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Structure, Performance Requirements and Test Methods of Brake Hose

制动软管的结构、性能要求及试验方法

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Structure, Performance Requirements and Test Methods of Brake Hose

1 Scope

This document specifies the structure, performance requirements, test methods and marking of brake hoses, brake hose end fittings and brake hose assemblies for automobiles, motorcycles, mopeds and trailers.

This document is applicable to hydraulic, pneumatic and vacuum brake hoses, as well as brake hose end fittings and brake hose assemblies for automobiles, motorcycles, mopeds and trailers.

This document is not applicable to spiral pipes for automobiles and high-temperature gas transmission rubber hoses.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in this text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 1690-2010 Rubber, Vulcanized or Thermoplastic - Determination of the Effect of Liquids

GB/T 7129-2001 Rubber or Plastics Hoses - Determination of Volumetric Expansion

GB/T 10125-2021 Corrosion Tests in Artificial Atmospheres - Salt Spray Tests

GB 12981-2012 Motor Vehicle Brake Fluids

GB/T 14905-2020 Rubber and Plastics Hoses - Determination of Adhesion between Components

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Brake Hose

Brake hose refers to a flexible hose used in the braking system to transmit hydraulic and pneumatic energy to a brake or booster.

3.2 Brake Hose End Fitting

Brake hose end fitting refers to an accessory, except the clamp, attached to the end of the brake hose for connection.

3.3 Brake Hose Assembly

Brake hose assembly refers to a brake hose fitted with brake hose end fitting.

NOTE: the brake hose can have armor or no armor.

3.4 Armor

Armor refers to a protective device mounted on the outside of the brake hose to increase the resistance of the brake hose to scratches or impacts.

3.5 Free Length

Free length refers to the straight length of the exposed brake hose between the hose end fittings when the brake hose assembly is in the vertical state.

3.6 Nominal Inside Diameter

Nominal inside diameter refers to the dimensions of the inside diameter of the brake hose expressed in millimeters.

3.7 Nominal Outside Diameter

Nominal outside diameter refers to the dimensions of the outside diameter of the brake hose expressed in millimeters.

4 General Requirements

4.1 The brake hose assembly used for the test shall be an unused product manufactured at least 24 h ago. Before the test, the brake hose assembly shall be placed at 15 °C ~ 32 °C for at least 4 h.

4.2 The brake fluid used in the test of the hydraulic brake hose assembly shall be HZY3 or HZY4 specified in GB 12981-2012. Alternatively, other test media may also be used for the test, but they shall be indicated in the test report.

4.3 Unless there are special requirements, the test shall be carried out at a room temperature of 15 °C ~ 32 °C.

4.4 The nominal inside diameter and nominal outside diameter allow the existence of positive and negative deviations, and for ease of reference, integers can be used. Among them, hydraulic brake hoses and other rubber brake hoses are expressed by nominal inside diameters, and pneumatic brake plastic hoses and vacuum brake plastic hoses are expressed by nominal outside

5.3.11.1.1 The pressure circulating device shall be able to apply a pressure of 11 MPa and automatically control the pressurization and depressurization cycle.

5.3.11.1.2 It shall have a test chamber with a suitable thermostatically controlled heating system capable of maintaining a temperature of 143 °C ± 3 °C.

5.3.11.2 Test procedures

5.3.11.2.1 Connect the hydraulic brake hose assembly specimen to a pressure circulating device that can generate a pressure of 0 MPa ~ 11 MPa.

5.3.11.2.2 Fill the pressure circulating device and the specimen with the brake fluid that complies with the stipulations of 4.2, and discharge the air.

5.3.11.2.3 Within 30 min, make the ambient temperature in the test chamber reach 143 °C ± 3 °C.

5.3.11.2.4 Turn on the pressure circulating device. Within 2 s, increase the pressure of the specimen from 0 MPa to 11 MPa ± 0.1 MPa, and maintain for 60 s ± 6 s, then, within the same time, decrease the pressure of the specimen from 11 MPa ± 0.1 MPa to 0 MPa, and maintain for 60 s ± 6 s. This is one cycle. At least 150 cyclic tests shall be performed.

5.3.11.2.5 After the test is completed, remove the specimen from the test chamber; drain the brake fluid; at room temperature, place it for at least 45 min.

