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Automobile and trailer - Specifications and bench test methods of pressure control equipment

汽车和挂车 气压控制装置 技术要求及台架试验方法

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Automobile and trailer - Specifications and bench test methods of pressure control equipment

1 Scope

This standard specifies the terms and definitions, performance requirements, bench test methods of pressure control devices in air pressure brake systems of automobile and trailer.

This standard applies to various control devices in automobile and trailer's air pressure brake systems, whose output air pressure changes with the change of operating force, operating handle position or control air pressure, such as foot brake valve, hand brake valve, relay valve, trailer control valve, load sensing proportional valve, trailer emergency relay valve, etc. Other similar control valves can be implemented with reference to it.

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 5620-2002 Road vehicles - Braking of automotive vehicles and their trailers - Vocabulary

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

3 Terms and definitions

The terms and definitions defined in GB/T 5620-2002, as well as the following terms and definitions, shall apply to this standard.

3.1

Static characteristics

The relationship curve between the output pressure at the outlet of the pressure control device and the change of the push rod stroke (or angular displacement, operating force, control air pressure), in each equilibrium state.

Note: The rated working pressure is expressed in kPa.

4 Performance requirements

4.1 Tightness

4.1.1 The pressure drop of the sample in the non-working state shall not be greater than 10 kPa.

4.1.2 The pressure drop of the sample in the working state shall not be greater than 20 kPa.

4.2 Static characteristics

4.2.1 The static characteristic curve shall be within the range of ±10% of the theoretical characteristic curve, meanwhile there shall be no sudden changes and abnormal phenomena.

4.2.2 The predominance (except hand brake valve and load-sensing proportional valve) shall meet the product design requirements.

4.2.3 The initial equilibrium pressure (except foot brake valve and hand brake valve) shall meet the product design requirements.

4.3 Response characteristics

The response time of the hand brake valve and foot brake valve shall not be greater than 0.2 s; the release time shall not be greater than 0.2 s. The response time of other control valves shall not be greater than 0.05 s; the release time shall not be greater than 0.05 s.

4.4 Safety braking characteristics

For the trailer emergency relay valve, test according to 6.6.5. When the output air pressure of the sample outlet begins to drop and drops to zero, the input air pressure of the air inlet shall meet the product design requirements.

4.5 Emergency braking characteristics

For the trailer's emergency relay valve, test according to 6.6.6. When there is air output at the sample outlet, its air inlet's input pressure shall be within the range of 210 kPa ~ 350 kPa or meet the product design requirements. When the air inlet pressure drops below 40 kPa, the air outlet output pressure shall be greater than 550 kPa or meet the product design requirements.

4.6 Low temperature performance

4.6.1 The pressure drop of low temperature air tightness shall not be greater than 3 times

the value specified in 4.1.

4.6.2 The low temperature static characteristic curve shall be within the range of ±12% of the theoretical characteristic curve; there shall be no sudden changes and abnormal phenomena.

4.7 High temperature performance

4.7.1 High temperature air tightness shall meet the requirements of 4.1.

4.7.2 High temperature static characteristics shall meet the requirements of 4.2.1.

4.8 Working durability

4.8.1 During the working durability test, the moving parts shall not be blocked or stuck; the connecting parts shall not be loose; the parts shall not be deformed or damaged to endanger the function.

4.8.2 After the working durability test, the pressure drop during the tightness test shall not be greater than 3 times the value specified in 4.1; the static characteristic curve shall be within the range of ±12% of the theoretical characteristic curve; there shall be no sudden changes and abnormal phenomena.

4.9 Pressure resistance

All parts shall be free of deformation and damage that endangers the function.

4.10 Vibration resistance

After the vibration resistance test, all parts shall not be deformed or damaged to endanger the function; all connectors shall not be loose. The pressure drop during the sealing test shall meet the requirements of 4.1; the static characteristics shall meet the requirements of 4.2.

4.11 Corrosion resistance

After the corrosion resistance test, no more than one corrosion point with a diameter greater than 2 mm shall be generated within any 100 cm^2 of the outer surface of the sample. Small and scattered corrosion points are allowed, but the total corrosion area shall not exceed 5 cm^2.

