



CIRCLE SEAL CONTROLS, INC.
CORONA, CA 91720

NO. QTR 1174

REV. -

PAGE: A-10

ECO No. 15693C

01-04-20

TITLE: Qualification Test Report for 8100 Series Valves

Powertech

Powertech Labs Inc. • 12388-88th Ave., Surrey, B.C. • Canada V3W 7R7

TEST CERTIFICATE

Certificate Number: PLI-5013, Rev. 0 **File:** 12745-36

Issued To: Circle Seal Controls, Inc.
P.O. Box 3300
2301 Wardlow Circle
Corona, CA 91718

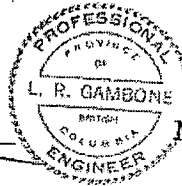
Part: Pressure Relief Device
Type Thermally Activated

Model: 8100 Series
5,000 psi Service Pressure @ 70°F
219°F Eutectic
Brass Body Design

As an independent inspection agency for NGV component testing, Powertech certifies that the above pressure relief device has met the design qualification requirements of ANSI/IAS PRD 1-1998 and ANSI/IAS PRD 1a-1999, "Pressure Relief Devices for Natural Gas Vehicle (NGV) Fuel Containers".

Prepared by:

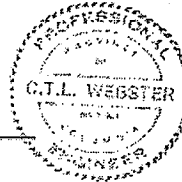
L.R. Gambone, P.Eng.



March 30, 2001

Approved by:


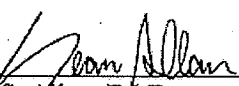
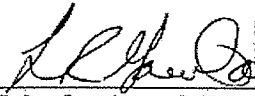
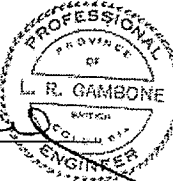
C.T.L. Webster, P.Eng.
Manager, Gas Systems Group

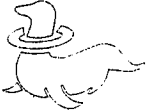


March 30, 2001





<p>Powertech  Gas Systems Engineering</p> <p>12388 - 88th Avenue Surrey, B.C. CANADA V3W 7R7 (604) 590-7500</p>	<p>TEST REPORT</p>	<p>Page 1 of 1 File: 12745-36</p>
<p>TEST: ANSII/AS PRD 1-1998 7.6 THERMAL CYCLING</p>		
<p>Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u></p>		
<p>Part Type: <u>Thermally activated PRD</u></p>		
<p>Part Model: <u>8100-22-BB</u> Serial #: <u>N/A</u></p>		
<p>Part Data: <u>One PRD sample, 219°F eutectic, 5,000 psi service pressure</u></p>		
<p>TEST PROCEDURE:</p> <p>One pressure relief device sample was thermally cycled between +82°C (+180°F) and -40°C (-40°F) for periods of 2 hours or more at each temperature for a total of 15 thermal cycles. Immediately following this test, the sample was pressure cycled 100 times between 300 psi and 5,000 psi at a rate of 10 cycles per minute.</p> <p>Following this test, the sample must meet the requirements of Section 7.11 (Leakage) and Section 7.12 (Benchtop Activation). The sample was subjected to Section 7.11 (Leakage) by pressurizing to 6,250 psi air at +21°C (+70°F) and monitoring for leakage by immersing in water for 3 minutes. The sample was subsequently activated per Section 7.12 (Benchtop Activation) by pressurizing to 1,250 psi nitrogen and inserting into a specially constructed chimney capable of maintaining a gas temperature of +593°C (+1,100°F).</p>		
<p>TEST RESULTS:</p> <p>At the completion of the thermal cycling test, the sample did not exhibit leakage.</p> <p>The sample activated after 49 seconds. A sample that had not previously been subjected to design qualification tests activated after 50 seconds.</p> <p>The results met the requirements of the above test.</p>		
<p>Tested by:</p> <p> S. Allan, E.I.T.</p>	<p>Approved by:</p> <p> L.R. Gambone, P.Eng.</p> <p></p>	<p>Date: <u>March 8, 2001</u></p>






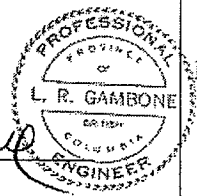
TITLE: Qualification Test Report for 8100 Series Valves

