GM	WORLDWIDE ENGINEERING STANDARDS	General Specification	GMW15397

Brake System Proportioning Valve 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 Scope. This specification establishes the quantitative requirements for proportioning valve assemblies for General Motors (GM) vehicles. It was created to support the GM advance purchasing activity for the proportioning valve assembly and is derived from the Brake Subsystem Technical Specification (BSTS). The proportioning valve assemblies shall be applied to passenger cars and light trucks (up to 6800 kg Gross Vehicle Weight (GVW).

1.2 Mission/Theme. The brake proportioning valve, as part of the brake apply system, shall quickly, repeatedly, and efficiently convert the driver's pedal force and travel inputs into hydraulic fluid displacement and pressure. The brake apply system works in conjunction with the foundation brakes to provide the vehicle with smooth, safe deceleration, retardation and retention performance under all driving conditions, as specified in this document.

1.3 Classification. Not applicable.

2 References

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

2.1 External Standards/Specifications.

SAE J1290

2.2 GM Standards/Specifications.

GMW3059	GMW14558	GMW14872
GMW8518	GMW14590	

2.3 Additional References.

Brake Subsystem Technical Specification (BSTS)

Program technical specification

Vehicle Technical Specification (VTS)

3 Requirements

3.1 Definition. The proportioning valve proportions the rear brake pressure with respect to the front brake pressure (see Appendix B). Integral proportioning valves will be required on some applications. The incremental cost for proportioning valves should be itemized separately. Some applications may use an external proportioning valve assembly.

3.1.1 Appearance.

3.1.1.1 Color. The proportioning valve body shall be silver or gray. Any deviations shall be agreed upon by GM Engineering.

3.1.1.2 Proportioning Valve Port Marking. The ports of the proportioning valve shall be appropriately marked near the ports in accordance with the platform error-proofing requirements.

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3.1.2 Content.

3.1.2.1 Physical Content. The proportioning valve assembly includes any of the following that are necessary in the design: valve, valve body, bracket, connector, insulator, lever, retainer, spacer, springs, and tee.

3.1.2.2 Functional Content. The proportioning valve assembly, as part of the brake applies assembly, operates with the pedal assembly, brake fluid, and calipers to transform pedal pushrod force and travel into hydraulic pressure and displacement. The apply system assembly will provide a signal to the chassis electrical subsystem in the event of a primary or secondary circuit hydraulic failure in the form of a reservoir fluid level sensor.

3.1.3 Environment Definition.

3.1.3.1 Temperature and Humidity Range. The proportioning valve assembly shall be designed to operate underhood under the temperature/humidity ranges shown in Table 1.

The temperature profile listed in Table 2 shall be used for all laboratory validation unless otherwise stated.

Table 1: Temperature and Humidity Range

Proportioning Valve	
Minimum Temperature	-40 °C
Maximum Sustained Temperature (> 10 minutes)	+100 °C
Maximum Excursion Temperature (TMAX) (< 10 minutes)	+120 °C
Relative Humidity Range	(0 to 100) %

Table 2: Cycles at Temperature

Percentage of Cycles at Each Level of Pressure	Temperature in °C
82	70
5	100
1	120
10	-20
2	-40

3.1.3.2 Temperature Shock - Water Splash. The proportioning valve assembly will be exposed to five (5) temperature shocks which occur when they encounter splash from freezing level salt water solution (1 % sodium chloride by weight) for 60 s while at an operating temperature T = (TMAX -20 °C), where TMAX is the maximum excursion temperature from Table 1.

3.1.3.3 Mechanical Vibration. The booster and master cylinder and proportioning valve combined assembly shall encounter 400 h of mechanical vibration along each axis, using the power spectral density specified in the program-specific technical specification.

3.1.3.4 Mechanical Shock. The booster and master cylinder and proportioning valve combined assembly shall be exposed to 40 half sine wave mechanical shocks in the upward, rearward, and both lateral directions based on Table 3.

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Table 3: Mechanical Shock

Component Location	Maximum G Level (Zero-to-Peak)		Total Duration in ms
	Upward, Rearward	Left, Right	
Underhood	14	7	10

3.1.3.5 Component Drop. The proportioning valve assembly may experience a one meter drop in any direction onto concrete. If the component is unable to operate for its full intended life following this exposure, the supplier shall inform the platform of appropriate handling requirements.

3.1.3.6 Atmospheric Pressure. The proportioning valve assembly will be exposed to between 45 kPa and 115 kPa during operation and storage.

3.1.3.7 Shipment. Proportioning valve assemblies shipped by air shall be exposed to a temperature of -50 °C and to a pressure of 15 kPa.

3.1.3.8 Corrosion. The proportioning valve assembly will be exposed to the 95th percentile corrosive environment which occurs in the north east United States of America and south east. Canada. This environment is composed of appropriate combinations of temperature, humidity, salt, splash, dust, mud, and component usage. The proportioning valve assembly shall meet the requirements as found in GMW14872 Corrosion Resistance Specification.