5 Test-related requirements

5.1 Test equipment

5.1.1 The instruments and equipment used in the test shall meet the test conditions of the relevant items and shall not have an adverse effect on the function of the test sample.

The accuracy level of all instruments and meters recording parameters in the performance test shall not be lower than level 0.5.

5.1.2 The total volume of the auxiliary pipeline in a single test loop shall not be greater than 0.15 L; the inner diameter of the pipeline shall not be less than 8 mm.

5.2 Test conditions

5.2.1 Unless otherwise specified, the sample shall be operated 5 times before testing.

5.2.2 Unless otherwise specified, the ambient temperature during the test is 8 °C ~ 38 °C.

5.2.3 During low temperature test, the dew point temperature of the compressed air at the test pressure shall be lower than -40 °C.

5.3 Test sequence and sample requirements

5.3.1 The samples used for durability test shall be tested in the order of tightness, static characteristics, low temperature performance, high temperature performance, working durability; meanwhile the same sample shall be used to complete all the above items.

5.3.2 Pressure resistance, vibration resistance, corrosion resistance tests should be carried out using different samples.

6 Test methods

6.1 Foot brake valve

6.1.1 Test principle diagram.

The test principle diagram is as shown in Figure 1.

6.1.2 Tightness.

6.1.2.1 Tightness in non-working state.

Place control valves A11 and A12 in the inflation position. Inflate from sample air inlets 11 and 12 to $P_E{}^{+50}_{0}$. Then place control valves A11 and A12 in the cut-off position. After stabilizing the pressure for 1 minute, record the pressure drop of pressure gauges M11 and M12, within 5 minutes.

6.1.2.2 Tightness in working state.

Place the control valve A1 in the inflation position. Inflate air from the sample inlet to $P_E{}^{+50}_{0}$. Then place the control valve A1 in the cut-off position. After stabilization for 1 minute, record the pressure drop of pressure gauge M1 within the next 5 minutes.

6.2.2.2 Tightness in working state.

Place control valves A1 and A4 in the inflation position. Inflate from the sample air inlet and control port to $P_E{}^{+50}_{0}$. Then place control valves A1 and A4 in the cut-off position. Stabilize for 1 min. Record the pressure drop of pressure gauges M2 and M4 within the next 5 min.

6.2.3 Static characteristics.

6.2.3.1 Static characteristic curve.

Replace the 1 L air cylinder at the sample air inlet in Figure 3 with a 40 L air cylinder. Open control valve A1. Inflate from the sample air inlet to $P_E{}^{+50}_{0}$. Operate the pressure regulating valve FR4, to slowly increase the input air pressure of the control port from zero to $P_E{}^{+50}_{0}$. Then slowly decrease to zero. Record the relationship curve between the output air pressure at the air outlet and the input air pressure at the control port.

6.2.3.2 Predominance.

Place the control valve A1 in the inflation position. Inflate the sample from the inlet port 1 to $P_E{}^{+50}_{0}$. Place the control valve A4 in the inflation position. Operate the pressure regulating valve FR4, to increase the sample output pressure to 200 kPa, at a pressure increase rate of (100 ± 20) kPa/s. After 2 s, record the pressure difference between the output pressure at the outlet and the input pressure at the control port.

6.2.3.3 Initial equilibrium pressure.

Place the control valve A1 in the inflation position. Inflate the sample from the inlet port to $P_E{}^{+50}_{0}$. Place the control valve A4 in the inflation position. Operate the pressure regulating valve FR4, to slowly increase the input pressure at the sample control port. Record the input pressure value of the control port, when the sample outlet starts to output air.

