



Brake Subsystem 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. This specification establishes vehicle and brake subsystem performance requirements for the Brake Subsystem. These requirements are in addition to the requirements specified in the Vehicle Technical Specification (VTS).

1.2 Applicability. Unless otherwise noted, this specification is applicable to passenger cars, multipurpose vehicles, and light trucks.

This specification applies to the brake subsystem or subsystems described in Table 1. The table defines the brake subsystem and serves as a summary of the key vehicle and brake subsystem characteristics required for brake system analyses.

1.3 Remarks. The brake subsystem is a functional subsystem that provides smooth, safe deceleration performance during the specified driving conditions, along with stationary vehicle parking capability. The brake subsystem operation is controlled by the driver via service brake controls and emergency brake controls.

Table 1: Vehicle Configuration Chart

Vehicle Program Information	Units	Vehicle/Brake System Description
Vehicle Platform Name/Code	Not applicable	
Maximum Vehicle Speed	kilometers/hour	
Brake System Regular Production Option (RPO)	Not applicable	
Vehicle Physical Definition		
Gross Vehicle Weight Rating	kilograms	
Front Gross Axle Weight Rating (GAWR)	kilograms	
Rear Gross Axle Weight Rating	kilograms	
Lightly Loaded Vehicle Weight (LLVW)	kilograms	
Percent Front LLVW Minimum	percent	
Percent Front LLVW Maximum	percent	
Center of Gravity Height GAWR	millimeters	
Center of Gravity Height LLVW	millimeters	
Wheelbase	millimeters	
Track Width Front	millimeters	
Track Width Rear	millimeters	
Maximum Tire Static Loaded Radius Front	millimeters	
Maximum Tire Static Loaded Radius Rear	millimeters	

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Vehicle Program Information	Units	Vehicle/Brake System Description
Minimum Wheel Rim Size	inch	
Front Brake		
Wheel Bolt Quantity	number	
Wheel Bolt Diameter	millimeter	
Caliper Piston Diameter	millimeter	
Caliper Number of Pistons	number	
Rotor Outer Diameter	millimeter	
Rotor Thickness	millimeter	
Friction Material Edgecode or Type	Number or Non-Asbestos Organic (NAO)/ Low Metallic (Met)/High Performance (HP)	
Rear Brake - Disc		
Caliper Piston Diameter	millimeter	
Caliper Number of Pistons	number	
Rotor Outer Diameter	millimeter	
Rotor Thickness	millimeter	
Friction Material Edgecode or Type	Number or NAO/Low Met/HP	
Park Brake Type	Drum in Hat (DIH)/Integrated Park Brake (IPB)/ Electric Park Brake (EPB)/Motor on Caliper (MoC)/Spot	
Park Brake Friction Material Edgecode		
Park Brake Nominal Clearance	millimeter	
Rear Brake - Drum		
Rear Wheel Cylinder Diameter	millimeter	
Drum Diameter	millimeter	
Nominal Clearance Setting	millimeter	
Friction Material Edgecode or Type	Number or NAO/Low Met/HP	
Brake Pedal Module		
Type	Fixed or variable	
Pedal Ratio at Initial Stroke		
Pedal Ratio at Maximum Stroke		
Brake Apply System		
Type	Vacuum, Hydraulic, e-boost	
Supplemental Vacuum Type	Manual Vacuum Pump (MVP)/ Electric Vacuum Pump (EVP)/Not Applicable	
Booster Size/Type	inch	
Booster Type	Single or Tandem	
Master Cylinder Diameter	millimeter	
Master Cylinder Stroke	millimeter	
No Power Supplemental Assist	yes/no	
Brake Fluid Type	Department of Transportation (DOT) 3/DOT 4	

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Vehicle Program Information	Units	Vehicle/Brake System Description
Hydraulic Split Configuration	Split Diagonal or Front/Rear	
Balance Strategy	Fixed/Dynamic Rear Proportioning (DRP)/Load sensing	
Chassis Control System		
Anti-lock Braking System (ABS)	yes/no/optional	
Electronic Stability Control	yes/no/optional	
Regenerative Braking	yes/no/optional	
Park Brake Apply System		
Park Brake Apply Method	Hand/Foot/Electric	
Park Brake Cable System	Direct Pull/Conduit Reaction	

2 References

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

2.1 External Standards/Specifications.

CMVSS 135 FMVSS 135

2.2 GM Standards/Specifications.

GMW3059	GMW14916	GMW15016	GMW15860
GMW14173	GMW14924	GMW15105	GMW16352
GMW14178	GMW14974	GMW15191	GMW16377
GMW14264	GMW14975	GMW15316	GMW16417
GMW14559	GMW14976	GMW15343	
GMW14763	GMW14980	GMW15392	