	TEST REPORT	Page 1 of 1
12388 - 88 th Avenue Surrey, B.C. CANADA V3W 7R7 (604) 590-7500	TEST: ANSII/AS PRD 1a-1999 7.7 SALT CORROSION RESISTANCE	
Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u>		
Part Type: <u>Thermally activated PRD</u>		
Part Model: <u>8100-22-BB</u>	Serial #: <u>N/A</u>	
Part Data: <u>Two PRD samples, 219°F eutectic, 5,000 psi service pressure</u>		
TEST PROCEDURE:		
<p>Two pressure relief device samples were installed in accordance with the manufacturer's recommended procedure and pressurized to 6,250 psi. The samples were subjected to 144 hours of salt spray (fog) testing per ASTM B117 with the pH of the salt solution adjusted to 4.0 through the addition of sulfuric acid in the test of one unit, and the pH of the salt solution adjusted to 10.0 through the addition of sodium hydroxide in the test of the second unit. Both salt solutions were aerated to provide oxygen and carbon dioxide.</p>		
<p>Following this test, the samples must meet the requirements of Section 7.11 (Leakage) and Section 7.12 (Benchtop Activation). The samples were subjected to Section 7.11 (Leakage) by pressurizing to 6,250 psi air at +21°C (+70°F) and monitoring for leakage by immersing in water for 3 minutes. The samples were subsequently activated per Section 7.12 (Benchtop Activation) by pressurizing to 1,250 psi nitrogen and inserting into a specially constructed chimney capable of maintaining a gas temperature of +593°C (+1,100°F).</p>		
TEST RESULTS:		
<p>At the completion of the salt corrosion test, none of the samples were found to exhibit leakage.</p>		
<p>The two samples activated after 49 seconds (pH 4.0) and 52 seconds (pH 10.0). A sample that had not previously been subjected to design qualification tests activated after 50 seconds.</p>		
<p>The results met the requirements of the above test.</p>		
Tested by:	Approved by:	Date: <u>March 8, 2001</u>
 S. Allan, E.I.T.	 L.R. Gambone, P.Eng.	

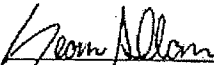
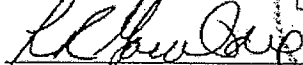



TITLE: Qualification Test Report for 8100 Series Valves

<p>Powertech  Gas Systems Engineering</p> <p>12388 - 88th Avenue Surrey, B.C. CANADA V3W 7R7 (604) 590-7500</p>	<p>TEST REPORT</p>	<p>Page 1 of 1 File: 12745-36</p>
<p>TEST: ANSI/IAS PRD 1-1998 7.8 GAS CONDENSATE CORROSION RESISTANCE</p>		
<p>Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u></p>		
<p>Part Type: <u>Thermally activated PRD</u></p>		
<p>Part Model: <u>8100-22-BB</u> Serial #: <u>N/A</u></p>		
<p>Part Data: <u>One PRD sample, 219°F eutectic, 5,000 psi service pressure</u></p>		
<p>TEST PROCEDURE:</p> <p>One pressure relief device sample was filled with a natural gas condensation solution and soaked for 100 hours at +21°C (+70°F). Following the soak, the solution was removed from the sample and the device was maintained at +82°C (+180°F) for 100 hours. The outlet port of the pressure relief device was sealed. The natural gas condensate solution consisted of the following (by volume): 10% benzene, 2.5% Fryquel No. 15 compressor oil, 1.0% methanol, 1.5% water, 0.2% mercaptan and 84.8% Stoddard solvent.</p> <p>Following this test, the sample must meet the requirements of Section 7.11 (Leakage) and Section 7.12 (Benchtop Activation). The sample was subjected to Section 7.11 (Leakage) by pressurizing to 6,250 psi air at +21°C (+70°F) and monitoring for leakage by immersing in water for 3 minutes. The sample was subsequently activated per Section 7.12 (Benchtop Activation) by pressurizing to 1,250 psi nitrogen and inserting into a specially constructed chimney capable of maintaining a gas temperature of +593°C (+1,100°F).</p>		
<p>TEST RESULTS:</p> <p>At the completion of the gas condensate corrosion resistance test, the sample did not exhibit leakage.</p> <p>The sample activated after 58 seconds. A sample that had not previously been subjected to design qualification tests activated after 50 seconds.</p> <p>The results met the requirements of the above test.</p>		
<p>Tested by:</p> <p> S. Allan, E.I.T.</p>	<p>Approved by:</p> <p> L.R. Gambone, P.Eng.</p>	<p>Date: <u>March 8, 2001</u></p>


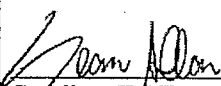
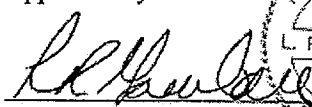
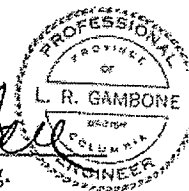