6.2.4 Response characteristics.

Replace the 1 L air cylinder at the sample inlet in Figure 3 with a 40 L air cylinder. Connect the pressure sensors Y4 and Y2 at the control port and outlet to the signal acquisition device. Place the control valve A1 in the inflation position. Inflate the sample from the air inlet to $P_E{}^{+50}_{0}$. Operate the pressure regulating valve FR4, to increase the input air pressure of the control port at a pressure increase rate of not less than 2 MPa/s. Measure the time Tx taken for the output air pressure of the sample outlet to rise from zero to 75% of the rated output air pressure. After stabilizing the pressure for 1 min, reduce the input air pressure of the control port at a pressure reduction rate

b) Place the sample handle in the inspection position. Place the control valve A1 in the inflation position. Inflate from the sample air inlet to $P_E{}^{+50}_{0}$. Then put the control valve A1 in the cut-off position. Stabilize for 1 min. Record the pressure drop of the pressure gauges M1 and M22 within the next 5 min.

6.3.3 Static characteristics.

Replace the 1 L air cylinder at the sample air inlet in Figure 5 with a 40 L air cylinder. Open the control valve A1. Inflate from the sample air inlet to $P_E{}^{+50}_{0}$. Drive the operating device, to slowly move the handle from the driving position to the parking position. Record the relationship curve between the output air pressure of the hand brake valve outlet and the angular displacement of the handle.

6.3.4 Response characteristics.

Replace the 1 L air cylinder at the sample air inlet in Figure 5 with a 40 L air cylinder. Connect the pressure sensor Y2 at the air outlet to the signal acquisition device. Place control valve A1 in the inflation position. Inflate the sample $P_E{}^{+50}_{0}$ from the air inlet. Operate the hand brake valve handle, to move the handle from the parking position to the driving position within 0.2 s. After maintaining the pressure for 1 min, return the handle from the driving position to the parking position within 0.2 s. Measure the time Tx for the sample outlet pressure to rise from zero to 75% of the rated output pressure, as well as the time Ts for the outlet pressure to drop from the rated output pressure to 25% of the value.

6.3.5 Low temperature performance.

After the sample inlet is inflated to $P_E{}^{+50}_{0}$, place it in a low temperature ambient chamber at (-40 ± 2) °C; keep it under pressure for (24 ± 1) h. Then, at this temperature, carry out the tightness and static characteristics tests according to 6.3.2 and 6.3.3, respectively. If the static characteristics test must be performed outside the ambient chamber, the sample must be kept at (-43 ± 2) °C for another 2 h ~ 3 h. The test must be completed within 15 min after the sample is taken out of the ambient chamber.

6.3.6 High temperature performance.

Except that the temperature of the ambient chamber is (80 ± 2) °C, the rest is the same as 6.3.4. If the static characteristic test must be carried out outside the ambient chamber, the sample must be kept at (83 ± 2) °C for another 2 h ~ 3 h. The test must be completed within 15 minutes after the sample is taken out of the ambient chamber.

6.3.7 Working durability.

6.3.7.1 Test principle diagram.

The test principle diagram is as shown in Figure 6.

6.4.3.1 Static characteristic curve.

a) Replace the 1 L air cylinder at the sample inlet in Figure 7 with a 40 L air cylinder. Set control valves A11 and A43 to the inflation position. Inflate from the sample inlet 11 and control port 43 to $P_E{}^{+50}_{0}$. Operate the pressure regulating valve FR43, to slowly reduce the input air pressure of the control port 43 to zero. Record the relationship curve between the output air pressure of the sample outlet 22 and the input air pressure of the control port 43.

b) Place the control valves A11 and A43 in the inflation position. Inflate from the sample inlet 11 and the control port 43 to $P_E{}^{+50}_{0}$. Open the control valve A41. Operate the pressure regulating valve FR41, to slowly increase the input air pressure of the control port 41 from zero to $P_E{}^{+50}_{0}$. Then slowly reduce it to zero. Record the relationship curve between the output air pressure of the sample outlet 22 and the input air pressure of the control port 41.

c) Place control valves A11 and A43 in the inflation position. Inflate from the sample air inlet 11 and control port 43 to $P_E{}^{+50}_{0}$. Then place control valve A42 in the inflation position. Operate the pressure regulating valve FR42, so that the input air pressure of control port 42 slowly rises from zero to PE. Then slowly drop it to zero. At the same time record the relationship curve between the output air pressure of sample outlet 22 and the input air pressure of control port 42.

