



Materials Technology

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EAR CONTROLLED DATA

Non Destructive Testing • Product Evaluation  
Metallurgical Analysis • Materials Testing • Welder Qualification

**JOB NUMBER:** TCT005206P.1  
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**DATE:** December 16, 2010

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**Report of Physical Testing of  
1/8" (3.2mm) Hydraulic Brake Hose Assemblies  
Part # BQ101**

**Prepared For:  
BrakeQuip, LLC  
Attn: Fred Anderson  
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**Client Purchase Order Number: Fred**

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**INTRODUCTION:**

This report presents the results of tests performed on, Part Number BQ101, 1/8 inch (3.2 mm) Hydraulic Brake Hose Assemblies. These tests were conducted in accordance with the test requirements of the **Federal Motor Vehicle Safety Standard No. 106 (10/07), Society of Automotive Engineers J1401-JUN 2003, Canada Motor Vehicle Safety Standard 106 (CMVSS 106), TSD #106 Rev. 1, Australian Design Rule 7/00, GB 16897-1997, ISO 3996-1995 and Japanese Industrial Standard JIS D2601:2006.** This work was requested by Fred Anderson of BrakeQuip, LLC. The samples were received on November 23, 2010 with the work conducted from November 23, 2010 through December 10, 2010.

**SAMPLE DESCRIPTION:**

Fifty (50) hose assemblies, assembled with 10m x 1 female fittings on one end and 10m x 1 male fittings on the other were submitted for testing.

**TEST RESULTS SUMMARY:**

The following are results of testing conducted on the above referenced hydraulic brake hose assemblies in accordance with the test requirements (see specification legend below).

Test Legend:	A (FMVSS 106)		B (SAE J1401)		C (ADR 7/00)		G (ISO 3996)	
	D (CMVSS 106 & TSD 106)				E (GB 16897)		F (JIS D2601)	
Tests	A	B	C	D	E	F	G	
Original (Unsoaked Hose)								
Constriction	C	C	C	C	C	C	C	C
Volumetric Expansion – Low	C	C	C	C	C	C	C	C
Burst Strength	C	C	C	C	C	C	C	C
Whip Resistance	C	C	C	C	C	C	C	C
Tensile Strength (Slow Pull)	C	C	C	C	C	C	C	C
Tensile Strength (Fast Pull)	C	C	C	C	N/A	C	C	C
Low Temperature Resistance (Cold Bend)	C	C	C	C	C	C	C	C
Brake Fluid Compatibility	C	C	C	C	C	C	C	C
End Fitting Corrosion Resistance (Salt Spray)	C	C	C	C	C	C	C	C
Ozone Resistance	C	C	C	C	C	N/A	N/A	N/A
Dynamic Ozone Resistance	C	C	C	C	N/A	C	C	C
Hot Impulse	C	C	C	C	N/A	C	C	C
Water Absorption (Soak Hose)								
Burst Strength	C	C	C	C	C	C	C	C
Whip Resistance	C	C	C	C	C	C	C	C
Tensile Strength (Fast Pull)	C	C	C	C	N/A	C	C	C

C= complies N/A = Not applicable

Australian Design Rule 7/00 states that the technical requirements of SAE J1401-JAN81 and FMVSS 106-74 shall be deemed equivalent. Both standards have been updated to the versions listed above and determined to be equal to or more severe in procedures and requirements.

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**SAMPLE IDENTIFICATION:****Construction (as supplied by manufacturer):**

Inner tube	=	EPDM
Reinforcement Braid	=	PVA
Inner Layer	=	CR
Reinforcement Braid	=	PVA
Cover	=	EPDM
End fitting	=	Trivalent Zinc Coating corrosion protection

**IDENTIFICATION MARKINGS:**

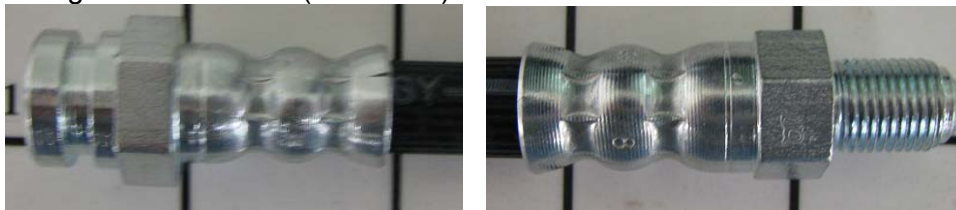
Hose Cover – DOT – GY – 11/10 - 1/8 - HL



180° opposite print- ---- BQ USA – 1/8 – BQ101 – 11/03/10 M - SAE J1401 ----



Fittings – \* 798 BQ (both ends)



Tracer Cords – Green

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**TEST METHODS AND RESULTS:**

**Constriction**

Hose assemblies were measured for hose constriction by means of a gage plug whose spherical end dimension is 0.080 inch (2.03 mm) in diameter. All hose assemblies permitted the gage to drop of its own weight a distance of three inches into the hose assembly within five seconds and **all were greater than 64 percent** of nominal inside diameter.