5.3.11.2.6 In accordance with the stipulations of 5.3.3, carry out the test.

5.3.12 Corrosion resistance of end fitting

In accordance with the stipulations of GB/T 10125-2012, carry out the neutral salt spray test; the test time is 24 h. After the test, use clean running water not higher than 40 °C to gently wash it, so as to remove the salt deposits. Then, within 2 min, use air to blow-dry it; check and record the corrosion of the metal substrate, excluding the corrosion of the folds or marked parts.

6 Pneumatic Brake Rubber Hose Assembly

6.1 Structure

The pneumatic brake rubber hose assembly is composed of metal-based brake hose end fittings (or clamps) at both ends and a brake hose in the middle.

6.2 Performance Requirements

The pneumatic brake rubber hose assembly or the corresponding parts shall be tested in accordance with 6.3. The test results shall satisfy the various performance requirements specified in Table 6.

ΔS---the length change rate, expressed in (%);

S_1---when the pressure is 0.1 MPa, the distance between the interval marking lines, expressed in (mm);

S_2---when the pressure is 1.4 MPa, the distance between the interval marking lines, expressed in (mm).

6.3.5 Bursting strength

After the pneumatic brake rubber hose assembly specimen is tested in accordance with 5.3.12, connect one end of the specimen to the pressure system; fill it with water; exhaust all the air, then, plug the other end. At a speed of 6.2 MPa/min ± 0.7 MPa/min, apply the pressure, until the end fitting of the specimen falls off, leaks, or the hose is damaged. Record the maximum pressure and the type of damage.

6.3.6 Tensile strength

In accordance with 5.3.6, carry out the test. The tensile speed is 25 mm/min ± 3 mm/min.

6.3.7 Bonding strength

In accordance with the stipulations of GB/T 14905-2020, carry out the bonding strength test between the outer rubber layer and the reinforcement layer. The specimen type is Type 8; the speed is 25 mm/min ± 5 mm/min.

6.3.8 Heat resistance

Bundle the pneumatic brake rubber hose assembly specimen 360° around the mandrel specified in Table 9. Place the mandrel with the bundled specimen in a high-temperature test chamber at 100 °C ± 2 °C, maintain for 70 h ± 2 h, then, take it out and cool to room temperature. Remove the specimen from the mandrel and straighten it; along the longitudinal direction, cut the specimen. Check with the naked eye whether there are cracks, carbonization or thermal degradation on the inner and outer surfaces of the specimen, and record them.

In accordance with 6.3.1, carry out the test.

8.3.3 Dimensional stability after high-temperature resistance

Place the plastic hose specimen in a high-temperature test chamber at 110 °C ± 2 °C and maintain for 4.0 h ~ 4.5 h. After taking it out, place it at room temperature for 30 min ± 2 min, then, measure the wall thickness and outside diameter of the specimen. The outside diameter shall be measured in two perpendicular directions of the cross-section of the specimen. Take the arithmetic mean of the measurement results in the two directions as the measured value of the outside diameter of the cross-section. Take the arithmetic mean of the measured values of the outside diameter of three cross-sections as the final test result.

8.3.4 Dimensional stability after boiling

Use a stainless steel wire rope to fix the plastic hose specimen in a container filled with distilled water. The size of the container shall be such that the specimen does not contact the inner wall of the container. Heat the container, until the water boils, and lasts for 2 h. When the distilled water in the container is insufficient, slowly add water, so as to ensure that the distilled water in the container remains boiling. After the test is completed, take the specimen out of the container and place it at room temperature for 30 min ± 2 min. After using a clean rag to wipe off the distilled water on the surface of the specimen, in accordance with the stipulations of 8.3.3, measure the wall thickness and outside diameter of the specimen.

8.3.5 Bursting strength

Connect one end of the pneumatic brake plastic hose assembly specimen to the pressure system; fill it with water; exhaust all the air, then, plug the other end. At a speed of 20 MPa/min ± 4 MPa/min, apply a pressure, until the end fitting of the specimen falls off, leaks, or the hose bursts. Record the maximum pressure and the type of damage.