2.3 Additional References.

- Auto Motor and Sport International (AMS) (European Publication) (www.ams-mag.com)
- BRAKES-117 Disc Brake Pad Life (ID)
- BRAKES-165 Brake Equilibrium Temperature Best Practice (ID)
- BRAKES-192 Brake Thermal and Lining Life Playbook Best Practice (ID)
- BRAKES-194 Brake Roughness Playbook Best Practice (ID)
- BRAKES-195 Fade and Performance Playbook Best Practices (ID)
- Component Technical Specification (CTS)
- Detroit Suburban Traffic Schedule
- File name: Endorsed_Baseline_20.40.00_Brake Sub System Integration_DFMEA.xlsm
(<https://documents.naeng.gm.com/gdm3/drl/objectId/090163bc823a50ce/chronicleId/090163bc81f9fecd>) (ID)
- Global Threaded Fastener Joint Product Quality Characteristic (PQC) Classification Template
(https://gmweb.gm.com/MANUFACTURING/me_mpmLaunch/g2kxzd/Bulletin%20Board/1029021_QD%20%20Critical%20Fastener%20Template%20by%20Commodity.pdf) (ID)
- GM 3640, GM Serviceability Design Best Practices Manual (ID)
- GM Automotive Regulation Information Database
<https://businessconnect.gm.com/sites/ARID/SitePages/Home.aspx> (ID)
- GM Squeak & Rattle (S&R) Noise Glossary (ID)
- Interface Control Documents (ICD) (<https://businessconnect.gm.com/sites/ICD/default.aspx>) (ID)

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- Labels, Literature and Vehicle Identification Number (VIN) (LL&V) website (<https://gmweb.gm.com/sites/toolkit/48Inl/Pages/Home-Page.aspx>) (ID)
- Stakeholders: 10.03.01 Engine Management
- Stakeholders: OC Noise and Vibration
- Vehicle Level Hazards, Compliance and Regulatory Mapping <https://share.gm.com/sites/SCM1/SitePages/Home.aspx> (ID)
- Vehicle Technical Specifications (VTS)

(ID) = This information is intended for internal distribution within General Motors and shall not be distributed outside the company. Contact the GM Lead Engineer for further instructions.

3 Requirements

3.1 System/Subsystem/Component/Part Definition. The brake subsystem generates and transmits braking torque to the tire/wheel system to decelerate and stop the vehicle by reacting to driver input at the brake pedal. The park brake function of the brake subsystem holds the vehicle stationary or decelerates the vehicle by reacting to driver input to the park brake apply system.

3.1.1 Appearance. Refer to applicable Component Technical Specifications (CTS) for appearance requirements.

3.1.2 Content.

3.1.2.1 Physical Content. The brake subsystem includes the front brake corner assemblies, the rear brake corner assemblies, the service brake apply system, the park brake apply system, the parking brake mechanism, the brake pedal assembly, the brake control system modulator(s), the brake hoses and pipes, vacuum hoses, the brake fluid, wheel speed sensors, electrical wiring, electrical connectors, and all brackets, fasteners, protective caps, cables, and necessary hardware.

3.1.2.2 Functional Content. The brake subsystem creates decelerating torque in response to input from the service brake apply system. The brake subsystem also provides a park brake function that is capable of decelerating the vehicle and is capable of holding the vehicle stationary. The park brake control system is separate from the service brake control system.

3.1.3 Ambient Environment. The brake subsystem will be exposed to the following environmental conditions in either customer usage or in the manufacturing and assembly process. Requirements in 3.2.1 Performance are valid for standard operating conditions, unless specified otherwise in either the requirement or the validation procedure. Under all of the operating conditions specified in this section, the brake subsystem operation shall not endanger the driver or occupants, though the performance of the vehicle may be reduced from the values specified in 3.2.1 Performance.

3.1.3.1 Temperature. The ambient temperature of the brake subsystem environment during operation and storage should range from -40 °C to 50 °C. The standard operating condition for ambient air shall be specified as -6 °C to 35 °C.

3.1.3.2 Humidity. The relative humidity range of the brake subsystem during operation and storage should range from 0% to 100%. The standard operating condition shall be specified as 25% to 95%.

3.1.3.3 Atmospheric Pressure. The atmospheric pressure of the brake subsystem environment during operation and storage should range from 330 mm-Hg and 860 mm-Hg during operation and storage. The standard operating condition shall be specified as 330 mm-Hg to 780 mm-Hg.

3.1.4 Interfaces.

3.1.4.1 Interface Control Documents (ICD). Reference Interface Control Documents (ICD) Portal: <https://businessconnect.gm.com/sites/ICD/default.aspx>.

