Product Test Report

Swagelok Company
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TITLE

Fugitive Emissions and Seat Leakage Performance Type Test of Swagelok® VB05 Block and Bleed Process Interface Valves Witnessed by a Third Party

PRODUCT TESTED

Valve Series	Description	Test Pressure	Test Quantity
VB05	Single ball/needle process interface valve 3/8 in. (9.5 mm) bore size (DN 15)	ANSI Class 1500	1
		ANSI Class 2500	1

PURPOSE

The valve assemblies were tested under laboratory test conditions to observe fugitive emissions and seat seal performance when tested according to MESC SPE 77/300, *Procedure and Technical Specification for Type Acceptance Testing (TAT) of Industrial Valves.*

TEST CONDITIONS

Original test date: August 2013

Test Media:

- Helium (Fugitive Emissions Tests)
- Nitrogen (Seat Seal Tests)

Test Pressures: As specified according to each test

Test Temperatures:

- Room Temperature Tests: 70°F (20°C)
- Elevated Temperature Tests: 250°F (121°C)
- Low Temperature Tests: –58°F (–50°C)

Fugitive Emissions Leakage Acceptance Criterion: Tightness Class B

Seat Leakage Acceptance Criteria:

- Ambient and Elevated Temperatures:
  - Ball valve: ISO 5208 Rate A
  - Needle valve: ISO 5208 Rate B
- Low Temperature:
  - Ball valve:1.5 mL/min × (valve DN size)
  - Needle valve: 4.8 mL/min × (valve DN size)

TEST METHOD

The test conditions and test method were as outlined in MESC SPE 77/300. This test protocol subjects the test valve to a series of mechanical and thermal cycles over the full range of the test valve temperature rating. The test valve is tested for seat leakage at various pressures and tested for static and dynamic fugitive emissions at rated pressure.

According to MESC SPE 77/300, Section C.1, testing an ASME Class 2500 valve qualifies that pressure class only, while a Class 1500 valve classifies both Class 1500 and Class 900. Thus, Class 2500 and Class 1500 valve were both tested.

Fig. 1: VB05 77/300 Test Sequence

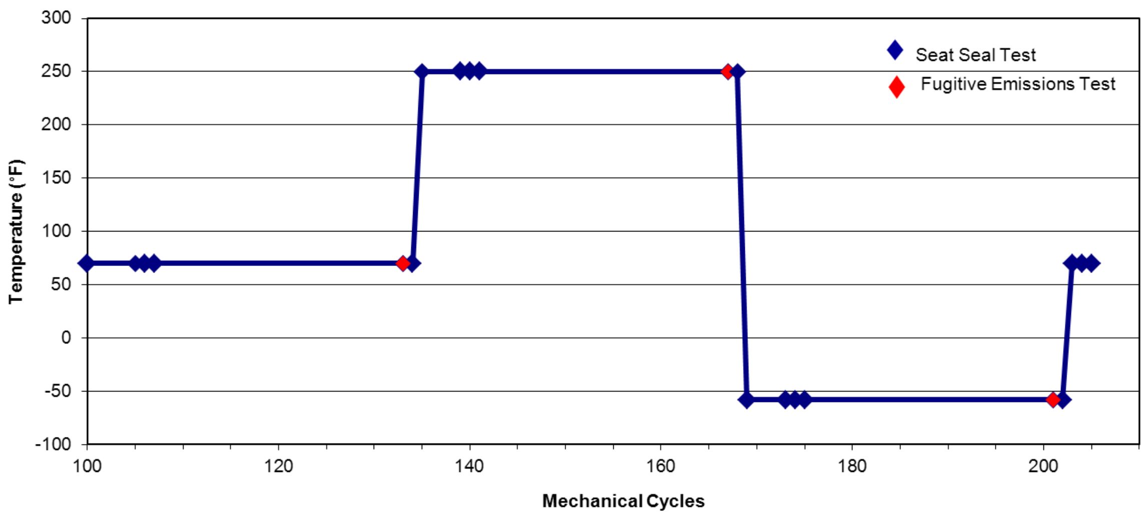

Figure 1 shows the thermal and mechanical profile required for the testing procedure as specified.

