

	SURFACE VEHICLE RECOMMENDED PRACTICE	
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Remanufactured Hydraulic Master Cylinder for Motor Vehicle Brakes - General Characteristics and Test Procedure		

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.

Figure 3 represents the typical cast iron master cylinder for which this standard was developed. Equivalent designs, regardless of materials utilized, could employ portions of this Recommended Practice to evaluate remanufactured products.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Hydraulic Brake Components Standards Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. **Scope**—This SAE Recommended Practice specifies the general characteristics and test procedure to define the minimum characteristics, performance, and durability requirements. 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 minimum characteristics, performance, and durability requirements are specified in SAE J1694.

- 1.1 **Type**—This document applies to remanufactured (factory rebuild) dual and single master cylinders used in hydraulically operated brake systems of highway vehicles. It covers cylinders used in passenger car, truck, bus, and similar vehicles utilizing motor vehicle brake systems. Refer to SAE J1153 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 J1153—Hydraulic Master Cylinders for Motor Vehicle Brakes—Test Procedure

SAE J1601—Rubber Cups for Hydraulic Actuating Cylinders

SAE J1694—Remanufactured Hydraulic Master Cylinder for Motor Vehicle Brakes—Performance Requirements

- 2.1.2 FMVSS PUBLICATION—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9371.

FMVSS 116

3. General Characteristics

3.1 Elastomeric Components

NOTE—SAE J1601 may be utilized in conjunction with this document as it relates to cups.

3.1.1 All elastomeric seal components must be new and compatible with the appropriate brake fluid at the temperatures defined in this specification. Cover diaphragms, reservoir grommets, and reservoir connection hoses may be reused if they are in good condition, appropriately cleaned and meet the requirements of this document.

3.1.2 All elastomeric seals and components shall duplicate the intended function of the original equipment equivalent (e.g., replacing an "O"-ring with a lip type seal may not totally duplicate the intended function in actual operation).

3.2 Bore Finish/Diameter and Vent Hole Diameter

3.2.1 The surface finish of the bore and diametral bore to piston clearance with appropriate seals (e.g., oversize, special design, etc.) shall meet all requirements of this document. Special reference to the test procedure sections for apply/release, leakage, replenishing, physical strength, high-temperature durability, and cold-temperature operation is necessary.

3.2.2 The cylinder bore shall be free of imperfections which would impair the function on the vehicle as evidenced by the durability and cold-temperature operation is necessary.

3.3 **Vent Port(s)**—The diameter of the vent port(s) shall be such that the durability requirements will be met with the seals selected for the application. Vent port(s) can be cleaned by other than a metal tool or carefully blown out.

3.4 **Structural or Surface Impairment**—All components metal, plastic, or elastomeric must be free of structural or surface damage which would impair the function, durability, or safety of the unit in field service. Consideration of heat, pressure, vibration, cold, etc., as well as normal field power (pressure) bleeding must be taken into consideration. Components such as reservoirs with cracks, pistons with corrosion voids in contact with seals, etc., must be reviewed and meet the requirements of this test procedure.

3.5 Production Leakage and Function Test

3.5.1 All units must meet a 100% production leakage test prior to shipment. The production test shall include tests for static leakage as well as leakage during movement of the piston(s) through full stroke, function, venting, and reservoir to master cylinder body seal if applicable (e.g., composite).

3.5.2 Upon successfully meeting the 100% production test requirements, the unit must be identified clearly in a readily seen location with the word REMANUFACTURED (or appropriate abbreviation) using brake fluid resistant marking.

3.5.3 It is recommended that a date code and remanufacturer identification also be included. These can be permanently marked on the master cylinder to show it has satisfactorily met the 100% production leakage and function test requirements.

3.6 **Shipping Protection**—Shipping protection shall be installed following the 100% production test to prevent foreign debris not compatible with or soluble in brake fluid from entering any openings such as outlet port(s) of the master cylinder. Reservoir port(s) or reservoir(s) for those units shipped without reservoir cover(s) must also be protected.

3.7 Consolidation of Assemblies or Components

- 3.7.1 Consolidation of master cylinder assemblies or components shall be done in such a manner as to assure the functional properties of the unit shall meet the original requirements. This includes but is not limited to piston displacement, reservoir volume, mounting interface dimensions, etc.
- 3.7.2 Outlet/brake tube adapters are acceptable so long as they provide adequate sealing, correct interface, and brake tube clearance from surrounding components.

3.8 Test Timing

- 3.8.1 The tests outlined in this procedure are required to qualify basic components, suppliers, and manufacturing processes to assure total product qualification. Where there is a range of dimensions, tolerances, or materials, the extreme limits must be tested to qualify the total product under all intermediate conditions.
- 3.8.2 Some or all of these tests will be required to be conducted periodically to qualify new or assure continued qualification of current components, suppliers, and manufacturing processes.

- 3.9 **Cleanliness**—Production remanufactured assemblies shall be tested per the following to assure the processes are sufficient to meet the internal cleanliness requirements before shipment.

Sample size and frequency shall be a minimum of one sample of each type (closed reservoir, open reservoir, composite, etc.) selected each day for the cleanliness procedure. If one of the samples fails the acceptance requirements, two more shall be selected from the same production lot. If either of these two fail to meet the acceptance requirements, that production lot shall be rejected and evaluated for rewash. The following procedure is to be used:

- 3.9.1 Clean the outside of the master cylinder with clean isopropyl alcohol and dispose of the alcohol.
- 3.9.2 Disassemble the master cylinder.

NOTE—The reservoir of a composite assembly should not be disassembled from the cylinder body unless necessary to disassemble the cylinder components.
- 3.9.3 Wash the bore and reservoir with clean isopropyl alcohol which has been filtered through a 5 μm filter. All alcohol is to be collected in a clean container.
- 3.9.4 Wash each individual part in clean alcohol.
- 3.9.5 Thoroughly wash a 5 μm filter with isopropyl alcohol. Bake the filter at $90\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ ($194\text{ }^{\circ}\text{F} \pm 18\text{ }^{\circ}\text{F}$) for a minimum of 10 min.
- 3.9.6 Filter alcohol used in steps 3.9.3 and 3.9.4 through the filter prepared in 3.9.5.
- 3.9.7 Dry the filter in a draft-free heat chamber. Weigh the foreign particles and examine the filter residue.

- 4. **Test Apparatus**—The basic apparatus shall be that shown and arranged in Figure 1 or equivalent. All hydraulic lines and fittings shall be of sufficient size as to permit unrestricted flow to and from test master cylinder(s). The apparatus shall operate per the following description and as called for in Section 6. It is desirable to have the test apparatus portable to facilitate cold, hot, and room temperature bench testing.