8.3.6 Resistance to heat and humidity

Place the plastic hose specimen in a constant temperature and humidity test chamber at 110 °C ± 2 °C and maintain for 24 h ~ 25 h. Within 30 s after it is taken out, weigh it, accurate to 0.01 g. Plug both ends of the specimen; place it in a constant temperature and humidity test chamber with a relative humidity of 95% and a temperature of 24 °C ± 2 °C and maintain for 100 h ± 2 h. Take out the specimen; use a clean rag to wipe off the water stains on the surface. Within 5 min, re-weigh it and record the mass, accurate to 0.01 g. In accordance with Formula (4), calculate the water absorption of the specimen. Install end fittings to both ends of the weighed specimen, then, in accordance with 8.3.5, carry out the test.

$$\Delta W = (W_2 - W_1)/W_1 \times 100 \qquad \cdots\cdots (4)$$

Where,

ΔW---the water absorption, expressed in (%);

maintain for 70 h ~ 72 h. After taking out the specimen, place it at room temperature for 30 min ± 2 min. Then, place the specimen, together with the test device shown in Figure 10, in a low-temperature test chamber at –40 °C ± 2 °C and maintain for 4.0 h ~ 4.5 h. At this temperature, in accordance with 8.3.7.2.4 and 8.3.7.2.5, carry out the impact test. Place the impacted specimen at room temperature for 1 h ~ 1.5 h. Install end fittings at both ends of the specimen, then, in accordance with 8.3.5, carry out the test.

8.3.11 Bursting strength after boiling resistance

In accordance with 8.3.4, carry out the water boiling test on the plastic hose specimen. After taking out the specimen, place it at room temperature for 30 min ± 2 min. Then, place the specimen, together with the test device shown in Figure 10, in a low-temperature test chamber at –40 °C ± 2 °C and maintain for 4.0 h ~ 4.5 h. At this temperature, in accordance with 8.3.7.2.4 and 8.3.7.2.5, carry out the impact test. Place the impacted specimen at room temperature for 1.0 h ~ 1.5 h. Install end fittings at both ends of the specimen, then, in accordance with 8.3.5, carry out the test.

8.3.12 Bursting strength after oil resistance

In accordance with 7.3 of GB/T 1690-2010, carry out the test. The test temperature is 100 °C ± 2 °C; the test time is 70 h ~ 72 h; the test medium is IRM903 standard oil specified in Table A.3 of GB/T 1690-2010. After taking out the specimen, place it at room temperature for 30 min ± 2 min; wipe off the oil stains on the outer surface of the specimen. Install end fittings at both ends of the specimen, then, in accordance with 8.3.5, carry out the test.

8.3.13 Bendability after high and low-temperature resistance

Place the plastic hose specimen in a high-temperature test chamber at 110 °C ± 2 °C and maintain for 24 h ~ 25 h. After taking it out, place it at room temperature for 30 min ± 2 min. Then, place the specimen, together with a mandrel whose diameter is 6 times the nominal outside diameter of the plastic hose, in a low-temperature test chamber at –40 °C ± 2 °C and maintain for 4.0 h ~ 4.5 h. At this temperature, at a constant speed and within 4 s ~ 8 s, bend the specimen around the mandrel at least 180°; check whether there are cracks on the outer surface of the hose.

8.3.14 Zinc chloride resistance

Plug both ends of the plastic hose specimen, then, bend the specimen at least 180° and fix it on the mandrel specified in Table 20 (the material of the mandrel cannot chemically react with the test solution). Soak them together in 50% zinc chloride (chemically pure) solution for 200 h ~ 202 h. Take out the mandrel that fixes the specimen; in this state, use a 7 times magnifying glass to check cracks on the outer surface of the specimen.

8.3.15 Methanol resistance

In accordance with 8.3.14, carry out the test. The test solution is 95% methanol.

In accordance with 5.3.6, carry out the test. The free length of the pneumatic brake plastic hose assembly specimen is 150 mm ± 3 mm; the tensile speed is 25 mm/min ± 3 mm/min.

8.3.19 Stretchability after boiling resistance

8.3.19.1 Test device

Between the upper and lower connectors of the tensile machine, install a container that can be heated. The lower device of the container can be connected with the lower end of the tensile machine. The upper device of the container ensures that the pneumatic brake plastic hose assembly specimen can be quickly subjected to the tensile test after being boiled in water for 5 min ~ 6 min.

8.3.19.2 Test procedures

Through the lower device of the container, vertically install the pneumatic brake plastic hose assembly specimen with a free length of 150 mm ± 3 mm on the tensile machine. Add distilled water that can immerse the specimen with a length of 100 mm ± 3 mm into the container, then, heat the container, until the water temperature is 95 °C ± 5 °C; maintain for 5 min ~ 6 min. Connect the upper end fitting of the specimen to the tensile machine. At a speed of 25 mm/min ± 3 mm/min, carry out the tensile test, until the end fitting of the specimen falls off or the hose is damaged. Record the maximum load and the type of damage.