Powertech Gas Systems Engineering	TEST REPORT	Page 1 of 1
12388 - 88 th Avenue Surrey, B.C. CANADA V3W 7R7 (604) 590-7500	TEST: ANSIIAS PRD 1a-1999 7.9 STRESS CORROSION CRACKING RESISTANCE	
Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u>		
Part Type: <u>Thermally activated PRD</u>		
Part Model: <u>8100-22-BB</u>		Serial #: <u>N/A</u>
Part Data: <u>One PRD sample, 219°F eutectic, 5,000 psi service pressure</u>		
<p>TEST PROCEDURE:</p> <p>One pressure relief device sample was subjected to a moist ammonia-air mixture for ten days in a glass chamber not larger than 305 mm (12 in.) on a side and having a glass cover. Approximately 600 ml of aqueous ammonia having a specific gravity of 0.90 was maintained at the bottom of the glass chamber below the sample. The sample was positioned 38 mm (1.5 in.) above the solution and supported in an inert tray. The moist ammonia mixture was maintained at atmospheric pressure with the temperature constant at approximately +34°C (+93°F). The sample was subjected to the stresses normally imposed on it as a result of assembly, i.e the sample was installed per the manufacturer's recommended assembly torque of 210 in.-lbs.</p> <p>Following this test, the sample shall not exhibit signs of cracking or delamination.</p>		
<p>TEST RESULTS:</p> <p>At the completion of the stress corrosion cracking resistance test, the sample exhibited no signs of cracking or delamination.</p> <p>The results met the requirements of the above test.</p>		
Tested by:	Approved by:	Date: <u>March 8, 2001</u>
 S. Allan, E.I.T.	 L.R. Gambone, P.Eng.	



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<p>TEST: ANSI/AS PRD 1-1998 7.10 VIBRATION</p>		
<p>Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u></p>		
<p>Part Type: <u>Thermally activated PRD</u></p>		
<p>Part Model: <u>8100-22-BB</u> Serial #: <u>N/A</u></p>		
<p>Part Data: <u>One PRD sample, 219°F eutectic, 5,000 psi service pressure</u></p>		
<p>TEST PROCEDURE:</p> <p>One pressure relief device sample was subjected to 2 hours of vibration in each of 3 orthogonal axes at a frequency of 17 Hz and at an amplitude of 1.5 mm (0.06 inch).</p> <p>Following this test, the sample must meet the requirements of Section 7.11 (Leakage) and Section 7.12 (Benchtop Activation). The sample was subjected to Section 7.11 (Leakage) by pressurizing to 6,250 psi air at +21°C (+70°F) and monitoring for leakage by immersing in water for 3 minutes. The sample was subsequently activated per Section 7.12 (Benchtop Activation) by pressurizing to 1,250 psi nitrogen and inserting into a specially constructed chimney capable of maintaining a gas temperature of +593°C (+1,100°F).</p>		
<p>TEST RESULTS:</p> <p>At the completion of the vibration test, the sample did not exhibit leakage.</p> <p>The sample activated after 63 seconds. A sample that had not previously been subjected to design qualification tests activated after 50 seconds.</p> <p>The results met the requirements of the above test.</p>		
<p>Tested by:</p> <p> S. Allan, E.I.T.</p>	<p>Approved by:</p> <p> L.R. Gambone, P.Eng.</p> <p></p>	<p>Date: <u>March 8, 2001</u></p>



CIRCLE SEAL CONTROLS, INC.
CORONA, CA 91720

NO. QTR 1174


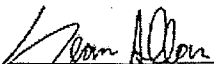

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<p>TEST: ANSI/IAS PRD 1-1998 7.13 FLOW CAPACITY</p>		
<p>Manufacturer: <u>Circle Seal Controls Inc., P.O. Box 3300, 2301 Wardlow Circle, Corona, CA, 91718</u></p>		
<p>Part Type: <u>Thermally activated PRD</u></p>		
<p>Part Model: <u>8100-22-BB</u> Serial #: <u>N/A</u></p>		
<p>Part Data: <u>Three PRD samples, 219°F eutectic, 5,000 psi service pressure</u></p>		
<p>TEST PROCEDURE:</p> <p>Three previously activated pressure relief device samples were tested for flow capacity using air supplied at 97 psig and at a temperature of +70.0°F. The flow capacity was measured using a Meter Equipment Manufacturing flowmeter.</p>		
<p>TEST RESULTS:</p> <p>The flow capacity was corrected to 100 psig air at +70°F and was determined to be 76 scfm, 88 scfm and 89 scfm for the 3 samples.</p>		
<p>Tested by:</p> <p> S. Allan, E.I.T.</p>	<p>Approved by:</p> <p> L.R. Gambone, P.Eng.</p>	<p>Date: <u>March 26, 2001</u></p>

