



Park Brake Apply Assembly Technical Specification

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 park brake apply subsystem transforms hand or foot lever force and travel into force and travel to the rear foundation brake subsystem. The park brake lever mechanically maintains the force and travel input to the foundation brake system until released by the driver. The park brake mechanism activates a switch that provides an electrical signal that is used to warn the operator the system is activated.

1.2 Applicability. This specification establishes the quantitative requirements for the park brake lever assembly. This document must only be used when invoked by a program technical specification (i.e., CG1229). References to the program technical specification are included in this document where program-specific requirements are expected to exist.

Note: The program technical specification may include additional program requirements that are not referenced in this document and may supercede any requirements included in this document. In the case of any conflicts between this document and the program technical specification, the program technical specification takes precedence.

These requirements shall be applicable to the vehicle parameters defined in the program technical specification

1.3 Remarks. See CG1229 for particular content of the park brake lever assembly.

The specification applies to the design of the park brake lever assembly comprised of the following content:

- Park brake lever (hand, foot apply) for left hand drive and right hand drive vehicles.
- Complete housings.
- Mounting to vehicle provisions.
- Manual release provision, including release cable and handle, if applicable.
- Internal mechanisms, including self-adjust mechanism, if applicable.
- Lever arm proposal, including close-out boot, hand grip, and pedal pad, if applicable.
- Wiring/connector location.
- Pull pin for self-adjust feature, if applicable.
- Pull pin that holds full release position, if applicable.

2 References

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

2.1 External Standards/Specifications.

ISO 2320

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2.2 GM Standards/Specifications.

GMW3044	GMW8518	GMW14558	GMW14937
GMW3059	GMW14089	GMW14573	GMW15272
GMW3172	GMW14264	GMW14668	GMW15347
GMW3359	GMW14376	GMW14688	
GMW4700	GMW14444	GMW14797	

2.3 Additional References.

- CG1229 Program Technical Specification
- GM Automotive Foot Control Design Objectives (ID)
<https://documents.gm.com/gdm3/drl/objectId/090163bc82f5e2a1/chronicleId/090163bc82f5e2a1>
- GM Best Practices (<https://e2ks.gm.com/e2ks/>) The supplier shall work with the GM responsible engineer to comprehend these requirements:
 - Brakes 131
 - Brakes 132
 - Brakes 139
 - Brakes 177
 - ELEC86-S5125 (Chassis Driver Interface and Brake System)
- Labels, Literature & Vehicle Identification Number (VIN) (LLV) website (ID)
(<https://gmweb.gm.com/sites/toolkit/48Inl/Pages/Home-Page.aspx>)
- Targets for Excellence Standard (ID)
- Vehicle Technical Specification (VTS)

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM lead engineer for further instructions.

3 Requirements

3.1 System/Subsystem/Component/Part Definition. The park brake lever assembly transforms handle or foot lever force and travel into a cable system which is attached to the rear foundation brake subsystem. The park brake mechanically maintains the force and travel input to the foundation brake system until released by the driver. The park brake mechanism activates a switch that provides an electrical signal that is used to make the operator aware of the system's activation.

3.1.1 Appearance.

3.1.1.1 Corrosion. No corrosion is allowed on any visible part at any time during the life of the vehicle.

3.1.1.2 Interior Harmony. The handle or foot lever trim material, grain, and color shall be coordinated with interior styling. See CG1229.

3.1.2 Content.

3.1.2.1 Physical Content. The park brake lever assembly includes the apply lever (hand or foot), electrical switch, front cable (if part of assembly, including a sealing grommet to provide for passing through the body), and required trim. See CG1229.

3.1.2.2 Functional Content. The park brake assembly operates with the rear foundation brakes to transform lever force and travel into retarding torque. The assembly will provide a signal to the chassis electrical subsystem when the park brake is applied.

3.1.3 Ambient Environment.

3.1.3.1 Environment Definition. No component function specified in this document shall be compromised when subjected to the environmental conditions outlined in this section. Furthermore, no change is allowed in fit or form of any part of the lever assembly that is visible to the customer.

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3.1.3.2 Temperature and Humidity Range. The park brake lever assembly shall be designed to operate under the temperature and humidity ranges shown in Table 1.

The minimum temperature is the minimum temperature at which a component will be expected to operate. Temporary degradation of the component function shall be permitted, but permanent loss of function shall not result in a walk home situation.

The maximum continuous temperature is the maximum temperature a component will experience on a continuous basis and be expected to maintain design functional life. The assembly shall be able to experience 1200 h/12 000 cycles per 160 000 km of operation during continuous thermal conditions. Occupant safety shall not be compromised during continuous thermal conditions.

The maximum excursion temperature is the maximum temperature the component will experience on an infrequent basis and be expected to maintain functional life. The assembly shall be able to experience 60 h/400 cycles per 160 000 km of operation during excursion thermal conditions. Occupant safety shall not be compromised during excursion thermal conditions.