FMVSS 106, SAE J1401, CMVSS 106, TSD 106, GB 16897, ISO 3996 & JIS D 2601 state that the inside diameter of any section of hydraulic brake hose assembly shall not be less than 64 percent of nominal inside diameter of the hose.

**Volumetric Expansion and Burst Strength**

The expansion and bursting strengths were determined in accordance with the methods and apparatus specified. The following tabulations show the results of expansion and burst test on four original (un-soaked) hose assemblies and burst test only on three hose assemblies that are soaked for 70-72 hours in distilled water heated to 85 degrees Celsius (185 degrees Fahrenheit) and one hose assembly that was stripped of its cover (28.6 mm) at its center and soaked for 70 hours in distilled water at room temperature.

**Expansion Per Meter (Foot) of Free Length  
 In Cubic Centimeters**

<b>Un-soaked Hose Sample No.</b>	<b>@ 6.9 MPa (1000 psi)</b>	<b>@ 10.3 MPa (1500 psi)</b>	<b>@ 20 MPa (2900 psi)</b>	<b>Bursting Strength* MPa (psi)</b>
1	0.33 (0.10)	0.42 (0.13)	0.94 (0.29)	86.5 (12,540)
2	0.32 (0.10)	0.42 (0.13)	0.92 (0.28)	79.8 (11,580)
3	0.39 (0.12)	0.45 (0.14)	0.96 (0.29)	81.2 (11,780)
4	0.36 (0.11)	0.52 (0.16)	0.92 (0.28)	78.7 (11,410)
<b>Specification Requirement</b>				
Low Expansion Hose cc/m (cc/ft)	<b>1.08 (0.33)</b> Maximum	<b>1.38 (0.42)</b> Maximum	<b>2.0 (0.61)</b> Maximum	<b>49 (7,000)</b> Minimum**

(\*) All assemblies withstood water pressure of **27.6 MPa (4,000 psi)** for 2 minutes **without rupture** prior to the burst test.

(\*\*) 34.5 MPa minimum for GB 16897

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**TEST METHODS AND RESULTS: (Cont.)**

Soaked Hose Sample No.	Bursting Strength* MPa (psi)
20	61.6 (8,940)
21	80.5 (11,670)
22	81.4 (11,800)
23 (stripped)	68.2 (9,890)
Specification Requirement	<b>49 (7,000) Minimum**</b>

(\*) All assemblies withstood water pressure of **27.6 MPa** (4,000 psi) for 2 minutes **without rupture** prior to the burst test.

(\*\*) 34.5 MPa minimum for GB 16897

**Whip Resistance**

Four original hose assemblies, three hose assemblies that are soaked for 70-72 hours in distilled water heated to 85 degrees Celsius (185 degrees Fahrenheit), and one hose assembly that was stripped of its cover (28.6 mm) at its center and soaked for 70 hours in distilled water at room temperature, were then coupled to the connecting rods of a Whip Test machine conforming to ASTM D571-72. While under constant water pressure, maintained between 235 and 250 psi supplied through the adjustable headers, the samples were subjected to the swirling action caused by the arms rotating at a speed of 800 +/- 10 rpm continuously for a period of **42.7 hours** (test discontinued). The apparatus was equipped with a pressure gage installed on the manifold, a pressure regulator to operate a limit switch to stop the machine when the pressure drops, a revolution counter, and an electric timer to indicate elapsed time.

There was **no water leakage** through rupture on the hose assemblies during the period of this test.

**Specifications state** the minimum life of any one of the sample hose assemblies, with free length ranging from 8 to 24 inches, running continuously on the flexing machine, **shall be 35 hours**. Hose armor, if present, shall be removed prior to the test.