6.4.3.2 Predominance.

Open control valves A11 and A43. Inflate from the sample air inlet 11 and control port 43 to $P_E{}^{+50}_{0}$. Open control valve A41. Operate the pressure regulating valve FR41, to increase the output air pressure of sample outlet 22 to 200 kPa, at a pressure increase rate of (100 ± 20) kPa/s. Record the pressure difference between the output air pressure of sample outlet 22 and the input air pressure of control port 41, after 2 s.

6.4.3.3 Initial equilibrium pressure.

a) Place control valves A11 and A43 in the inflation position. Inflate from the sample air inlet 11 and control port 43 to $P_E{}^{+50}_{0}$. Then place control valve A41 in the inflation position. Operate pressure regulating valve FR41, to slowly increase the input air pressure of sample control port 41. Record the input air pressure value of control port 41, when the sample air outlet 22 starts to output air.

b) Place control valves A11 and A43 in the inflation position. Inflate from the sample air inlet 11 and control port 43 to $P_E{}^{+50}_{0}$. Then place control valve A42 in the inflation position. Operate pressure regulating valve FR42, to slowly increase the input air pressure of sample control port 42. Record the input air pressure value of control port 42, when the sample air outlet 22 starts to output air pressure.

6.4.4 Response characteristics

Replace the 1 L air cylinder at the sample air inlet in Figure 7 with a 40 L air cylinder. Connect the pressure sensors Y1 and Y2 at the sample control port 41 and the air outlet 22 to the signal acquisition device. Set the control valves A11 and A43 to the inflation position. Inflate from the sample air inlet 11 and the control port 43 to $P_E{}^{+50}_{0}$. Then set the control valve A41 to the inflation position. Operate the pressure regulating valve FR41, to increase the input air pressure of the sample control port 41, at a pressure increase rate of not less than 2 MPa/s. Measure the time Tx for the output air pressure of the sample outlet 22 to rise from zero to 75% of the rated output air pressure. After stabilizing the pressure for 1 min, reduce the input air pressure of the sample control port 41, at a pressure reduction rate of not less than 2 MPa/s. Measure the time Ts for the output air pressure of the sample outlet 22 to drop from the rated output air pressure to 25% of the value.

6.4.5 Low temperature performance

After the sample inlet is inflated to $P_E{}^{+50}_{0}$, place it in a low-temperature ambient chamber at (-40 ±2) °C, to keep it under pressure for (24 ±1) h. Then, at this temperature, carry out the sealing and static characteristics tests according to 6.4.2 and 6.4.3, respectively. If the static characteristics test must be performed outside the ambient chamber, the sample must be kept at (-43 ±2) °C for another 2 h ~ 3 h. The test must be completed within 15 min after the sample is taken out of the ambient chamber.

6.4.6 High temperature performance.

Except that the ambient chamber temperature is (80 ± 2) °C, the rest is the same as 6.4.5. If the static characteristics test must be performed outside the ambient chamber, the sample must be kept at (83 ± 2) °C for another 2 h ~ 3 h. The test must be completed within 15 min after the sample is taken out of the ambient chamber.

6.4.7 Working durability.

6.4.7.1 Test principle diagram.

The test principle diagram is as shown in Figure 8.

6.4.7.2 Test procedure.

a) Carry out the driving brake durability test according to the test sequence and test conditions specified in Table 1. The output air pressure ratio in the number of cycles of each test item is the same as 6.1.7.2 b).

b) Carry out the parking brake durability test according to the test sequence and test conditions specified in Table 2.

c) During the test, pay attention to observe whether the sample has abnormal conditions such as blocking and jamming, whether the connectors are loose, whether the parts have deformation and damage that endangers the function.

6.5.2 Tightness.

6.5.2.1 Tightness in non-working state.

Place the control valve A1 in the inflation position. Inflate it from the sample air inlet to $P_E{}^{+50}_{0}$. Place the control valve A1 in the cut-off position. After stabilization for 1 min, record the pressure drop of pressure gauge M1 within the next 5 min.

