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Performance requirements and bench test methods for hydraulic brake caliper assembly

液压制动钳总成性能要求及台架试验方法

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Performance requirements and bench test methods for hydraulic brake caliper assembly

1 Scope

This standard specifies the terms and definitions, performance requirements, test methods for the bench test of hydraulic brake caliper assemblies for automobile service brakes.

This standard applies to the hydraulic brake caliper assembly, for the service brakes of category M and category N vehicle, whose maximum design total mass as specified in GB/T 15089 is less than 3500 kg. Other categories of hydraulic brake calipers may 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 10125-1997 Corrosion tests in artificial atmospheres - Salt spray tests

GB/T 15089 Classification of power-driven vehicles and trailers

QC/T 316 Bench test methods of fatigue strength for automobile service brake

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Required fluid amount

The amount of brake fluid, which is injected to maintain the specified hydraulic pressure, in the brake caliper.

Note: The unit of required fluid amount is mL.

4.1.2 Low-pressure tightness. Carry out the test, according to 5.1.2. The pressure drop shall not be greater than 0.34 kPa.

4.1.3 High-pressure tightness. Carry out the test, according to 5.1.3. The pressure drop shall not be greater than 0.2 MPa.

4.1.4 Bleed screw tightness. Carry out the test, according to 5.1.4. There shall be no liquid leakage, at the bleed screw.

4.1.5 The tightness of the oil pipe's connection thread. Carry out the test, in accordance with 5.1.5. There shall be no liquid leakage, at the bolted connection.

4.2 Required fluid amount

Carry out the test, according to 5.2. The required fluid amount of the new brake pads (with spacers) and metal brake pads of equivalent thickness (without spacers) shall meet the requirements of product technical conditions.

4.3 Drag torque

Carry out the test, according to 5.3. The maximum value of the drag torque, during the first rotation of the brake disc, shall not be greater than 5 N • m; the maximum value, during the 10^{th} rotation, shall not be greater than 3.5 N • m.

4.4 Caliper rigidity

Carry out the test, according to 5.4. The deformation of the caliper, along the axis of the hydraulic cylinder, shall not be greater than 0.2 mm, OR meet the requirements of product technical documents.

4.5 Piston return

Carry out the test, according to 5.5. The return amount of the piston shall not be greater than 0.6 mm, OR meet the requirements of product technical documents.

4.6 Piston sliding resistance

Carry out the test, according to 5.6. The piston sliding resistance shall be in the range of 70 N ~ 700 N, OR meet the requirements of product technical documents.

4.7 Piston actuation pressure

Carry out the test, according to 5.7. The input pressure, when the piston starts to move, shall not be greater than 0.10 MPa, OR meet the requirements of product technical documents.

4.8 Caliper sliding resistance

Carry out the test, according to 5.8. The caliper sliding resistance of the floating brake caliper shall not be greater than 100 N, OR meet the requirements of the product technical documents.

4.9 Strength

4.9.1 Torsional fatigue strength. After the test according to 5.9.1, the brake caliper assembly shall not be deformed or damaged, which affects the performance; there shall be no hydraulic leakage, during the whole test.

4.9.2 Compressive breaking strength. Carry out the test, according to 5.9.2. The brake caliper assembly shall be free from leakage, cracks, damage.

4.10 Durability

4.10.1 High-pressure durability.

4.10.1.1 After the test in accordance with 5.10.1, the parts shall not be deformed or damaged, which affect the performance.

4.10.1.2 The low-pressure tightness and high-pressure tightness, after the test, shall meet the requirements of 4.1.2 and 4.1.3, respectively.

4.10.2 Working durability.

4.10.2.1 After the test is carried out, according to 5.10.2, it allows wear on the piston, sealing ring, inner wall of the cylinder bore; BUT there shall be no damage, that affects the performance.

4.10.2.2 The low-pressure tightness and high-pressure tightness, after the test, shall meet the requirements of 4.1.2 and 4.1.3, respectively.

4.10.3 Vibration durability.

After the test according to 5.10.3, the brake caliper assembly shall not have damages, such as damage, cracking, falling off parts, shearing, that affect the performance. The tightening torque's drop value of threaded parts shall not be greater than 30% of the lower limit of the torque, which is specified in the product technical documents; there shall be no leakage, throughout the test.

4.11 Waterproof performance

After the test according to 5.11, there shall be no water intrusion in the cylinder block and inside the guide pin's dust cover.

4.12 Corrosion resistance

Carry out the test, according to 5.12. The brake caliper assembly shall meet the

5.2.4 Pressurize to 16 MPa or the pressure specified in the product technical documents, for the 5th time. Close the global valve. Open the liquid volume control valve. After the liquid level of the liquid volume pipe is stable, record the liquid level height of the liquid volume pipe, which is the required fluid amount by the system, V_0.

5.2.5 Remove the solid metal joint. Connect the brake caliper assembly to the brake oil pipe. Drain the air in the system. Open the fluid volume control valve. Adjust the liquid level of the fluid volume pipe to zero. Close the fluid volume control valve.

5.2.6 Repeat operations 5.2.3 and 5.2.4. Record the required fluid amount, V_1, of the system including the brake caliper assembly.

5.2.7 The value, which is obtained by subtracting V_0 from V_1, is the required fluid amount of the brake caliper assembly.

5.3 Drag torque

5.3.1 Use a lint-free cloth and a solvent such as acetone, to wipe the friction surface of the brake disc. Then install the brake disc on the test device. The runout of the end face, which is measured on the working surface, at 10 mm away from the outer edge of the brake disc, shall not be greater than 0.05 mm. The parallelism, between the brake disc and the brake caliper's installation surface, shall not be greater than 0.10 mm.

