



SURFACE VEHICLE RECOMMENDED PRACTICE

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Remanufactured Hydraulic Master Cylinder for Motor Vehicle Brakes - Performance Requirements

RATIONALE

This document has been determined to contain basic and stable technology, however it does not specifically represent the current state of the art design of tandem master cylinders for passenger vehicles and light trucks. Although this Recommended Practice is not directly applicable to many current master cylinder designs, it does incorporate procedures and requirements that can be appropriate and beneficial. Many aspects of these can be applied to designs of the same or similar concept including aluminum body as well as more current state of the art designs.

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1. **Scope**—This SAE Recommended Practice defines minimum requirements for general characteristics, performance, and durability. It is applicable to remanufactured assemblies (factory rebuild) only. This document applies to master cylinder assemblies and components of current established designs but does not cover fluid level sensors, integral proportioning valves, or those master cylinders used in anti-lock brake or traction control systems. These will be covered by other standards.

The general characteristics and test procedure are specified in SAE J1693.

- 1.1 **Type**—This document applies to remanufactured (factory rebuild) single and dual output master cylinders used in hydraulically operated brake systems highway vehicles. It covers such cylinders where they are employed in passenger car, truck, bus, and like brake systems utilizing motor vehicle brake fluids. Refer to SAE J1154 for the standard applicable to new assemblies from commercial production.

2. References

- 2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

- 2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1154—Hydraulic Master Cylinders for Motor Vehicle Brakes—Performance Requirements

SAE J1693—Remanufactured Hydraulic Motor Cylinder for Motor Vehicle Brakes—General Characteristics and Test Procedure

3. **Requirements**—A master cylinder assembly shall, when tested in accordance with the procedures of SAE J1693, meet the following requirements:

- 3.1 **Unrestricted Apply and Release**—Per procedure 6.1, the piston(s) must move smoothly throughout full design stroke after starting, and must be completely returned to its original position(s) on the fifth stroke within 5 s by the force of the return springs.

3.2 Venting

NOTE—Venting is the communication of reservoir pressure to the bore(s) and outlet(s) of the master cylinder by means of opening the vent port communication between the master cylinder bore(s) and reservoir(s).

- 3.2.1 Per procedure 6.2.1, the cylinder bore(s) shall be vented to the reservoir(s).
- 3.2.2 Per procedure 6.2.2, the cylinder bore(s) shall not be vented to the reservoir(s).

3.3 Residual Pressure Valve

NOTE—The requirements of 3.3 are applicable only to master cylinders which contain a residual check valve(s).

- 3.3.1 Per procedure 6.3.1, air shall flow through outlet port(s).
- 3.3.2 Per procedure 6.3.2, air at pressure below manufacturer's minimum residual valve specification shall not flow through outlet port(s) into reservoir(s), and above manufacturer's maximum specification air shall flow through outlet port(s) into reservoir(s).

3.4 Applied Leakage

- 3.4.1 Per procedure 6.4.1, the reservoir pressure measuring device(s) shall not exceed 7 kPa (1.0 psi) increase above atmospheric after $30 \text{ s} \pm 1 \text{ s}$ interval.
- 3.4.2 Per procedure 6.4.3, there shall be no drop in pressure in excess of 7 kPa (1.0 psi) after $30 \text{ s} \pm 1 \text{ s}$ interval.
- 3.4.3 Per procedure 6.4.4, there shall be no drop in pressure in excess of 345 kPa (50.0 psi) after $30 \text{ s} \pm 1 \text{ s}$ interval.

3.5 Fluid Displacement—Per procedure 6.5, the average fluid volume discharge at the outlet port(s) per stroke shall be as indicated by design specifications.

3.6 Replenishing

NOTE—Replenishing is the pumping of fluid from the reservoir(s) on successive strokes of the piston(s) through the replenishing port(s) and the bore(s) to the outlet(s).

- 3.6.1 Per procedure 6.6, the difference in fluid volume discharge at the outlet port(s) for any application shall not vary greater than 5% from the average calculate in 6.5.
- 3.7 Physical Strength**—Per procedure 6.7, the pressure measuring device(s) shall show no abrupt decline in pressure and the cylinder shall show no sign of leakage or structural fracture.

3.8 High Temperature Durability

- 3.8.1 Per procedure 6.8.1, the cylinder shall vent.
- 3.8.2 Per procedure 6.8.2, the leakage shall not exceed five drops total.
- 3.8.3 Per procedure 6.8.3, see requirements 3.4.2.
- 3.8.4 Per procedure 6.8.4, see requirements 3.4.3.

3.9 Static Leakage

- 3.9.1 Per procedure 6.9.1, leakage shall not exceed five drops total.
- 3.9.2 Per procedure 6.9.2, leakage shall not exceed five drops total.

3.10 Cold Temperature Operation

- 3.10.1 Per procedure 6.10.1, the cylinder shall vent.
- 3.10.2 Per procedure 6.10.2, leakage shall not exceed five drops total.
- 3.10.3 Per procedure 6.10.3, see requirements 3.1 except allow 30 s maximum time.
- 3.10.4 Per procedure 6.10.4, see requirements 3.4.2.
- 3.10.5 Per procedure 6.10.5, see requirements 3.4.3.

3.11 Storage Corrosion Resistance

- 3.11.1 Per procedure 6.11.1, leakage at entrance to bore(s) shall not exceed five drops total.
- 3.11.2 Per procedure 6.11.2, piston(s) must start to move at 222 N (50.0 lb) maximum force.
- 3.11.3 Per procedure 6.11.3, see requirements 3.1.
- 3.11.4 Per procedure 6.11.4, see requirements 3.4.2.
- 3.11.5 Per procedure 6.11.5, see requirements 3.4.3.

3.12 Reservoir Capacity—Per procedure 6.12, the fluid volume(s) required to fill the reservoir(s) shall be not less than the design specification for reservoir fluid capacities.

NOTE—This procedure is required only if consolidation creates different reservoir capacities.

3.13 Reservoir Fluid Depletion—Per procedure 6.13, the master cylinder usable fluid of the reservoir(s) shall not be depleted. On master cylinders incorporating a cover diaphragm(s), the convolutions shall be distended.

3.14 Push Rod Retention—Per procedure 6.14, the push rod shall remain intact in the piston or master cylinder (when applicable).

3.15 Examination

- 3.15.1 Per procedure 6.15.1, master cylinders up to and including 51 mm (2.0 in) bore diameter shall have 2.03 mm (0.080 in) minimum diameter at the smallest opening of hydraulic outlet(s).
- 3.15.2 Because these specifications spell out only minimum requirements, none are specified for procedure 6.15.2.

3.16 Cleanliness

- 3.16.1 Per procedure 3.9.7, foreign material (contaminants) are classified as particles not soluble in brake fluid such as metal, plastic, rubber, sand, fibers, etc.
- 3.16.2 Per procedure 3.9.7, the maximum foreign material weight shall not exceed 15 mg.
- 3.16.3 Per procedure 3.9.7, the maximum foreign material particle size shall not exceed the corresponding dimensions as shown in Table 1: