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FLUID CONTROL RESEARCH INSTITUTE, PALAKKAD

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**FUGITIVE EMISSION TESTING OF VALVE
for**

DELVAL FLOW CONTROLS PVT LTD, SATARA- 412 801

Report No. : FCRI/ET/233/2014

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DATE OF RECEIPT : 01-12-2013

APPROVED BY

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SUMMARY

A ON/OFF valve of size 8" x ASME Class 150 with Wafer ends was tested for fugitive emission at 10 bar operating pressure at elevated temperature of 177° C using Helium as the Test fluid with 3000 numbers of mechanical cycles and three thermal cycles under the leak rate category of **100 ppm** as per **standard method for the Evaluation of External leakage of manual and automated On-Off valves ANSI/ISA 93.00.01-1999**. Helium mass spectrometer with sniffing probe method was used to measure the leakage flow rate from the stem seal and body bonnet seal. During the test leakage rate was within allowable limit. The Valve qualifies for the leakage category of 100 ppm, temperature class of the valve room temperature to 177 ° C. During the test program, stem seal adjustment was not adjusted.

Tested by

Witnessed by

Checked by

NISHANTH. R

S. MANIKANDAN

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1. TECHNICAL SPECIFICATION OF THE VALVE ASSEMBLY UNDER TEST

Valve type : Double Eccentric type High performance Butterfly Valve

Valve size & Press rating : 8" x ASME Class 150 with Wafer ends

Valve operator : Pneumatic Rotary actuator.

Valve Sl.No : VLA140145-01

Valve performance class : Leakage category of 100 ppm.

Make : DelTech,

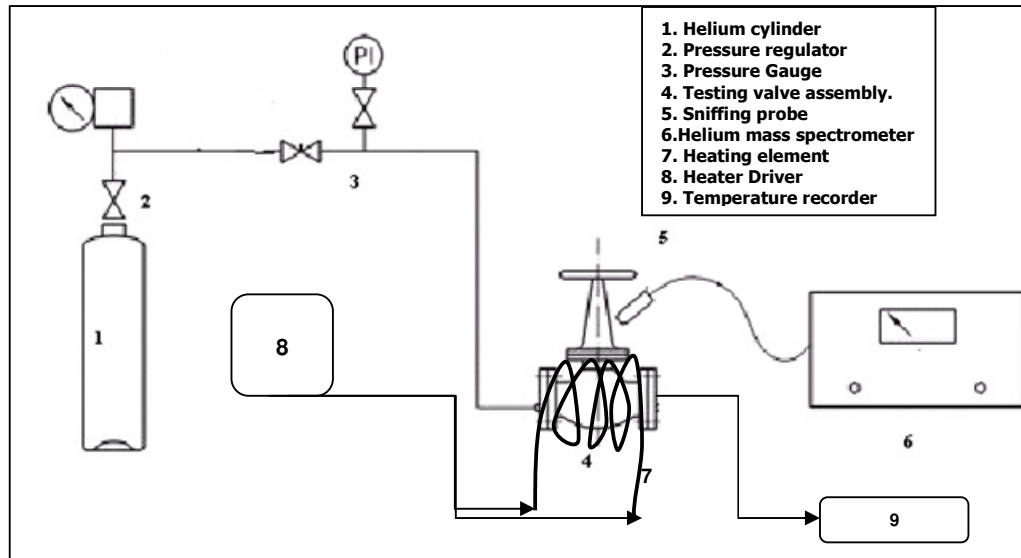
2. EQUIPMENT SPECIFICATION USED IN THE TEST

1. Helium Mass spectrometer
 Make: Alcatel, Model: ASM 142
 Measurement range: 1.07×10^{-7} to 1.10×10^{-1} mbar l/sec in sniffing mode
2. Pressure Gauge
 Make : Budenberg Pressure : 0-150 bar
 Accuracy : 0.15bar Dial Size : 4"
3. Double stage Pressure Regulator
 Range: 0-250 bar make: ESAB
 Type: Bellow
4. Helium Gas
 Pressure: 150 bar, Purity: 99.99%
5. Tubes and Fittings
 Make: swagelok, Size: 1/4" Pressure range: 400 bar
6. Heater
 Capacity : 3000 watts Type: flexible coil type
 Voltage Range : 440 V
7. Thermocouple
 Type: "T" Type Range: 0 to 400 °C
 Accuracy: 0.1 °C
8. Temperature Indicator
 Make : Max Thermo Type : PID Controller
 Model No : MC-2838 Resolution : 0.1 °C

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3.0 METHOD OF TEST**Fig. 1 Schematic of the Experimental Setup**

For fugitive emission testing, a fully assembled valve with all accessories was taken for test. The test valve interior was checked for dryness and the packing also checked prior to the test. The valve was mounted in a test rig as shown in figure no.1. The test valve was pressurized with Helium gas through a pressure reducing valve to rated pressure of 10 bar. Leakage through the body and stem seals were measured using He mass spectrometer. The test fluid was used in the test was helium gas of 99.99 % purity.

