken into account.

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.

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4.3 Instructions.

4.3.1 Evaluation Procedure. Each evaluator will start their evaluation by sitting comfortably in the vehicle driver seat and fastening their safety belt. Adjust the seat, pedals, steering wheel tilt and telescope (as applicable) to the normal driving positions. Each evaluator is to drive the vehicle for a minimum of five (5) minutes, taking the opportunity to make final adjustments to their normal driving positions.

Note: To preserve seat, steering and pedal adjustments, complete the test procedure with one evaluator before moving on to the next.

4.3.2 Evaluator Measurements. With the evaluator seated in the driver seat, measure the shortest, straight-line distance from the driver's knee to the start switch/button or key head with the ignition in run (refer to Figure 1). Make this measurement three times for each evaluator, one for each of the following foot positions:

- Gas pedal (baseline position)
- Lightly resting on brake pedal
- Pulled back in relaxed position to replicate use of cruise control

Record ignition switch to knee distance information on Data Sheet A3 in Appendix A.

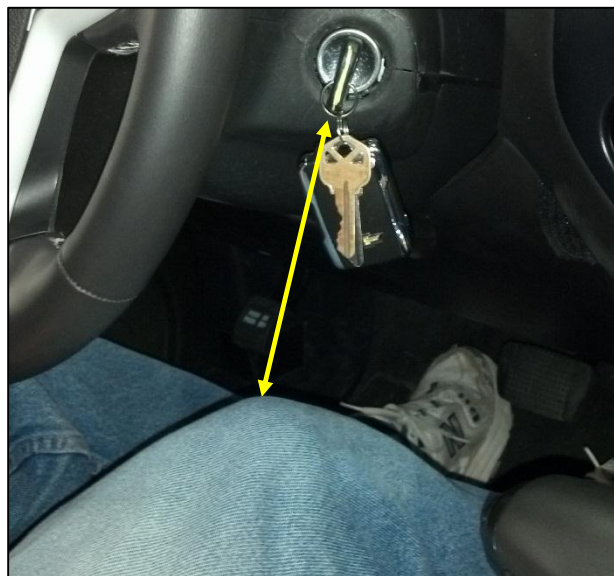


Figure 1: Knee to Ignition Key Distance Measurement

Take a baseline photograph of the evaluator in their normal driving positions with their foot on the gas pedal (refer to Figure 2 for an example). Ignition should be in run position.

Record photo identification number on Data Sheet A3 in Appendix A.

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Figure 2: Baseline Normal Driving Position

Preserving normal driving positions, measure and document each evaluator's preferred seat, steering column, and pedal adjustments, including:

- Seat fore-aft travel location with respect to forward stop
- Seat height adjustment with respect to full down
- Seat cushion angle with respect to full down
- Seat back angle with respect to the vertical
- Steering column tilt height with respect to full down
- Steering column telescope with respect to fully collapsed
- Pedal adjustments with respect to full down

Record each evaluator's preferred seat, steering and pedal information on Data Sheet A3 in Appendix A.

4.3.3 Subjective Evaluation.

4.3.3.1 Normal Driving Positions. With the evaluator seated comfortably, evaluate the risk of the driver's knee contacting the ignition key or start switch/button causing unintended change to vehicle power mode. Movements to be evaluated should include any normal driving motions while in a vehicle. Examples include, but are not limited to, the following:

- Moving right foot from gas to brake pedals, both slowly and quickly
- Moving right foot from brake to gas pedals, both slowly and quickly
- Use of the clutch pedal if applicable
- Panic brake stops
- Feet pulled back in relaxed position to replicate use of cruise control
- Twisting to look back over each shoulder

The preceding movements should also be evaluated with the shift lever in all gear positions if the vehicle has a shift mechanism in the vicinity of the ignition key or button.

Photograph any knee to ignition switch contact position (refer to Figure 3 for an example). Record contact and photo identification number on Data Sheet A4 in Appendix A.

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Figure 3: Knee to Key in Normal Position

4.3.3.2 Abnormal Driving Positions. Once the vehicle is evaluated for robustness throughout normal driving motions, have the evaluator deliberately try to change the vehicle power mode with their knee through abnormal motions, or motions that would not occur in a normal driving scenario (refer to Figure 4 for an example). Record photo identification number on Data Sheet A5 in Appendix A.



Figure 4: Deliberate Knee to Key Evaluation - Abnormal Position (Right Foot Raised)

4.3.3.3 Key Ring Attachments. Consideration should also be given to the possibility of inadvertently changing the vehicle power mode through a key tag, large ring, stand-alone transmitter, or similar items. Examples include, but are not limited to:

- Upward leg movement transmitting a force through the attached object into the key
- Lateral leg movement pinching or twisting the attached object against the steering column or shroud (refer to Figure 5)
- Forward leg movement transmitting a force through the attached object
- Attached object acting as lever arm with key ring flipped over the head of the key (refer to Figure 6)
- Quick knee movement causing impulse or swing movement of the attached object.

Record photo identification number on Data Sheet A6 in Appendix A.

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