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ISO3996 – 1995(E): Road Vehicles - Brake Hose Assemblies for Hydraulic Braking Systems Used with Non-petroleum-base Brake Fluid

ASSESSMENT REPORT

REPORT No: C4555-AS1

Prepared for:

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1.0 SCOPE

This report describes the procedures and results of tests to performance requirements prescribed in International Organisation for Standardization standard ISO3996:1995(E) - Road Vehicles - Brake Hose Assemblies for Hydraulic Braking Systems Used with Non-petroleum-base Brake Fluid

2.0 DEFINITIONS

For the purposes of this International Standard, the following definitions apply.

2.1 Brake hose assembly: Brake hose equipped with end fittings for use in a brake System.

2.2 Brake hose: Flexible conduit intended for use in a brake System to transmit and contain the fluid pressure medium used to apply forte to the vehicle's brakes.

2.3 End fitting: Coupling designed for permanent attachment to the ends of a brake hose assembly by crimping or swaging.

2.4 Free length: Linear length of brake hose ex- posed between the end fittings of a brake hose assembly while maintained straight.

2.5 Leaks; burst: Loss of test fluid through the brake hose assembly other than by the designed inlet(s) and outlet(s).

2.6 Cracking: Interruption of a surface due to environment and/or stress.

3.0 TEST COMPONENTS IDENTIFICATION

The hose assemblies are braided hydraulic brake hoses 3.2 mm internal diameter with stainless steel end fittings.

The hoses bear the following undeletable markings:

GALFER C-0012 3.2mm HL

The sample hydraulic brake hose assemblies had permanently attached stainless steel end fittings

The end fitting plastic sleeves bear the following protruding markings:

D.O.T. F.T.S.

4.0 TEST EQUIPMENT AND INSTRUMENTATION

The following table identifies the equipment used to conduct the performance tests of the hydraulic hoses.

Equipment Type	Manufacturer	Model/ Serial No.	Calibration Status
Gauge Plague	FABMAC Heavy Equipment	TICG01/001	N/A
Vernier Calliper	Sidchrome	26115 26116 26117	Calibrated
Expansion Test Apparatus	FABMAC Heavy Equipment	TICEA01/001	N/A
High Pressure Gauge	Steward Buchanan	12-10000/ 764825	Calibrated
Whip Test Apparatus	FABMAC Heavy Equipment	TICWA01/001	N/A
Ozone Air Apparatus	FABMAC Heavy Equipment	TICOA01/001	N/A
Salt Spray Apparatus	FABMAC Heavy Equipment	TICSA01/001	N/A
Manual Hydraulic Pump	ENERPAC	P141	N/A
Pulsating Pressure Apparatus	FABMAC Heavy Equipment	TICPP01/001	Calibrated
Watch	SWATCH	-	Checked
Refrigeration Chamber	Labec	I-DF4507	N/A
Oven	Labec	OTWMD18	N/A

5.0 TESTS

5.1 General Test conditions

The hose assemblies for the Performance tests were new and unused. They were more then 24 h old.

For the last 4 h prior to testing, they were maintained at a temperature of 15^0C to 32^0C.

The temperature of the test room was between 15^0C and 32^0C for all tests.

5.2 Hydrostatic pressure test

All hose assemblies were subjected to a hydrostatic pressure test, using inert brake fluid conforming to ISO 4925 as the pressure medium. The test pressure was 22.0 MPa.

The pressure was held for 15 s.

There were no hose assemblies showing leaks under this test.

5.3 Constriction test

The constriction of the hose assemblies was measured in that part of the brake hose end fittings which contains the hose, with a gauge plug as described in Figure 1 of the standard. The constriction measured was no more then 2.03mm

5.4 Expansion test

5.4.1 The Sample used in this test has been subjected to pressure above 10.3 MPa prior to this test and allowed to recover for more than15 min.

5.4.2 The free length of brake hose assembly was measured with it vertical and a mass of 567 gm + 3 gm attached to the lower end.

5.4.3 The hose assembly was carefully threaded into the adaptors designed to seal in the same manner as in actual use. The hose assembly was not twisted. The hose assembly was maintained vertical and straight without tension while under pressure.

5.4.4 All the air from the apparatus was bled by allowing approximately 0.25 l of water to flow from the reservoir tank through the hose assembly and into the burette.

5.4.5 The valve to the burette was closed and 11 MPa pressure applied to the hose assembly.

The hose assembly was inspected within 10s for leaks at the connections and then the pressure released completely in the hose. The water level in the burette was adjusted to Zero.

