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**Performance requirements and bench test methods of motor
vehicle brake master cylinder**

汽车液压制动主缸性能要求及台架试验方法

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Performance requirements and bench test methods of motor vehicle brake master cylinder

1 Scope

1.1 This standard specifies the terms and definitions, product classifications, performance requirements, test devices, test methods of automobile hydraulic brake master cylinder assemblies.

1.2 This standard is applicable to the tandem double-cavity hydraulic brake master cylinder assembly for automobiles (hereinafter referred to as "brake master cylinder"). Other types of brake master cylinders can make reference to this standard.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 10125-2012 Corrosion tests in artificial atmospheres - Salt spray tests

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Fluid supply cavity

A cavity, which communicates with the reservoir, through the fluid supply hole (see Figure 1, Figure 2). The brake fluid is supplied to the brake service cavity, at the moment when the brake is released.

3.2

Brake service cavity

A cavity, which communicates with the brake circuit, through a drain hole or residual valve (see Figure 1, Figure 2). The hydraulic pressure, which is built up in the brake service cavity, during braking, is the same as the hydraulic pressure in the circuit, to which it is connected.

5.9 Pressure shock

After the pressure shock test, the brake master cylinder shall be free from deformation and damage, which affect the function. When the test pressure is the maximum working hydraulic pressure of the brake master cylinder, the tightness shall meet the requirements of Table 2. If the brake master cylinder has its own storage tank, after the pressure shock test, no brake fluid shall escape from the reservoir.

5.10 Compressive strength

After the pressure test, the brake master cylinder shall be free from abnormal phenomena, such as deformation and leakage; its hydraulic tightness shall meet the requirements of 5.2.3.

5.11 Working durability

During the test, there shall be no leakage or any abnormality in the brake master cylinder; the piston shall be flexible. After the test, the hydraulic tightness shall meet the requirements of 5.2.3. If it is equipped with the reservoir, then during the working durability test, there shall be no brake fluid overflowing from the reservoir. After the test, the connection between the reservoir and the brake master cylinder shall not be loose.

5.12 Vibration performance

5.12.1 During the vibration performance test, there shall be no brake fluid overflowing from the reservoir. After the test, the connection between the reservoir and the brake master cylinder shall not be loose. There shall be no deformation or damage, which may affect the function.

5.12.2 Compared with before the test, the residual tightening torque shall be greater than 50%.

5.13 Salt spray corrosion resistance

After the salt spray corrosion resistance test, the brake master cylinder shall meet the requirements of Table 3.

6 Test device

6.1 Test device of brake master cylinder

6.1.1 Drive

The push rod head of the drive device shall be consistent with the size and specification of the push rod head of the real vehicle sample. The initial included angle, between the push rod and the axis of the brake master cylinder, shall not be greater than 2° . The drive device can push the piston of the sample once and periodically. The piston of the sample can move to the maximum stroke position. The pushing distance can be adjusted and can be fixed at any position. The rate of sample's pressure-building, during pushing, can be adjusted. When the piston of the sample is pushed once, the maximum working hydraulic pressure of the sample, 130% of the maximum working hydraulic pressure, can be established, in the brake service cavity of the sample, which can ensure that the piston of the sample can return quickly, without other restrictions in different pushing positions. When pushing the piston of the sample periodically, the pushing frequency, pressure increasing time, pressure holding time, pressure reducing time, pause time, etc. can be adjusted.

6.1.2 Load device

The load device can simulate the working state of the hydraulic brake wheel cylinder in the brake. The relationship, between the loading pressure and the sample stroke, can be adjusted as required. The movable parts in the load device can be locked as required.

6.1.3 Measuring device

6.1.3.1 The effective measurement values of instruments or meters, which are used to measure pressure, shift, displacement, flow, moment, length, shall be greater than the values to be measured. The relative error of measurement shall not exceed $\pm 1\%$. However, it may use the level 1.5 pressure gauge, to monitor the pressure value of the working durability test.

6.1.3.2 The relative error of the time measuring instrument, to measure the return time of the sample without load, shall not exceed $\pm 5\%$.

6.1.3.3 When measuring the initial pressure-building travel, output function, no-load return time, hydraulic tightness, differential pressure performance, the total effective volume of the test circuit is 135 ~ 150 mL.

8.1.2 Connect the drain hole of the sample to the gas source. Gradually introduce gas, which has a pressure of not more than 0.15 MPa, into the drain hole. Record the lowest gas pressure, which is input to the drain hole, when gas flows out of the compensating hole (residual pressure of residual valve).

8.2 Tightness

8.2.1 Vacuum tightness

8.2.1.1 Close the sample's liquid drain hole. Connect the two fluid supply holes, to the vacuum source (if the sample comes with a reservoir, the vacuum source is directly connected to the liquid filling port of the reservoir).

8.2.1.2 Vacuum the system to the absolute pressure (250 ± 50) Pa (or the pressure agreed by the supplier and the buyer). Then cut off the vacuum source. Immediately record the pressure rise value in the test system, within 5 s after that.

