



Electrical Component Force and Torque Requirements

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 standard specifies the haptic characteristics, performance and validation procedure for interior switches and controls, including push buttons, rockers, rotary knobs, stalks, etc. Compliance to this standard will help ensure a high level of interior control harmony and customer perception of high quality for the controls in a vehicle. Haptic approval is part of the Touch, Appearance, Lighting and Color (TALC) Specifications for Production Part Approval Process (PPAP).

1.2 Applicability. This standard applies to all GM vehicle programs, and all switches and controls including push buttons, rockers, rotary knobs, stalks, etc.

1.3 Remarks. Some button geometries or special cases may have unique requirements associated with them, consult the Component Lead Engineer and TALC Lead Engineer. See Appendix C, Figure C1 thru Figure C21 for examples of switches, knobs, 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.

GMW3059

GMW3431

GMW14155

2.3 Additional References.

- Customer Actuation Sounds Team
- Part Drawing
- Previous TALC Issues List and Action Items

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities.

3.1.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.1.2 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.

3.1.2 Equipment.

3.1.2.1 Power Supply (12 V to 14 V capability, 60 A).

3.1.2.2 Direct Current (DC) Voltmeter.

3.1.2.3 Data acquisition equipment capable of torque or force readings to 0.05 N cm (torque) and ± 0.05 N (force).

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December 2015

Page 1 of 19

3.1.2.4 The equipment shall be capable of recording data points at 0.1 mm increments for linear switches and 0.1 degrees for rotational switches.

3.1.2.5 Ammeter or similar test equipment to detect make and break of the circuit. This is to be used in conjunction with the button travel.

3.1.2.6 Previous TALC Issues List and Action Items.

3.1.3 Test Vehicle/Test Piece. Samples must be dimensionally correct to the intended design, including internal components. The samples shall meet electrical and mechanical specifications. Tests shall be conducted using random samples from the latest build event. Any deviations from this should be noted on the evaluation form.

3.1.4 Test Time.

Calendar time: 2 to 4 days

Test hours: 4 to 12 hours

Coordination hours: 24 to 48 hours

3.1.5 Test Required Information. The data shall be presented according to Component Force Measurement Data Sheet, see Appendix A, Data Sheet A1. Samples shall be identified by number.

3.1.6 Personnel/Skills. The TALC Evaluator/Approval Engineer should have training/experience in the TALC evaluation process. The supplier shall have training and experience in the usage of the preceding equipment.

3.2 Preparation. The supplier is responsible to measure their components and submit the requested data to the Design Release Engineer (DRE) and the TALC Engineer prior to the TALC Review.

3.3 Conditions.

3.3.1 Environmental Conditions. Test samples shall be measured at $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

3.3.2 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.

3.4 Instructions.

3.5 Data. The supplier shall present documentation from measurements and analysis of production variations according to the Component Force Measurement Data Sheet, see Appendix A, Data Sheet A1.

3.6 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.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard 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.

3.7.1 Test Results. If the data is not within the limits of the specifications (see GMW3431), the switches may still be evaluated and used as a starting point for the review process.

4 Requirements and Procedure

4.1 Requirements.

4.1.1 Haptic Specification. Before or during the technical review, the supplier will provide an assembly and/or component that will demonstrate capability of meeting this requirement. The assembly and/or components will become an "Initial Master Sample" and will be used in TALC reviews as the reference for haptic performance (issues for improvement may be noted on the initial master sample). Note that this specification may not apply

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December 2015

Page 2 of 19

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to all control types; requirements for controls of different configurations may need to be determined. In these cases, follow 4.1.1.1. All parts listed in the appendices need to fulfill the described parameters for TALC approval. When a carryover component (such as a window switch) is used on the vehicle program, the TALC engineer may choose to match the preceding attributes of other components to the carryover component.