3.1 Test program

The test valve was mounted on a test the rig vertically, as per the instructions of the manufacturer. All sealing systems have been properly adjusted before test. The Leakage from the stem seal and from the body seals was separately measured.

Leak measurement using the sniffing method

Helium leak detector was fitted with a detector probe (sniffer), to measure helium concentration due to emissions from stem sealing systems and body seals.

Before starting the test, helium spectrometer was activated in the auto-calibration mode. Prior to each measurement, the ambient helium concentration around the source was determined by moving the probe randomly at a distance of one or two meters from the source. End connections of the valve body have been checked to insure that they do not affect the results of the evaluation of the body seals. The probe was positioned as close as possible to the potential leak source.

Probe was moved, while observing the instrument readout maximum. The method has been repeated two times. The maximum leakage values were recorded.



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Preliminary tests at the room temperature

Test valve was pressured with the test fluid to the test pressure as specified in the relevant standard. After the test pressure was stabilized, measure both leakages from the stem seal and the body-bonnet seals. The test result was recorded in the data sheet.

Mechanical cycle test at the room temperature

The test valve was subjected to 10 bar pressure at ambient temperature with 45 mechanical cycles. Opening the valve from full close to full open of the rated stroke and back to full close was considered as one mechanical cycle. The leakage from the stem seal and body-bonnet before and after 45 cycles were noted. The test result has been recorded in the data sheet. All leakage measurements are verified equal or lower than the values specified with standard. All results of leakage measurements were recorded in the data sheet.

Mechanical cycle test at temperature transition of RT to 177°C

After completion of 45 mechanical cycles at ambient temperature, the test valve was heated to 177° C and the pressure to 10 bar. Test valve was subjected to 170 mechanical cycles at this transition temperature condition. The leakage from the stem seal before & after cycles was noted down. The test result has been recorded in the data sheet.

Mechanical cycle test at elevated temperature of 177°C

After completion of 215 mechanical cycles at transition temperature, the test valve was elevated to 177° C and the pressure to 10 bar. Test valve was subjected to 600 mechanical cycles at this condition. The leakage from the stem seal before & after cycles was noted down. The test result has been recorded in the data sheet.

Mechanical cycle test at temperature transition of 177°C to RT

After completion of 815 mechanical cycles at elevated temperature, the test valve was cooled to Room temperature and the pressure to 10 bar. Test valve was subjected to 170 mechanical cycles at this transition temperature condition. The leakage from the stem seal before & after cycles was noted down. The test result has been recorded in the data sheet.

This is considered as one thermal cycle.

Two more thermal cycle with 3000 mechanical cycles as described was performed. This completes leakage rate category of 100 ppm with 3000 mechanical cycles and three thermal cycles as per ANSI/ISA-S93.00.01-1999.

4.0 RESULTS

Mode of operation	: Sniffing Mode
Test Fluid	: 99.99% Helium
Number of Mechanical Cycle	: 3000
Testing Pressure	: 10 bar
Elevated Temperature	: 177 °C
Allowable Leakage Rate	
For Stem Seal	: 100 ppm (2.5 x 10 ⁻⁴ mbar l/s)

One number of ON/OFF Valve was tested as per the Standard. The leakage measurement in stem seal and body seal are recorded before and after the mechanical cycles. Leakage rate obtained for various conditions are tabulated in Table 1. Leakage values were within the allowable values specified by the customer.