Test Preparation and Initial Cycling

1. The test valves were placed into glove boxes that were equipped to supply pressurized nitrogen and helium to the test valves. Bubble cups were used for seat leak detection, consisting of 6 mm tubing placed in water to a depth of 5 mm, as specified. A helium leak detector with a sniffer probe was used for fugitive emissions testing.
2. Three thermocouples were installed on the test valves: one on the outside surface, one inside the valve near the ball valve seat, and one on the needle valve bonnet.
3. The test valve end screws were wrapped with adhesive foil tape to facilitate fugitive emissions testing of the valve end screw body seals. The tape contained a hole near the top of the end screw to allow insertion of the sniffer probe to determine the helium leak rate of the end screw body seals.
4. The test valves were pressurized to their Cold Working Pressure (CWP) with nitrogen and the ball and needle valves were cycled 100 times:
   a. Class 2500 valve CWP: 6250 psig (430 bar)
   b. Class 1500 valve CWP: 3750 psig (258 bar)
5. The test pressure was vented.

Initial Ambient Temperature Test

1. A test pressure of 29 psig (2.0 bar) of nitrogen was applied, and the ball and needle valves were closed and tested for seat leakage for 5 minutes. The test pressure was vented.
2. Step 1 was repeated with a test pressure of 35% of CWP.
3. Step 1 was repeated with a test pressure of 70% of CWP.
4. Step 1 was repeated with a test pressure of 110% of CWP.
5. The test pressure was vented and the test valves were pressurized with helium at a test pressure of 110% of CWP.
6. The test pressure was maintained for 15 minutes, then the test pressure was reduced to 100% of CWP.
7. The ball and needle valves were cycled 25 times. During the 25th cycle, each valve stem was sniffed for dynamic fugitive emissions leakage by placing the sniffer probe within 3 mm of the valve stem, as specified.
8. Each valve stem was sniffed for static fugitive emissions leakage.
9. The test valve end screw and needle bonnet body seals were sniffed for static fugitive emissions leakage.
10. The test pressure was vented and the test valves pressurized with nitrogen to 100% of CWP. The ball and needle valves were closed and tested for seat leakage for 5 minutes.
11. The test pressure was vented.

Elevated Temperature Test

1. The test valve bodies were wrapped with heat tape and the temperature slowly increased until the valve interior temperature reached 250°F (121°C). The heating was controlled so that the difference between the test valve body surface and internal temperature did not exceed 20°C (36°F).
2. A test pressure of 29 psig (2.0 bar) nitrogen was applied, and the ball and needle valves were closed and tested for seat leakage for 5 minutes. The test pressure was vented.
3. Step 2 was repeated with a test pressure of 33% of the valve elevated temperature working pressure (WP).
4. Step 2 was repeated with a test pressure of 66% of WP.
5. Step 2 was repeated with a test pressure of 100% of WP.
6. The test pressure was vented and the test valves pressurized with helium at a test pressure of 100% of WP.
7. The test pressure was maintained for 15 minutes.
8. The ball and needle valves were cycled 25 times. During the 25th cycle, each valve stem was sniffed for dynamic fugitive emissions leakage.
9. Each valve stem was sniffed for static fugitive emissions leakage.
10. The test valve end screw and needle bonnet body seals were sniffed for static fugitive emissions leakage.
11. The test pressure was vented and the valve pressurized with nitrogen to 100% of CWP. The ball and needle valves were closed and tested for seat leakage test for 5 minutes.
12. The test pressure was vented and the valves allowed to return to ambient temperature without any forced cooling.

Low-Temperature Test

1. The test valves were placed into an insulated container. A controlled flow of vaporized liquid nitrogen was directed into the container to cool the test valves to –58°F (–50°C). The cooling was controlled so that the difference between the test valve body surface and internal temperatures did not exceed 20°C (36°F).
2. The test steps from the Initial Ambient Temperature Test were repeated at low temperature.
3. The test valves were allowed to return to ambient temperature without any forced heating.

Final Ambient Temperature Test

1. A test pressure of 29 psig (2.0 bar) nitrogen was applied, and the ball and needle valves were closed and tested for seat leakage for 5 minutes. The test pressure was vented.
2. The above step was repeated with a test pressure of 102 psig (7.0 bar).
3. The above step was repeated with the test valve CWP as the test pressure.