4.1.1.1 Other Control Types. For control types that do not have specified requirements in this specification, haptic specifications will be agreed upon between Human Vehicle Integration (HVI), TALC, the component Bill of Material (BOM) Family Owner (BFO), Component Lead Engineer, Supplier, Program Engineering Manager (PEM) or Vehicle Chief Engineer (VCE), and Studio as appropriate. The specifications consist of actual reference part(s) supplied either by the supplier or by GM and shall be retained as the Initial Master Sample.

4.1.2 Wobble and Looseness. Knobs and buttons shall be evaluated for wobble in the design position. There shall be no "loose tooth" feel.

4.1.2.1 Wobble/Looseness Procedure. Apply a 15 N force to a defined point on the button surface in a direction normal to the sphere, plane or axis of motion. The location of the applied force shall be as far as possible from the center of rotation of the button/knob based upon surface shape and actuation direction(s). There shall be < 0.25 mm of movement in the direction of the applied force. It is not intended for the force to be applied in the direction of "designed" button or knob motion (see Figure 1).

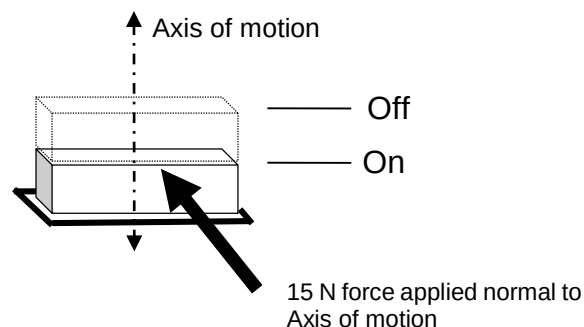


Figure 1: Test Setup

4.1.3 Other Control Qualities. Each control shall provide a high quality perception that is free from non-desirable noises and rattles (defined by the Customer Actuation Sounds Team, and Noise, Vibration and Harshness (NVH) team, see GMW14155) stickiness, friction, sudden increases or decreases in effort or other effects that might adversely impact the perceived quality of the control.

4.2 Validation.

4.2.1 Switch Haptics and Quality. Suppliers need to deliver measurements using the GM Component Force Measurement Data Sheet, see Appendix A, Data Sheet A1 for every delivered TALC part.

4.2.2 Data Collection. The test equipment shall be set up for the specific switch. The travel limits shall be set to allow full button travel in both directions (on to off and off to on). Any fixtures required shall be reviewed and approved by the TALC engineer. Any additional mass of the applied fixture shall be calculated out of the data. All measurements to be taken at nominal operating condition, unless otherwise specified.

4.2.2.1 Curve Intake. The collection of data shall occur in one run without interruption to the switch or test equipment through full travel. Actuation speed shall be linear 0.5 mm/s; angular 0.8 degrees per second.

4.2.2.2 Torque. The fixture equipment rotation shall be centered about the button's point of rotation. The fixture shall travel freely without movement relative to the control.

4.2.2.3 Force. The data measurement point shall be described by the Part Drawing. The probe shall not move relative to the point location during motion of the knob. If the measurement point is not described on the drawing, the supplier must confirm the point, in writing, with the lead engineer, TALC engineer or BFO.

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December 2015

Page 3 of 19

4.2.2.4 Tolerances. The Appendix B, Figure B1 describes percentages for tactile ratio, travel to peak, travel to contact, etc. are referring to the measured value of a specific part and not to the target value to keep the characteristics of the tactile curve. After durability test a reduction of 20% of force/torque is allowed.

4.2.3 Master Samples. Once the component meets the specification and all action items are closed; the supplier will provide a minimum of two parts including filled out Component Force Measurement Data Sheet, see Appendix A, Data Sheet A1; one to be retained by the TALC evaluator/approval engineer as the buyoff target. These samples will typically be the sample from the latest TALC review and will be made from production tools. The approved Component Force Measurement Data Sheet, see Appendix A, Data Sheet A1 is required for PPAP submission. One master sample will be handed back to the supplier to be maintained at their manufacturing facility.