If the vehicle target life is greater than 160 000 km, the hours and cycles should be adjusted accordingly. See CG1229.

In order to indicate that the design is capable to perform as requested under extreme temperatures and humidity conditions, see 3.1.5.1 Durability Life-Cycle and GMW14376 for test details.

Table 1: Temperature and Humidity Range

Minimum Temperature	-40 °C
Maximum Continuous Temperature	80 °C
Maximum Excursion Temperature (TMAX)	85 °C
Relative Humidity Range	0% to 100%

3.1.3.3 Mechanical Vibrations. The park brake lever assembly shall encounter 24 h of mechanical vibration in released lever position along each axis, using the power spectral density shown in Appendix A, Figure A1 and Tables A1, A2, and A3.

3.1.3.4 Mechanical Shock. The park brake lever assembly shall be exposed to 40 half sine wave mechanical shocks in released lever position in the upward, rearward, and both lateral directions based on Table 2. See program-specific technical specification.

Table 2: Mechanical Shock Conditions

Component Location	Maximum G Level (Zero – to – Peak)		Total Duration (milliseconds)
	Upward, Rearward	Left, Right	
Passenger Compartment	18	9	10

3.1.3.5 Component Drop. The park brake lever assembly must withstand a 1 m drop in any direction onto concrete without degrading part function or assembly, as outlined in this document. If the component is unable to pass this test, the supplier will inform GM and support the release of handling requirements in the technical specification and plant operating procedures.

3.1.3.6 Atmospheric Pressure. The park brake lever assembly will be exposed to between 330 mmHg and 850 mmHg during operation and storage.

3.1.3.7 Shipment. Park brake lever assemblies shipped by air shall be exposed to a temperature of -50 °C and to a pressure of 127 mmHg.

3.1.3.8 Corrosion. Typically, lever assemblies are considered interior parts with high/medium visibility and must meet the cosmetic corrosion performance and validation requirements found in GMW15272.

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Independent of the design of the park brake lever assembly, the mechanism of galvanic corrosion has to be considered and must be prevented, by specific design and/or material choice.

For Zinc plated parts, GMW3044, GMW4700, and GMW3359 are applicable.

3.1.3.9 External Contaminants. All components of the park brake lever assembly must withstand prolonged exposure to brake fluid, engine oil, transmission fluid, power steering fluid, coolant/anti-freeze, windshield washer fluid, gasoline, transaxle or differential lube, air conditioning refrigerant, battery acid, water, snow, ice, salt (Sodium Chloride (NaCl) and Calcium Chloride (CaCl₂)), dirt, grit, sand, dust, ozone (O₃), steam cleaning, car wash chemicals and detergents, engine cleaners, carpet and upholstery cleaners, coffee, soft drinks, silicone spray, and assembly lubricants.

See additions or deletions to this list in CG1229.

3.1.4 Interfaces. The park brake assembly shall be designed to interface with the subsystems and components described in 3.1.4. The available packaging space will be as shown in a math file available from the GM engineering contact person. See CG1229.

3.1.4.1 Park Brake Apply Assembly to Other Subsystem Interfaces.

3.1.4.1.1 Interior. The park brake apply lever assembly will provide trim compatible with the interior styling. Hand operated levers will provide covering over the handle mechanism up to the handle trim. The requirements found in GMW14444, GMW14797, GMW14668, and GMW14688, must be met. Foot operated levers will be painted on all areas visible to the driver. The pedal pad will be compatible with the interior styling.

3.1.4.1.2 Body Structure.

3.1.4.1.2.1 Park Brake Lever Assembly Mounting. The park brake lever assembly will interface with the body, as shown in the packaging math file noted in 3.1.4. The supplier shall ensure that no spring hooks, spring wires, or irregular edges be found in the periphery of the part, such that they can catch, hook, or damage wiring, insulation, or carpeting during assembly. Mounting points shall be provided. See program technical specification.

3.1.4.1.3 Chassis Electronics and Controls.

3.1.4.1.3.1 Park Brake Switch Signal. The connector for the park brake switch shall be as specified in CG1229. The switch shall be capable of passing GMW3172. (Electrical signal and power transmission group to be involved in selection of connector). If a wiring jumper harness is required (sometimes called a pigtail), it must meet the requirements contained in the Knowledge Set ELEC86-S5125 (Chassis Driver Interface and Brake System) located in the GM Best Practice website. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.1.4.1.4 Human Factors. The driver foot size (ball of foot), heel point, hip point for male and female extremes shall be considered in the design of the brake and accelerator pedals. The pedal assembly shall comply with the requirements in the GM Automotive Foot Control Design Objectives.

3.1.5 Usage Definition. The park brake lever shall be subject to GMW14376 without failure. No component function specified in this document shall be compromised when subjected to the durability life cycling outlined in this section. Furthermore, no change is allowed in fit or form of any part of the lever assembly that is visible to the customer.