6.5.2.2 Tightness in working state.

a) Place the sample swing arm in the no-load position, control valves A1 and A4 in the inflation position. Inflate from the sample air inlet and control port to $P_E{}^{+50}_{0}$. Place control valves A1 and A4 in the cut-off position. After stabilization for 1 min, record the pressure drop of pressure gauges M2 and M4 within the next 5 min.

b) Place the sample rocker in the half-load position and full-load position respectively. Repeat 6.5.2.2 a).

6.5.3 Static characteristics.

6.5.3.1 Static characteristic curve.

a) Replace the 1 L air cylinder at the sample air inlet in Figure 9 with a 40 L air cylinder. Open control valve A1 and fill the sample air from the air inlet to $P_E{}^{+50}_{0}$. When the sample rocker is placed in the no-load, half-load, full-load positions respectively, place control valve A4 in the filling position. Then operate pressure regulating valve FR4, to make the control port input pressure slowly rise from zero to $P_E{}^{+50}_{0}$. Then slowly drop to zero. Record the relationship curve between the output air pressure at the air outlet and the change of the control port input pressure.

b) Place control valves A1 and A4 in the filling position. Inflate from the sample's air inlet and control port to $P_E{}^{+50}_{0}$. Drive the operating device, to slowly rotate the sample rocker from stop point 2 to end point 1. Record the relationship curve between the output pressure of the air outlet and the angular displacement of the rocker.

6.5.3.2 Initial equilibrium pressure.

Place the sample rocker in the full load position. Open the control valve A1. Inflate from the sample's air inlet to $P_E{}^{+50}_{0}$. Place the control valve A4 in the filling position. Operate the pressure regulating valve FR4, to slowly increase the input air pressure of the sample control port. Record the input air pressure value of the control port, when the sample air outlet begins to output air.

6.5.4 Response characteristics.

to make the input air pressure of the sample control port rise, at a pressure increase rate of not less than 2 MPa/s. Measure the time Tx for the output air pressure of the sample's air outlet 2 to rise from zero to 75% of the rated output air pressure. After stabilizing the pressure for 1 min, make the input air pressure of the sample control port 4 decrease, at a pressure reduction rate of not less than 2 MPa/s. Measure the time Ts for the output air pressure of the sample outlet 2 to drop from the rated output air pressure to 25% of the value.

6.6.5 Safety braking characteristics

Place the control valves A1-2 and A2 in the cut-off position, and control valve A11 in the inflation position. Operate the pressure regulating valve FR11, to slowly increase the input air pressure of the air inlet 11 from zero. Record the input air pressure of the air inlet 11, when the output air pressure of the sample outlet 2 starts to decrease after rising and when it drops to zero.

6.6.6 Emergency braking characteristics.

Place the control valves A1-2 and A2 in the cut-off position, and control valve A11 in the inflation position. Inflate from the sample's air inlet 11 to $P_{E}{}^{+50}_{0}$. Operate the pressure regulating valve FR11, to reduce the input air pressure of the air inlet at a pressure reduction rate of not less than 0.1 MPa/s. Record the input air pressure value of the air inlet 11, when the sample outlet 2 starts to output air, as well as the output air pressure value of the air outlet 2 when the input air pressure of the air inlet 11 drops below 40 kPa.

6.6.7 Low temperature performance.

After the sample's air inlet is inflated to $P_{E}{}^{+50}_{0}$, place it in a low-temperature ambient chamber at (-40 ± 2) °C and kept under pressure for (24 ± 1) h. Then, at this temperature, carry out the tightness and static characteristics tests according to 6.6.2 and 6.6.3, respectively. If the static characteristics test must be performed outside the ambient chamber, the sample must be kept at (-43 ±2) °C for another 2 h ~ 3 h. The test must be completed within 15 min after the sample is taken out of the ambient chamber.

6.6.8 High temperature performance.

Except that the ambient chamber temperature is (80 ± 2) °C, the rest is the same as 6.6.7. If the static characteristics test must be performed outside the ambient chamber, the sample must be kept at (83 ± 2) °C for another 2 h ~ 3 h. The test must be completed within 15 min after the sample is taken out of the ambient chamber.

6.6.9 Working durability.

6.6.9.1 Test principle diagram.

The test principle diagram is as shown in Figure 12.

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