8.3.20 Stretchability after alternating cold - boiling resistance

Place the pneumatic brake plastic hose assembly specimen with a free length of 150 mm ± 3 mm in a low-temperature test chamber at –40 °C ± 2 °C and maintain for 30 min ± 5 min. Then, take out the specimen; place it at room temperature for 30 min ± 5 min. In accordance with the stipulations of 8.3.4, boil it in water for 15 min ± 2 min; take out the specimen; place it at room temperature for 30 min ± 5 min. This is one cycle. A total of 4 cyclic tests shall be carried out. After the test is completed, in accordance with 5.3.6, carry out the test; the tensile speed is 25 mm/min ± 3 mm/min.

8.3.21 Vibration resistance

8.3.21.1 Test equipment

8.3.21.1.1 The vibration testing machine shall be able to adjust the vibration frequency and amplitude.

8.3.21.1.2 The vibration testing machine shall have an air source for supplying air pressure to the specimen.

8.3.21.1.3 The vibration testing machine shall maintain stable and avoid resonance.

8.3.21.1.4 The vibration testing machine shall be equipped with an instrument and meter for measuring the leakage of the specimen.

The identification strip shall be located on the outer surface of the brake hose and parallel to the longitudinal axis of the brake hose; its width shall not be less than 1.6 mm, and shall be clearly visible. The identification strip shall be marked with the identification content specified in 9.1.3, and its identification requirements shall comply with the stipulations of 9.1.2. Hydraulic brake hoses using petroleum-based brake fluid shall have a green identification strip.

9.1.2 Identification requirements

For the identification of each brake hose, the interval from the end of one identification to the beginning of the other identification shall be less than 152 mm; the identification content shall be expressed by printed English letters or numbers; the height of the font shall be greater than 3.2 mm.

9.1.3 Identification content

See the identification content below:

a) Serial No. of Standard: “GB 16897”.

b) Date of manufacture.

c) Manufacturer or its abbreviation.

d) Nominal size: for rubber brake hose and hydraulic plastic brake hose, expressed as the nominal inside diameter plus the unit symbol of millimeter; for pneumatic brake plastic hose and vacuum brake plastic hose, expressed as the diameter symbol “ϕ”, followed by the “nominal outside diameter of hose × wall thickness”.

Example 1: hydraulic brake hose with a nominal inside diameter of 3.2 mm is expressed as “3.2 mm”.

Example 2: plastic brake hose with a nominal outside diameter of 12 mm and a wall thickness of 1.5 mm is expressed as “ϕ12 × 1.5”.

e) Type of hose: the standard expansion hydraulic brake hose is expressed as “HR”, and the low expansion hydraulic brake hose is expressed as “HL”; the pneumatic brake hose is expressed as “A”; the thick wall vacuum brake hose is expressed as “VH”, and the thin wall vacuum brake hose is expressed as “VL”.

9.2 End Fitting of Brake Hose

Except for the brake hose assembly whose end fitting is deformed relative to the brake hose by crumpling, cold extrusion, thermal bonding or press-fitting processes, at least one of the brake hose end fittings shall have an identification expressed through the method of etching, embossing or bonding. This identification shall be expressed by printed English letters or numbers; the height shall not be less than 1.6 mm. The identification content is the abbreviation of the manufacturer or a traceable identification of the manufacturer.

9.3 Brake Hose Assembly

9.3.1 For the brake hose assembly with end fittings installed through the processes of crumpling, cold extrusion, thermal bonding or press-fitting, the identification shall be made in accordance with the stipulations of 9.3.2 or 9.3.3

9.3.2 In accordance with the position recommended by the assembly manufacturer, add a band identification on the brake hose assembly. The band identification shall freely move along the longitudinal axis of the brake hose assembly between the end fittings of both ends. The band identification shall be expressed by printed English letters or numbers with a height of not less than 3.2 mm through the method of etching, embossing or bonding. See the identification content below:

a) Serial No. of Standard: “GB 16897”;

b) Date of manufacture;

c) Manufacturer or its abbreviation.

9.3.3 For the brake hose assembly with end fittings installed through the processes of crumpling, cold extrusion, thermal bonding or press-fitting, at least one end of the brake hose assembly shall have an identification on the end fitting. The identification shall be expressed through the method of etching, embossing or bonding. Indicate the manufacturer’s abbreviation or a traceable identification of the manufacturer of the brake hose assembly with printed letters or numbers with a height of not less than 1.6 mm.

10 Date of Implementation

For models with newly applied vehicle type approval, this Standard shall be implemented from the date of implementation.

For models that have obtained vehicle type approval, this Standard shall be implemented in the 7^{th} month from the date of implementation.

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