5.4.6 Pressure of 6.9 MPa was applied to the hose assembly and maintained in the hose for 5s with the valve to the burette closed.

The valve to the burette was opened within 3 s for 10 s -to allow the water in the expanded hose to

5.4.7 The test in 6.4.6 was repeated twice, so that the amount of water in the burette was the total of the three expansions. This burette reading was measured to the nearest 0,05 cm3.

5.4.8 The volumetric expansion, *E*, in cubic centimetres per metre of free length was calculated using formula

$$E = \frac{\frac{V}{3} - C}{l}$$

Where *V* is the total volume of three expansions, in cubic centimetres, read on the burette; *C* is the correction factor, in cubic centimetres and *l* is the free length of Sample, in metres.

5.4.9 The water level was readjusted in the burette to zero as above and procedure given in 5.4.6 and 5.4.7 repeated, to obtain the expansion at a pressure of 10.3 MPa.

The maximum expansion of any hose assembly tested in accordance with 6.4.4 did not exceed the values given in table 2 of the standard.

5.5 Burst strength test

The Sample was connected to the pressure System and filled completely with water or brake fluid, allowing all air to escape.

Pressure of 27.6 MPa was applied at the rate of (172.5 + 69) MPa/min and 'held for 120s. At the expiration of this hold period, the pressure was increased at a rate of(172,5 + 69) MPa/min until the hose bursted. The maximum pressure obtained on the calibration gauge was red to the nearest 0,69 MPa and recorded as the bursting strength of the hose assembly.

When tested under hydraulic pressure, each Sample of hose assembly was able to withstand a pressure hold of 2 min at the specified pressure and was able to withstand the minimum burst pressure specified in table3 of the standard.

5.6 Brake fluid compatibility

The hose assemblies were attached below a 0.5 l reservoir filled with 100 ml of compatible non-petroleum-base brake fluid as specified in ISO 4926.

5.6.1 The hose assembly was filled with compatible non petroleum-base brake fluid as specified in ISO 4926 and sealed the lower end.

5.6.2 The hose assembly was placed vertically in an oven and conditioned at 120^0C for 70 h, then cooled to room temperature for 30 min.

5.6.3 The hose assembly was drained within 10 min. The constriction requirements were verified according to requirements of Constriction Test described above.

5.6.4 The hose assembly was subjected to Burst Strength Test

After having been subjected to a temperature of 120^0C for 70 h while filled with compatible non-petroleum-base brake fluid as specified in ISO 4926, the hose assembly met the Constriction Test requirements. It then was able to withstand a pressure of 27.6 MPa for 120 s and had not burst at less than 34.5 MPa. In addition, under the conditions of Burst Strength Test, the hose assembly burst within 3 h.

5.7 Whip test

5.7.1 The free length of each hose assembly was measured as 360mm with the assembly vertical with a mass of 570 gm attached to the lower end, using a vernier calliper.

5.7.2 The non-rotating header of the apparatus as described in Clause 6.7.2 of the standard was equipped to permit attachment of each hose assembly with individual setting for length. When mounted in the whip test apparatus the projected length of each hose assembly was less than the free length by 44.5 mm.

5.7.3 The hose assemblies were installed in the apparatus without any twist. The water or brake fluid was applied with pressure held between 1.55 MPa and 1.72 MPa. All hoses and passages were bled to eliminate air pockets or bubbles. The motor rotating the rotating head of the apparatus was started and the duration of the test noted. The rate of rotation was measured periodically until a hose assembly failed by loss of pressure.

The minimum life on the whip test apparatus was more than 35 h for any one of the Sample hose assemblies.

5.8 Tensile strength test

The hose assembly was fitted in the test apparatus described in Clause 6.8.1 of the standard and an increasing tensile load at a Speed of 25 mm/min was applied until failure. The total load at the time of failure and the type of failure were recorded.

All the hose assemblies were able to withstand the minimum load 1446 N without the end fittings pulling off or rupture of the hose.

5.9 Water absorption test

5.9.1 The suitably closed off hose assembly was immersed in water heated at 850C + 20C for 70 h.

5.9. 2 The Tensile Strength and Burst Strength tests were performed within 10 min after removal of hose assemblies from the water. The whip test was started within 20 min after removing the hose assemblies from the water.

Separate samples of hose assemblies, after immersion in water, passed all requirements for Burst Strength, Whip, and Tensile Strength tests as indicated for non-aged brake hose assemblies.