3.1.5.1 Durability Life-Cycle. Test per GMW14376. Testing must be performed such that 99% reliability is demonstrated at a confidence of 50%.

Note: The lever assembly supplier is responsible to perform this test with an entire park brake system with parts located in the actual vehicle position. Park brake components, other than the lever assembly, which are required to complete this test (rear brake, cables, rear suspension frame, etc.) will be supplied by the responsible GM engineer.

Any trim components (close-out boots, bezels, etc.) that are included with the park brake lever assembly must be mounted in the design position for the following durability cycle testing. No cracks, tears, discoloration, or other visual defects are allowed for any trim piece at the end of testing.

If there is no manual transmission option for the intended vehicle, the number of load cycles can be reduced to one (1), as opposed to the normal three (3), per GMW14376.

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3.2.1 Performance Requirements. The following performance requirements apply to the park brake lever assembly.

3.2.1.1 Disengagement. At the cable loads generated by the lever at 30% and 80% of full travel, the lever assembly must not disengage when a 3.6 kg (35.6 N) weight falling through a 90 degree arc on a 305 mm radius impact either side of the apply point of the lever arm.

The pawl-sector interface must be designed such that a tip-to-tip condition cannot result in premature release during the test outlined in this section, as well as the tests named in 3.2.2.9.1. This includes applications of the park brake lever done with the release mechanism activated until the desired holding point (see GMW14376 "Functional Robustness Test").

3.2.1.2 Lateral Lever Play. See GMW14376.

3.2.1.3 Release Button Force.

3.2.1.3.1 Park Brake Not Applied. For an unloaded lever, the force required to fully depress the release button shall be between 1.2 kg (12 N) and 1.8 kg (18 N).

3.2.1.3.2 Park Brake Applied. The force necessary to release the parking brake shall be between 1.2 kg (12 N) and 1.8 kg (18 N) at all ratchet positions, while the lever input force upon release does not exceed the force to apply the lever to that position.

3.2.1.4 Lever Ratchet Increment. The park brake system shall ratchet in a maximum of 3 degree increments of lever rotation. Push-to-release levers are allowed up to 4.5 degrees of rotation per tooth. The first tooth must be engaged prior to 30% of the total available lever rotation for foot operated park brake and maximum of 8 degrees for hand operated park brake systems.

3.2.1.5 Full Travel Range/Lever Ratio. The park brake system shall accommodate a full travel range of angular handle rotation, as specified in CG1229. Travel range is measured in degrees.

The minimum amount of total cable take-up shall be as specified in CG1229 (after losses due to assembly stiffness up to a 67 kg (675 N) lever input). If the lever assembly is self-adjusting, the lever travel required to lock the tensioning mechanism at the beginning of stroke shall not be counted towards meeting the minimum cable take-up requirement.

The minimum lever ratio attained shall be as specified in the program technical specification. Designs utilizing variable ratios shall be analyzed to determine impact on Vehicle Technical Specification (VTS) grade performance requirements.

No part produced shall deviate by more than 4% from the final travel/ratio curves.

3.2.1.6 Switch Activation. The park brake shall activate the park brake switch prior to the first ratchet position. Quiet apply (clutch) style levers shall activate the switch between 2 degrees and 8 degrees of rotation. The park brake shall not damage the switch upon return, through all tolerance conditions. The voltage drop measured before, during and at the end of the specified cycle life and at the rated amperage shall not exceed 250 mV, measured prior to the mating connector voltage drop.

3.2.1.7 Noise.

3.2.1.7.1 Noise Due To Vibration. No rattles should be heard when the unit is vibrated in released lever position from 10 Hz to 75 Hz at $\pm 2G$ in a triaxle mode in a 50 dB(A) environment.

3.2.1.7.2 Ratchet Noise. During the apply stroke, any noise made by the apply mechanism shall be as allowed in CG1229.

3.2.1.7.3 All Noises. A subjective rating of at least level 9.0 according to GMW14264, must be achieved for all noises when applying, holding, or releasing the park brake apply system (this includes, but is not limited to, ratchet noise, cable rattle, self-adjust mechanism, etc.) at any apply speed or force.

3.2.1.7.4 Squeaks and Rattles. There shall be no customer annoyance due to squeaks and rattles of brake components during vehicle testing, according to GMW8518. The final authority for the determination of whether a noise is objectionable lies with the Lead Engineer and/or the Squeak and Rattle Engineer.

3.2.1.8 Adjust Mechanism. The adjust mechanism shall provide a minimum cable slack take-up of 50 mm for hand operated park brake lever, or as specified in CG1229. The minimum/maximum tension provided shall be as specified in CG1229. If an adjuster nut is applicable, the adjuster nut must be a prevailing torque type, according to the latest ISO 2320 standard.

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