8.2.2 Air tightness

8.2.2.1 Connect the sample and drive to the test circuit.

8.2.2.2 Use the push rod of the drive device, to push the piston of the sample beyond the initial pressure-building travel of the sample.

8.2.2.3 Connect the drain hole of the sample to the gas source. Adjust the gas source pressure to (50 ± 2) kPa. Then cut off the gas source.

8.2.2.4 After stabilizing for 3 ~ 5 s, measure the pressure drop of each brake service cavity of the sample, within 10 s after that.

8.2.2.5 The push rod of the drive device returns to its original position.

8.2.2.6 Block the liquid drain hole of the sample. Connect the fluid supply hole to the gas source. If the sample has its own reservoir, the gas source is connected to the liquid filling port of the reservoir.

8.2.2.7 Adjust the air source pressure to (0.5 ± 0.05) MPa. Keep it for 10 s. Observe whether the sample and the built-in reservoir have air leakage; whether the reservoir has deformation that affects the function.

8.2.3 Hydraulic tightness

8.2.3.1 Connect the sample, load device, pressure measurement device to the test circuit.

8.2.3.2 Use a threaded connector or a real vehicle connector, which matches the sample's drain hole, to connect to the sample's drain hole. When the torque increases, the tightening speed is about 3 r/min; the tightening torque is the lower limit of the design value (or the tightening torque mutually agreed between the supplier and the

hole, during this process. This process is one measurement cycle. Totally 3 cycles of measurements are made. The time interval between the two measurement cycles is 10 s.

8.5.4 Record the displacement of each cavity in 3 cycles. Take the average value of the measured values of the 3 cycles, as the measured value of each cavity displacement of the sample.

8.6 No-load return time

8.6.1 Connect the sample, the drive device, the load device, the time measuring instrument to the test circuit.

8.6.2 Fill the sample and load device with brake fluid.

8.6.3 After pushing the sample's piston to the maximum stroke position (no pressure build-up), close the sample's drain hole.

8.6.4 Quickly withdraw the thrust of the push rod. Record the time, for the first piston of the sample to fully return to its original position, without other restrictions.

8.7 Differential pressure performance

8.7.1 Differential pressure at slow pressurization

8.7.1.1 Connect the sample, load device, pressure measurement device to the test circuit.

8.7.1.2 Push the piston of the sample, at a speed of (3 ± 1) mm/s, to build up a pressure of slightly more than 4 MPa, in the brake service cavity of the sample. Measure and record the pressure difference between the two brake service cavities, when the pressure of one of the two brake service cavities reaches 4 MPa.

8.7.2 Differential pressure at quick pressurization

8.7.2.1 Connect the sample, the load device, the pressure measuring device to the test circuit.

8.7.2.2 At a pressure-building rate of (20 ± 5) MPa/s, establish a pressure of slightly more than 13 MPa, in the brake service cavity of the sample. Measure and record the pressure difference between the two brake service cavities, when the pressure of one of the two brake service cavities reaches 13 MPa.

8.8 Flow

8.8.1 Connect the sample, which has its own reservoir, to the test circuit. The installation height of the external reservoir is configured, according to the actual vehicle.

8.8.2 Connect one drain hole of the sample to the flow measuring device. Block the

other drain hole (or switch it with a reversing valve), as shown in Figure 5.

8.8.3 The inner diameter of each connecting oil pipe shall not be smaller than the inner diameter of the brake master cylinder's drain hole. The brake fluid in the reservoir shall be replenished in time.

8.8.4 Adjust the speed of the hydraulic pump. When the pressure difference, between the sample's brake service cavity and the oil pipe outside the drain hole, reaches 2 kPa, keep the speed of the hydraulic pump stable. Then record the maximum flow value at this time.

8.8.5 Replace the other drain hole. Repeat 8.8.2 ~ 8.8.4.

8.9 Pressure shock

8.9.1 Connect the sample, the load device, the pressure measuring device to the test circuit.

8.9.2 Carry out the test, under the following test conditions:

- a) The stroke of the first piston is 70% ~ 90% of the maximum stroke of the sample;
- b) The test pressure is 130% of the maximum working hydraulic pressure; the deviation does not exceed ± 1.0 MPa;
- c) The pressure-building rate is (20 ± 5) MPa/s;
- d) The pressure holding time is 1 s;
- e) The test frequency is (0.2778 ± 0.0278) Hz;
- f) The number of tests is 1000.

8.9.3 After the test, check whether the sample has deformation or damage, which may affect the function. If the sample has its own reservoir, observe whether the brake fluid overflows from the reservoir.

8.9.4 Carry out the hydraulic tightness test, according to 8.2.3.

8.10 Compressive strength

8.10.1 Connect the sample to the measuring device.

8.10.2 Block the drain hole. Push the first piston, to make the hydraulic pressure of the brake service cavity reach twice the maximum working hydraulic pressure, within 10 ~ 30 s. Release it to the initial state, after maintaining the pressure for 5 s.

8.10.3 Record pressure changes and states.

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