5.10 Cold bend test

5.10.1 The hose was conditioned in a straight position together with a mandrel of 76.2 mm diameter in air at - 45 “C. Then, while still at this temperate, bent evenly 180^0 around the mandrel within 5s.

5.10.2 The cover of the brake hose was examined with the naked eye for cracks or breaks.

The hose cover had not brake nor crack visibly to the naked eye without magnification.

5.11 Ozone resistance test under dynamic conditions

All the samples of hose assembly were preconditioned in a non-stressed condition heated at 300C for 24h prior to the start of the test.

5.11.1 The samples of hose assembly was assembled on the dynamic ozone test apparatus described in Clause 6.11.2 of the standard so that they met the relative position and flex parameters shown in figure 6 of the standard. The hose assembly was installed 220 mm long, over the fixture pins until the hose assembly has bottomed out. Band clamps were used to retain the hose assembly on the pins securely.

5.11.2 The test apparatus and the hose assembly was installed in a stabilized ozone chamber containing air mixed with ozone at an ozone partial pressure of 100 mPa $\pm$ 10 mPa [(100 $\pm$ 10) parts of ozone per 100 million Parts of air by volume]. The air temperature in the chamber was 400^0C $\pm$ 30^0C.

5.11.3 The cycling test was started when the chamber reached the specified ozone concentration no later than 1 h after putting the test apparatus in the chamber. The flex rate was within 0.3 Hz $\pm$ 0.05 Hz. The stroke was 76.2 mm $\pm$ 2.5 mm. The cycling test duration was 48 h.

5.11.4 The outside cover of the hose assembly was examined for cracks.

No cracks on the outer cover were visible to the naked eye without magnification at the worst stress condition, ignoring the areas immediately adjacent to or within the area covered by the band clamps.

5.12 Hot impulse strength test

5.12.1 The hose assemblies was connected to a pressure cycling apparatus capable of producing a pressure of 0 to 11 MPa.

5.12.2 The pressure cycling apparatus and hose assemblies were filled with ISO 4926 compatible non-petroleum-base brake fluid, and bled free of air.

5.12.3 The hose assemblies were placed in a circulating air oven and an oven temperature of 1400C was attained within 30 min.

5.12.4 The hose assemblies were subjected to a cycling internal pressure of 11 MPa for 60s then 0 MPa for 60 s. Pressures were attained within 2 s. The assemblies were pressure cycled for 150 cycles.

5.12.5 The hose assemblies were removed from the oven. The hose assemblies were disconnected from the apparatus and the fluid drained. The hose assemblies were cooled in air at room temperature for 45 min.

5.12.6 The hose assemblies were subjected to the Pressure Hold and Burst tests.

After having withstood impulsing for 150 cycles without leakage, a brake hose assembly was able to withstand a 2 min pressure hold at 27.6 MPa without leakage and did not burst at less than 34.5 MPa.

5.13 Salt Spray test

5.13.1 Each end fitting of the hose assembly was plugged.

5.13.2 A salt Solution (5 ± 1) Parts by mass of sodium chloride to 95 Parts of distilled water was mixed, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 % (m/m) of sodium iodide and not more than 0.3 % (m/m) total impurities. Ensure that the Solution is free of suspended solids before it is atomized.

5.13.3 After atomization at 350C, the collected Solution was in the pH range of 6.5 to 7.2. pH measurements were made at 250C. -

5.13.4 A compressed air supply was maintained to the nozzle free of oil and dirt, and between 68.9 kPa and 72.4 kPa.

5.13.5 The Hose assembly was placed in the apparatus as described in Clause 6.13.2 of the standard.

5.13.6 The hose assembly was subjected to the NSS test in ISO 9227 continuously for 24 h min.

5.13.7 The mixture was regulated so that each collector collected from 1 ml to 2 ml of Solution per hour for each 80 cm2 of horizontal collecting area.

5.13.8 The exposure zone temperature was maintained at 350C ± 20C.

5.13.9 Upon completion, the salt deposit was removed from the surface of the hose assemblies by washing gently and dipping in clean running water not warmer than 370C and then drying with air within 2 min.

5.13.10 The end fittings for base metal corrosion were examined and results recorded.

Following the 24 h exposure test, samples did not show any signes of base metal corrosion.

6.0 CONCLUSION

The assessed brake hoses comply with the performance requirements of

ISO3996:1995(E) - Road Vehicles - Brake Hose Assemblies for Hydraulic Braking Systems Used with Non-petroleum-base Brake Fluid

Signed _____ Date: ____/____/_____