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**TEST METHODS AND RESULTS (cont.)**

**Tensile Strength**

Tension tests were conducted in a testing machine conforming to ASTM E4 of 1000 pounds capacity. The specimens were secured so that the hose and fittings had a straight centerline corresponding to the machine pull. Results of the tension test for the original (unsoaked) hose and three hose assemblies that are soaked for 70-72 hours in distilled water heated to 85° C (185° F) and one hose assembly that was stripped of its cover (28.6mm) at its center and soaked for 70hrs in distilled water at room temperature.

**Slow Pull (1 inch per minute) Tensile Strength, kN (lbs)**

Hose Sample No.	Un-soaked Hose	Hose. Sample No.	Soaked Hose
9	2.93 (658) A	28	3.11 (701) A
10	3.15 (709) A	29	3.51 (789) A
11	3.29 (740) A	30	3.27 (735) A
12	3.27 (735) A	31 (stripped)	3.18 (715) A

Location of Rupture: A = End Fitting B = Stripped Area

**FMVSS 106, SAE J1401, ISO 3996, CMVSS 106 & TSD 106 - Specification Requirement: 1.44 kN (325 Lbs) at one inch per minute separation**

**GB 16897 – Specification Requirement: 1500 N (325 Lbs) at one inch per minute separation**

**JIS D 2601 – Specification Requirement: 1446 N (325 Lbs) at one inch per minute separation**

**Fast Pull (2 inch per minute) Tensile Strength, kN (lbs)**

Hose Sample No.	Un-soaked Hose	Hose. Sample No.	Soaked Hose
13	3.04 (684) A	32	3.57 (802) A
14	3.37 (757) A	33	3.19 (716) A
15	3.28 (738) A	34	3.63 (815) A
16	3.28 (737) A	35 (stripped)	3.22 (723) A

Location of Rupture: A = End Fitting B = Stripped Area

**FMVSS 106, SAE J1401, ISO 3996, CMVSS 106, TSD 106, & JIS D2601 - Specification Requirement: 1.65 kN (370 lbs) at two inches per minute separation**

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**TEST METHODS AND RESULTS (cont.)**

**Low Temperature Resistance**

One original hose assembly was conditioned in a cold cabinet in a straight position at negative 48 degrees Celsius for 70 hours. After conditioning and without removal from the cold cabinet, the hose was bent around a mandrel having a diameter of 3 inches. The hose assembly **did not crack or break** per specification.

**Specifications state:**

**FMVSS 106, SAE J1401, CMVSS 106, TSD 106, ISO 3996 & JIS D2601:** No visible crack without magnification when bent around 3 inch mandrel after conditioning at negative 45 degrees Celsius to negative 48 degrees Celsius (negative 49 degrees Fahrenheit to negative 54 degrees Fahrenheit ) for 70 hours.

**GB 16897:** No visible crack without magnification when bent around 3 inch mandrel after conditioning at negative 40 degrees Celsius (negative 40 degrees Fahrenheit) for 70 hours.

**Brake Fluid Compatibility**

Four brake hose assemblies were filled with SAE RM 66-05 compatibility brake fluid, the lower end sealed and placed in a vertical position in an oven at 120 degrees Celsius (248 degrees Fahrenheit) for 70 hours. After removal from the oven the specimen was allowed to cool to room temperature for 30 minutes and then drained. Constriction was again determined as well as burst strength.

The constriction measurements were again found to be satisfactory as they **exceeded 64 percent of the** nominal inside diameter requirement.

Hose Sample No.	Bursting Strength* MPa (psi)	Hose. Sample No.	Bursting Strength* MPa (psi)
36	98.04 (14,220)	38	78.53 (11,390)
37	84.80 (12,300)	39	91.91 (13,330)

**Specification Requirement:** 34.5 (5,000) Minimum

(\*) All assemblies withstood water pressure of **27.6 MPa** (4000 psi) for 2 minutes **without rupture** prior to the burst test.

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### TEST METHODS AND RESULTS (cont.)

#### End Fitting Corrosion Resistance

Hose assembly end connections, after being exposed to the 24-hour salt spray in accordance with ASTM B117-97, **exhibited no evidence** of red rust or white corrosion.

**Specifications state** end fittings shall exhibit no base metal corrosion except where crimping or stamping has caused displacement of the protective coating.

#### Ozone Resistance

##### **Static Ozone**

A specimen was wrapped around a three-inch diameter mandrel (approximately eight times the nominal outside diameter of the hose) and the ends were bound with tape where they crossed one another. After conditioning for a period of 24 hours at room temperature and while on the mandrel, the specimen was placed in a cabinet containing air mixed with ozone in the proportion of 100 +/- 5 parts of ozone per 100 million parts of air by volume. The ambient temperature in the cabinet was maintained at 40 degrees Celsius (104 degrees Fahrenheit) during the exposure of the specimen.