5.3.2 Fix the brake caliper assembly on the test device, according to the actual vehicle installation state. Then connect the hydraulic pressure source's pressurized pipeline to the brake caliper's fluid inlet, to completely drain the air in the system, as shown in Figure 4.

5.3.3 Retract the piston of the brake caliper assembly, so that the gap, between each side of the brake pad and the brake disc, is greater than 0.5 mm.

5.3.4 Idle the brake disc. Zero the drag torque measuring device.

5.3.5 Pressurize the brake caliper assembly to 7 MPa. Keep the pressure for 5 s. Then release the pressure to zero. Repeat 10 cycles.

5.3.6 After placing for 2 min, make the brake disc rotate at (45 ~ 50) r/min. Measure and record the maximum drag torque, during the 1st and 10th rotation of the brake disc.

5.4 Caliper rigidity

5.4.1 Fix the brake caliper assembly on the mounting bracket. Then connect the hydraulic pressure source, to the fluid inlet of the brake caliper, to completely drain the air in the system, as shown in Figure 5.

5.4.2 The measurement point of the deformation of the caliper shall be selected at a flat part, avoiding the unevenness of the casting surface, to reduce the measurement error.

1 - Air pressure source; 2 - Globe valve; 3 - Pressure gauge; 4 - Brake caliper (specimen); 5 - Piston limit stop; 6 - Pull pressure sensor; 7 - Thrust device; 8 - Displacement measuring device

Figure 7 -- Schematic diagram of test device for piston sliding resistance and starting pressure

5.6.2 Apply air pressure to the brake caliper, to push the piston to move out about 5 mm. Push the piston back to the original position, through the thrust device, after the pressure is relieved. This is regarded as one operation cycle. It is carried out 3 cycles in total.

5.6.3 Apply air pressure to the brake caliper, to push the piston to move out about 5 mm. After the pressure is released, push the piston back 4 mm, at a constant speed of no more than 0.5 mm/s, through the push rod of the thrust device. Record the maximum thrust value during this process, which is the piston sliding resistance.

5.7 Piston actuation pressure

After completing the test of 5.6, push the piston back to the original position. Then slowly pressurize the brake caliper, from the fluid inlet, to move the piston outward about 1 mm. Record the input pressure, when the piston starts to move.

5.8 Caliper sliding resistance

5.8.1 Install the brake caliper assembly on the test bench, according to the actual vehicle installation state. Confirm that the brake pads are installed in place. Then connect the hydraulic pressure source's pressurizing pipeline to the fluid inlet of the brake caliper, to empty the air in the system, as shown in Figure 8.

5.8.2 Pressurize the brake caliper assembly to 0.5 MPa. Release the pressure to zero, after maintaining the pressure for 1 s. Repeat this for 3 cycles.

5.8.3 Apply 1 MPa hydraulic pressure, to the brake caliper. Hold this pressure.

5.8.4 Push the fan-shaped simulated disk, through the thrust device, to drive the caliper to move about 4 mm, as relative to the brake caliper's mounting bracket, to the side near the mounting surface of the bracket, at a rate of not more than 2.0 mm/s. Then return to the original position. The above operation is repeated 4 cycles in total. Record the maximum resistance, during the 4^{th} movement.

shall be as close to a sine wave as possible. At the same time, the brake caliper shall be braked once a minute; the brake hydraulic pressure is 3.5 MPa; the pressure holding time is 1 s.

5.10.3.3 The brake caliper shall first be equipped with new brake pads. Vibrate it continuously for 1.0 x 10^6 cycles. Then use brake pads in full-wear state to replace it. Then vibrate it continuously for another 1.0 x 10^6 cycles.

5.10.3.4 After the test, check whether the specimen is damaged, cracked, parts falling off and shearing, or other damages, which affect the performance. Measure the tightening torque of the bracket mounting bolts and the oil pipe connection bolts.

5.11 Waterproof performance (see Figure 9)

5.11.1 Place the brake caliper assembly in an incubator, at (120 ± 5) °C for 70 h.

5.11.2 Take the brake caliper assembly out of the incubator. Place it indoors, to return to room temperature.

5.11.3 Install the brake caliper on the bracket, according to the actual vehicle installation state. Connect the pressurizing pipeline of hydraulic pressure source to the fluid inlet of the brake caliper, to completely exhaust the air in the system.

5.11.4 Apply hydraulic pressure of 3.5 MPa to the brake caliper. Hold the pressure for 5 s. Then release the pressure. After confirming that the brake gap meets the requirements of the product technical documents, place the brake caliper and the mounting bracket together into the water tank, as shown in Figure 9. The distance, between the water surface and the center axis of the brake caliper piston is (300 ± 30) mm.

5.11.5 Apply 500 brakes to the caliper, at a braking frequency of (0.278 ± 0. 027) Hz and a brake hydraulic pressure of (3.5 ± 0.15) MPa.

5.11.6 Take the brake caliper assembly out of the water tank. Wipe off the moisture attached to the surface.

5.11.7 Remove the dust cover and guide pin's protection cover. Check and record whether there is water intrusion in the inside of the cylinder block and the guide pin's dust cover.

5.11.8 Replace the brake pads with the brake pads in full-wear state, to repeat the above test.

5.12 Corrosion resistance

5.12.1 Measure the piston actuation pressure, according to 5.7.

5.12.2 Adjust the axial position of the piston and brake pad, according to the actual

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