3.1.3.9 External Contaminants. The proportioning valve 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 (A/C) refrigerant, battery acid, water, snow, ice, salt (NaCl and $CaCl_2$), dirt, grit, sand, dust, Ozone (O_3), steam cleaning, car wash chemicals and detergents, and engine cleaners.

3.1.3.10 Internal Contaminants. The proportioning valve assembly must withstand brake fluid contaminants which include water (up to 10% by weight) and assembly lubricants. The supplier shall provide the platform with a report showing the proportioning valve assembly's robustness to solid contaminant. Included in this report will be data supporting susceptibility to failure of different sizes, shapes, and material composition of solid contaminant as introduced in the manufacturing, use, and servicing of the assembly.

3.1.4 Interfaces. The proportioning valve assemblies shall be designed to interface with the subsystems and components described in the following paragraphs and shown in Figure A1.

3.1.4.1 Proportioning Valve Assembly to Other Subsystem Interfaces.

3.1.4.1.1 Chassis Electronics and Controls.

3.1.4.1.1.1 Electrical Grounding. The proportioning valve components shall not be used for electrical ground paths.

3.1.4.2 Brake System Assemblies.

3.1.4.2.1 Brake Pipes. The proportioning valve assembly shall be designed to have fluid outlets located on the outboard side for both left and right hand drive. See the program-specific technical specification for pipe and fitting specifics. The recommended installation torque shall exceed the +3 sigma torque to seal by 50 %. The -3 sigma torque to fail must exceed the recommended installation torque by 50 %. The values for +3 sigma torque to seal, -3 sigma torque to fail, and recommended installation torque shall be determined and reported by the supplier to the platform. Production intent brake pipe double inverted flare tube nuts or equivalent shall be required.

3.1.4.2.2 Brake Fluid. The proportioning valve shall be compatible with DOT 3, DOT 4, and DOT 5 brake fluid.

3.1.4.2.3 ABS/TCS/ESC Interface. The proportioning valve shall be compatible with the antilock brake system, traction control system, and electronic stability control system (ABS/TCS/ESC) hydraulic modulator and the associated control system. The ABS/TCS/ESC usage is defined in paragraphs 3.1.5.3 thru 3.1.5.5.

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3.1.4.2.4 Primary Brake Circuit Compliance. The nominal total primary circuit compliance curve (including ABS/TCS/ESC) shall be provided by the platform for each application. This compliance shall be used for all proportioning valve performance testing and fluid displacement calculations except where specified otherwise. See program technical specification.

3.1.4.2.5 Secondary Brake Circuit Compliance. The nominal total secondary circuit compliance curve (including ABS/TCS/ESC) shall be provided by the platform for each application. This compliance shall be used for all proportioning valve performance testing and fluid displacement calculations except where specified otherwise. See program technical specification.

3.1.5 Usage Definition. The passenger car customer usage data given in this section are for high levels of usage in 161 000 km of United States of America (USA) retail customer driving. The truck customer usage data given in this section are for high levels of usage in 241 400 km of USA retail customer driving. Note that low levels of usage may be more appropriate for certain failure mechanisms, such as corrosion. See program technical specification.

3.1.5.1 Line Pressure Distribution.

3.1.5.1.1 Passenger Car Pressure Distribution. The proportioning valve pressure distribution will be generated by the platform for each individual application. The total number of applications for the life validation is 767 000. Table A1 shows a typical passenger car pressure distribution. See program technical specification.

3.1.5.1.2 Truck Pressure Distribution. The proportioning valve pressure distribution will be generated by the platform for each individual application. The total number of applications for the life validation is defined in the program technical specification. See program technical specification.

3.1.5.2 Antilock Brake System Applications. The ABS will be activated up to 10 000 cycles for passenger cars and 27 000 cycles for truck applications. Each cycle represents an entire ABS operation. See paragraphs 3.1.5.1.1 and 3.1.5.1.2 for ABS cycle pressure distributions.

3.1.5.3 Traction Control System Applications. The TCS unit will expose the proportioning valve and master cylinder to up to 30 000 TCS cycles where each cycle represents an entire TCS operation.

3.1.5.3.1 TCS Transition to Base Brake Application. The usage in Table 4 represents the interruption of a TCS operation with a non-ABS brake application. The effect of this usage is to short stroke the master cylinder which may have a detrimental effect on seal durability. This characteristic is due to a delay in opening the master cylinder isolation valve; this valve must open before fluid is allowed to flow from the master cylinder to the brakes.

Table 4: TCS to Base Brake Pressure Profile

Pressure in MPa	Number of Cycles
1.0	5000
5.0	450
10.0	50

3.1.5.3.2 TCS Transition to ABS Brake Application. This usage represents the interruption of a TCS operation with an ABS brake application. The effect of this usage is that excess fluid from the foundation brakes must be returned to the master cylinder reservoir. The master cylinder valve(s) and proportioning valve assembly shall withstand openings at the pressures listed in Table 5. There shall be no damage after the pressure cycling tests.

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