After the specimen had been exposed to this mixture for a period of 70 hours, the cover of the specimen was examined under 7-power magnification ignoring the areas immediately adjacent to or within the area covered by the tape.

The outer cover of the hose was observed at the specified magnification after the above exposure test, and **did not exhibit cracking**.

##### **Specifications state:**

**FMVSS 106, SAE J1401, CMVSS 106 & TSD 106:** No visible crack under 7-power magnification ignoring areas immediately adjacent to or within the area covered by binding after conditioning as detailed above.

**GB 16897:** No visible crack under 7-power magnification ignoring areas immediately adjacent to or within the area covered by binding after conditioning at 40 degrees Celsius (104 degrees Fahrenheit) for 70 hours and 50 parts of ozone per 100 million parts of air by volume.

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**TEST METHODS AND RESULTS (cont.)**

**Dynamic Ozone**

Four hose specimens (cut to lengths of 218 +/- 3 mm (8.6 +/- 0.1 inch)) were subjected to a dynamic ozone exposure test. Samples were assembled on the prescribed SAE test apparatus in a stabilized ozone chamber containing air mixed with ozone in the proportion of 100 +/- 5 parts of ozone per 100 million parts of air by volume. The ambient temperature in the cabinet was maintained at 40 degrees Celsius (104 degrees Fahrenheit) during the exposure of the specimen. The flex rate was set at 0.30 Hz +/- 0.05 Hz and the hoses were examined for cracks every 24 hours in the area of worst stress condition, for cracks visible to the eye without magnification.

The test was discontinued following completion of 48 hours when **no cracks were visible** in any of the samples.

**Specifications state:**

**FMVSS 106, SAE J1401, CMVSS 106, TSD 106, ISO 3996 & JIS D2601:** No visible crack without magnification ignoring areas immediately adjacent to or within the area covered by band clamps after conditioning as detailed above.

**Hot Impulse**

Four hose assemblies were pressure cycled 150 times with fluid and ambient temperatures maintained at 146 degrees Celsius (295 degrees Fahrenheit). The cycles consisted of 1 +/- 0.1 minute at 11 MPa + 0.5, -0 MPa (1600 psi + 75, -0 psi) pressure followed by 1 +/- 0.1 minute at 0 pressure. The pressure medium was hydraulic brake fluid.

Following the pressure cycling described above the hose assemblies were conditioned at room temperature for 45 minutes minimum and then tested for pressure hold and burst strength.

Sample No.	Bursting Strength* MPa (psi)
40	95.42 (13,840)
41	86.05 (12,480)
42	93.42 (13,550)
28	94.80 (13,750)
Performance Requirement	<b>34.5 (5,000) Minimum</b>

\*Prior to the burst test all of the samples withstood water pressure of 4,000 psi for 2 minutes **without fluid seepage.**

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**TEST METHODS AND RESULTS: (Cont.)**

**No sign of fluid seepage, cracking or separation were noted during the impulse cycling.**

Specifications state samples shall show no signs of fluid seepage, cracking or separation while being cycled. Following impulse testing, the hose assemblies must meet the original requirements of the pressure hold and burst strength tests.

**CALIBRATED TEST EQUIPMENT:**

- PT-171-016 – Digital Caliper Due Date 9/30/11
- PT-172-037 – Constriction Gauge Due Date 2/11/11
- PT-173-026 – Fisher Scientific Digital Thermometer Due Date 9/17/11
- PT-173-033 – Thermotron Temperature/Humidity Chamber Due Date 9/16/11
- PT-172-050 – Mandrel Due Date 7/20/11
- PT-174-006a – Ozone Test Chamber - temp Due Date 9/15/11
- PT-174-006b – Ozone Test Chamber - analyzer Due Date 3/17/11
- PT-174-002 – Salt Spray Cabinet Calibrated per Use
- PT-174-029 – Testing Machine Due Date 11/2/11
- PT-174-015 – Pressure Transducer Due Date 9/28/11
- PT-174-020 – Whip Machine Due Date 7/26/11
- PT-174-012 – Pressure gauge Due Date 10/18/11
- PT-175-003 – Chamber Oven Due Date 9/15/11

**REMARKS:**

The samples will be discarded thirty days from the date on this report unless further instructed by the client

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