3.1.4.2 Design Failure Mode and Effects Analysis (DFMEA). Reference Endorsed_Baseline_20.40.00_Brake Sub System Integration_DFMEA.xlsm stored in Global Document Management (GDM) system: <https://documents.naeng.gm.com/gdm3/drl/objectId/090163bc823a50ce/chronicleId/090163bc81f9fecd>.

3.1.5 Usage Definition. This paragraph defines the high percentile severe usage conditions that the vehicle may experience during its target life within its target market area as defined in the Market Segment Specification(s). The data in Table 2 assumes that the vehicle target life is 241 350 km (150 000 mi).

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Table 2: Global Usage Requirements

Function	United States		Western Europe		China		Global	
	Applications	On-Time (hours) (Valve)/(Motor)	Applications	On-Time (hours) (Valve)/(Motor)	Applications	On-Time (hours) (Valve)/(Motor)	Applications	On-Time (hours) (Valve)/(Motor)
Ignition	50 000	6000	45 000	6200	46 000	8800	50 000	8800
Service Brake (dynamic and static)	1 200 000	2500	1 400 000	1500	2 100 000	4400	2 100 000	4400
ABS	6700	3.7	6700	3.7	11 500	4.7	11 500	4.7
DRP	20 000	12.5	20 000	12.5	20 000	12.5	20 000	12.5
TCS	27 000	15	27 000	15	27 000	15	27 000	15
ESC	2500	3.5	2500	3.5	2500	3.5	2500	3.5
BA (Spike Apply)	650	0.9	650	0.9	650	0.9	650	0.9
BA (Faded Brake)	50	0.1	50	0.1	50	0.1	50	0.1
BA (Rear Brake Boost)	1000	1000	1000	1000	1000	1000	1000	1000
BA (Pre-fill)	1000	0.56	1000	0.56	1500	0.8	1500	0.8
ACC	44 000	66/12	80 000	120/21	44 000	66/12	80 000	120/21
FSR-ACC	950 000	1900/310	890 000	1200/210	1 600 000	2800/450	1 600 000	2800/450
Traffic Jam Assist	44 000	66/12	80 000	120/21	44 000	66/12	80 000	120/21
Hill Start Assist	60 000	36	60 000	36	60 000	36	60 000	36
Hill Start Assist S/S BAS3	350 000	200	350 000	200	350 000	200	350 000	200
Auto. Vehicle Hold	Refer to EPB							
Hill Descent Control	2500	7.5	2500	7.5	2500	7.5	2500	7.5
Trailer Sway Control	500	0.7	500	0.7	500	0.7	500	0.7
Brake Cleaning	20 000	5.5	20 000	5.5	20 000	5.5	20 000	5.5
EPB (dynamic)	100	0.25	100	0.25	100	0.25	100	0.25
EPB (normal)	100 000		100 000		150 000		150 000	
CPS braking	1000	1.1	1000	1.1	1000	1.1	1000	1.1

Note: ACC = Adaptive Cruise Control, BA = Brake Apply, BAS = Belt Alternator Starter, CPS = Caliper Positioning System, ESC = Electronic Stability Control, FSR-ACC = Full Speed Range – Adaptive Cruise Control, S/S = Start/Stop, TCS = Traction Control System.

3.2 Product Characteristics. The following (3.2.1) specifies the requirements for brake subsystem performance. Unless otherwise specified, these requirements shall apply to a vehicle with burnished brakes (as defined by Federal Motor Vehicle Safety Standard (FMVSS) 135/Canada Motor Vehicle Safety Standard (CMVSS) 135 or other regional standard) when operated on a level, dry, asphalt road surface at standard operating ambient conditions. These brake subsystem requirements either flow down from VTS requirements or expand the scope of the performance requirements to comprehend other brake subsystem conditioning or braking conditions. Validation per these requirements shall be performed using tires, wheels, suspension, steering, and powertrain combinations defined in 1.2 of this specification. Refer to 6.1 for brake subsystem specific definitions of terms.

3.2.1 Performance Requirements.

3.2.1.1 Government Regulations. The vehicle shall comply with all applicable regional specific regulations in which the vehicle is marketed. For regulations where self-certification testing is required, the pass margins shall be sufficient to assure that all vehicles comply. When measured performance provides pass margins < 10% supplemental compliance margin analysis and a judgment signed by the Design Release Engineer are required. The judgment letter will address each specific test stage where the pass margin is < 10%. Reference the GM Automotive Regulation Information Database to access government regulations.

3.2.1.2 Brake Balance. Reference GMW14916.

3.2.1.2.1 Vehicles with Electronic Brake Distribution (EBD). Brake balance shall transition from front-biased to rear-biased (Z-critical) when evaluated with the transmission in neutral, with the front and rear brakes in the warm burnished ramp apply condition, and with the vehicle ballasted to the LLVW, maximum percent front condition as in Table 3.

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