5 Provisions for Shipping

Not applicable.

6 Notes

6.1 Glossary.

Button/Knob: The interface of the switch to the customer, where the customer touches to actuate the switch.

Full Travel: Total switch button travel from the nominal "off" position (unactuated), through the "on" position(s) to the physical stops of the button travel or twice the peak force is observed. Force at Full Travel (F_{ft}).

Graphics: Refers to the numbers, letters, symbols labeled on the components. The graphics characteristics include font type, stroke width, and line definition.

Hash: The chop in the force measurement data associated with frictional force changes.

Hysteresis: The force curve associated with return to off or unactuated position.

Interference: Any physical contact between surfaces.

Make/Break Points: Refers to the point in the button travel where electrical contact is made or opened.

Peak Force: The maximum force through full switch travel.

Pre-Load: The force that has to be overcome to begin movement of the button when applied opposite to the reaction force vector.

Range: In an assembly of more than one switch/button, such as the driver's window switch, the range is defined as the minimum force of any single button to the maximum force of any single button, regardless of being the same or different button being measured.

Snap In: Some switch rotary and slider switches may have a negative "snap in" force at or near the detent. This force is designed so a button does not get hung up due to friction in a none-design position. It is typically 10% of the peak force.

Tactile Ratio: Comparison of Peak Force (F_p) to minimal Contact Force (F_c) after the first peak. Tactile Ratio = $100 \times (F_p - F_c)/F_p$ and expressed as a percentage.

Total Travel: Total switch button travel from the nominal "off" position (unactuated), through the "on" position(s) to the physical stops of the button travel (in millimeters) is defined as achieving 3x peak force in the hard stop.

Touch: Touch as defined in TALC relates to the force and travel (haptics) during button/control actuation.

Uniformity: Refers force required to actuate within and between components. These items should be the same across the entire vehicle.

6.2 Acronyms, Abbreviations, and Symbols.

BFO	BOM Family Owner
BOM	Bill of Material
CTS	Component Technical Specification
DC	Direct Current
DRE	Design Release Engineer
EOT	End of Travel

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December 2015

Page 4 of 19



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F_c	Contact Force
F_{ft}	Force at Full Travel
F_p	Peak Force
HVI	Human Vehicle Integration
NVH	Noise, Vibration and Harshness
PEM	Program Engineering Manager
PPAP	Production Part Approval Process
PTM	Production TALC Master
s_c	Percent of Overall Travel
s_p	Percent of Total Travel
S_{tt}	Total Travel
TALC	Touch, Appearance, Lighting and Color
VCE	Vehicle Chief Engineer

7 Additional Paragraphs

7.1 All parts or systems supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances**.

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:
GMW15199

9 Release and Revisions

This standard was originated in March 2006. It was first approved by the Global Human Vehicle Integration committee in November 2007. It was first published in December 2007.

Issue	Publication Date	Description (Organization)
1	DEC 2007	Initial publication.
2	DEC 2015	5 Year Refresh. (Electrical - Customer Switch Global Subsystem Leadership Team)

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December 2015

Page 5 of 19

Appendix A

Data Sheet A1: Component Force Measurement Data Sheet (Page 1 of 3)

This form confirms that the supplier has successfully completed the Component Force Measurement Review process. For parts listed on this form, there are no outstanding issues. Note any exceptions in the comments section.

The TALC team has established master TALC samples from production tooling as part of the TALC review process. These samples have been assigned a Production TALC Master (PTM) number and have been signed by the TALC engineer. Both the supplier and the TALC engineer have a sample of this PTM.

MODEL YEAR and PROGRAM: _____

DATE: _____

SUPPLIER: _____

PART NUMBER	PART NAME	MASTER SAMPLE

COMMENTS:

Approved: _____ **Date:** _____
TALC Engineer

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December 2015

Page 6 of 19

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