Fig. 2 Test Setup

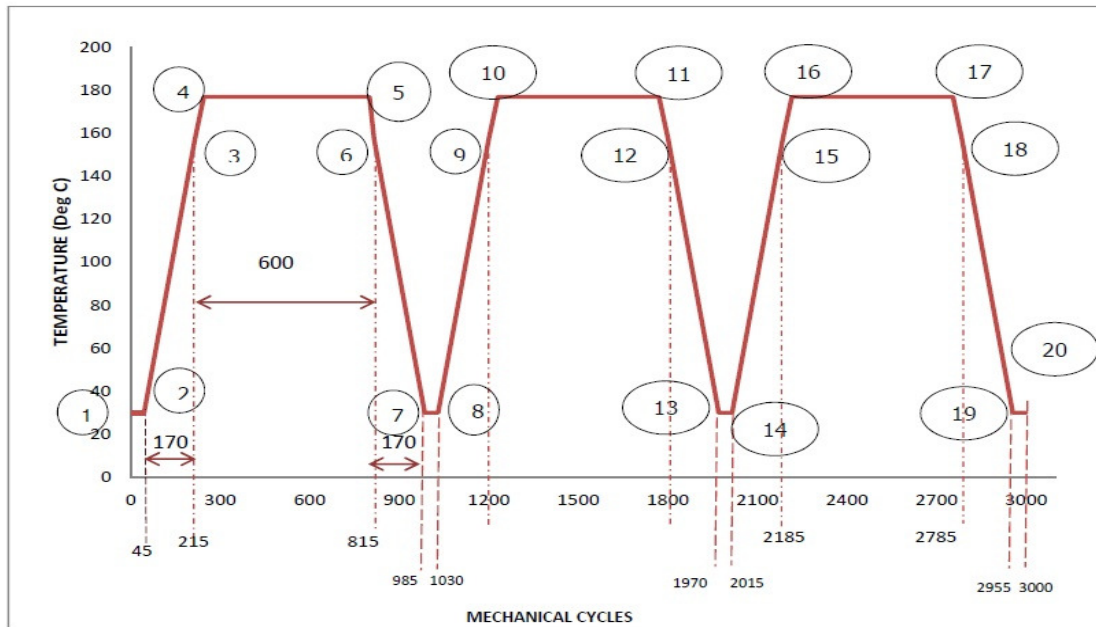


Fig. 3 Test Profile



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Test Condition			Leakage rate (ppm)		No. of Mechanical Cycles	No of Thermal Cycles	Stem adjustment
Sl. No.	Pressure	Temperature	Bonnet	Stem			
	(bar)	(°C)					
1	10	Room Temp.	0.4	0.4	NIL	NIL	
2	10	Room Temp.	0.48	0.4	NIL	NIL	
3	10	Room Temp.	0.48	0.4	NIL	NIL	
4	10	Room Temp.	4.8	4.8	45	1	
5	10	Room Temp.	5.2	5.6	45	1	
6	10	Room Temp.	6.4	6.4	45	1	
7	10	157.2	24	23.2	215	1	
8	10	157.2	28.4	28.4	215	1	
9	10	157.2	30	30.0	215	1	
10	10	176.2	34.4	31.2	215	1	
11	10	176.7	48	48.0	815	1	
12	10	176.7	52	52	815	1	
13	10	176.7	60	60	815	1	
14	10	157.2	52	54	815	1	
15	10	Room Temp.	40	40	985	1	
16	10	Room Temp.	48	48	985	1	
17	10	Room Temp.	48	48	985	1	
18	10	Room Temp.	15.2	15.2	1030	2	
19	10	Room Temp.	15.2	15.6	1030	2	
20	10	Room Temp.	15.2	15.2	1030	2	
21	10	157.2	14	14	1200	2	
22	10	157.2	14	14	1200	2	
23	10	157.2	14	14	1200	2	
24	10	176.7	14	14	1200	2	
25	10	176.7	14	14	1800	2	
26	10	176.7	14	14	1800	2	
27	10	176.7	14	14	1800	2	
28	10	157.2	16.8	18	1800	2	
29	10	Room Temp.	20.4	20.4	1970	2	
30	10	Room Temp.	20.8	20.8	1970	2	

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SI.NO	Test Condition		Leakage rate (ppm)		No. of Mechanical Cycles	No of Thermal Cycles	Stem adjustment
31	10	Room Temp.	20.8	20.8	1970	2	
32	10	Room Temp.	12	12	2015	3	
33	10	Room Temp.	12	12	2015	3	
34	10	Room Temp.	12	12	2015	3	
35	10	157.2	26.8	26.8	2185	3	
36	10	157.2	26.8	27.2	2185	3	
37	10	157.2	26.8	28	2185	3	
38	10	176.7	20	20	2185	3	
39	10	176.7	4.8	4.8	2785	3	
40	10	176.7	4.8	4.8	2785	3	
41	10	176.7	4.8	4.8	2785	3	
42	10	157.2	4.8	4.8	2785	3	
43	10	Room Temp.	4.8	4	2955	3	
44	10	Room Temp.	4.8	4	2955	3	
45	10	Room Temp.	4.8	4	2955	3	
46	10	Room Temp.	4.8	6.8	3000	3	
47	10	Room Temp.	5.2	6.4	3000	3	
48	10	Room Temp.	6.4	6	3000	3	



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5.0 CONCLUSION

One number ON/OFF valve was tested for fugitive emission as per the ANSI/ISA-S93.00.01-1999 by sniffing probe methods. 3000 numbers of mechanical cycle and three thermal cycles were applied at valve pressure of 10 bars and temperature of 177 °C. Stem seal adjustment was not done during the test. Leakage rate at the body bonnet seal and stem seal are recorded. The recorded leakage rates are within the allowable limit at elevated temperature condition as per the standard.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies Leakage category of 100 ppm.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies for temperature range of Room temperature to 177 °C.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies for pressure rating of ASME Class 150.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies for 3000 number of mechanical cycles.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies for 3 number of thermal cycles.

As per section 4.4.1 of ISA 93.00.01-1999, the valve qualifies for no stem seal adjustment.