Anti-Static Test

The electrical resistance between each test valve body and each valve stem was measured with an ohmmeter.

TEST RESULTS

All testing was witnessed by an independent third party.

Table 1: Class 1500—Valve Initial Ambient Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	1313 (90.4)			Pass
Seat Test	2625 (180)			Pass
Seat Test	4125 (284)			Pass
Dynamic Fugitive Emissions (Stems)	3750 (258)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	3750 (258)	0 mL/ min	1.2 mL/ min	Pass

Table 2: Class 1500—Valve Elevated Temperature Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	1165 (80.2)			Pass
Seat Test	2330 (160)			Pass
Seat Test	3530 (243)			Pass
Dynamic Fugitive Emissions (Stems)	3530 (243)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	3530 (243)	0 mL/ min	1.2 mL/ min	Pass

Table 3: Class 1500—Valve Low-Temperature Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	22.5 mL/ min	72 mL/ min	Pass
Seat test	1313 (90.4)			Pass
Seat Test	2625 (180)			Pass
Seat Test	4125 (284)			Pass
Dynamic Fugitive Emissions (Stems)	3750 (258)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass (1)
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	3750 (258)	22.5 mL/ min	72 mL/ min	Pass

Note 1: After a packing adjustment, as permitted by the test specification, the needle valve passed the test.

Table 4: Class—1500 Valve Final Ambient Temperature and Anti-Static Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Acceptance Criteria
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	102 (7.0)			Pass
Seat Test	3750 (258)			Pass
Anti-Static Test	N/A	10 ohms	10 ohms	Pass

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Table 5: Class 2500—Valve Initial Ambient Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	2188 (150)			Pass
Seat Test	4375 (301)			Pass
Seat Test	6875 (473)			Pass
Dynamic Fugitive Emissions (Stems)	6250 (430)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	6250 (430)	0 mL/ min	1.2 mL/ min	Pass

Table 6: Class 2500—Valve Elevated Temperature Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	1940 (133)			Pass
Seat Test	3881 (267)			Pass
Seat Test	5880 (405)			Pass
Dynamic Fugitive Emissions (Stems)	5880 (405)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	5880 (405)	0 mL/ min	1.2 mL/ min	Pass

Table 7: Class 2500—Valve Low-Temperature Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	22.5 mL/ min	72 mL/ min	Pass
Seat test	2188 (150)			Pass
Seat Test	4375 (301)			Pass
Seat Test	6875 (473)			Pass
Dynamic Fugitive Emissions (Stems)	6250 (430)	1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Stems)		1.7×10^{-5} std cm^3/s	1.1×10^{-5} std cm^3/s	Pass
Static Fugitive Emissions (Body Seals)		4.2×10^{-6} std cm^3/s	3.2×10^{-6} std cm^3/s	Pass
Seat Test	6250 (430)	22.5 mL/ min	72 mL/ min	Pass

Table 8: Class 2500—Valve Final Ambient Temperature and Anti-Static Test Results

Test Description	Test Pressure psig (bar)	Acceptance Criteria		Test Result
		Ball Valve	Needle Valve	
Seat test	29 (2.0)	0 mL/ min	1.2 mL/ min	Pass
Seat test	102 (7.0)			Pass
Seat Test	6250 (430)			Pass
Anti-Static Test	N/A	10 ohms	10 ohms	Pass

The tests were conducted beyond the product's recommended operating parameters and do not modify the published product ratings.

These tests were performed to consider a specific set of conditions and should not be considered valid outside those conditions. Swagelok Company makes no representation or warranties regarding these selected conditions or the results attained. Laboratory tests cannot duplicate the variety of actual operating conditions. Test results are not offered as statistically significant. See the product catalog for technical data.

SAFE PRODUCT SELECTION

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Referenced Documents

MESC SPE 77/300, *Procedure and Technical Specification for Type Acceptance Testing (TAT) of Industrial Valves*. Shell Global Solutions International B.V., The Netherlands

ISO 5208, *Industrial Valves – Pressure Testing of Metallic Valves*, International Organization for Standardization, 1, ch. De la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland