12388 88th Ave.,
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Swagelok Company – Check Valve – ISO 19880-3 Section 6 – Bending Moment

Prepared for: Swagelok Company
PO Reference: 4506406901

Project Number: PL-05589
Test Report Number: TR-05589-05-R0

Client: Swagelok Company
29500 Solon Road
Solon, Ohio, 44139, USA

Manufacturer: Swagelok Company
29500 Solon Road
Solon, Ohio, 44139, USA

Part Type: Check Valve

Part Numbers and Serial Numbers:

Part #	Description
SS-CVT6FK6-H2 (PLI: 3786)	3/8" CV Bending Moment Compound A
SS-CVT6FK6-H2 (PLI: 3787)	3/8" CV Bending Moment Compound B
SS-CVT9FK9-H2 (PLI: 3784)	9/16" CV Bending Moment Compound A
SS-CVT9FK9-H2 (PLI: 3785)	9/16" CV Bending Moment Compound B
SS-CVT12FK12-H2 (PLI: 3782)	3/4" CV Bending Moment Compound A
SS-CVT12FK12-H2 (PLI: 3783)	3/4" CV Bending Moment Compound B

Receipt Date: 2024-10-24

Test Dates: 2025-01-31 to 2025-02-14

Test Medium: Hydrogen gas

TEST CONDUCTED

The following test was conducted in accordance with:

- ISO 19880-3 – 2018, Gaseous hydrogen — Fuelling stations — Part 3: Valves, Clause 6

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TEST PROCEDURE

Bending Moment (per ISO 19880-3:2018, Clause 5.9)

Each sample was rigidly mounted horizontally, and the inlet connection was assembled with tubing 300 mm long as shown in Figure 1.

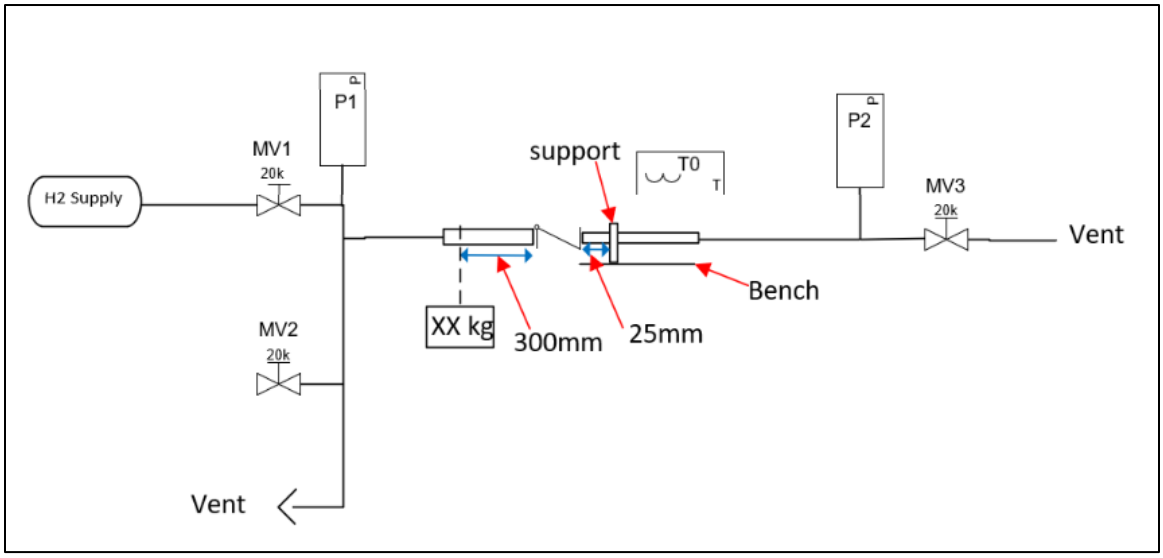

Figure 1. Bending moment test setup

The outlet connection was rigidly supported 25 mm from the valve outlet. The sample is pressurized to 5.25 MPa and the appropriate weight was applied in accordance with the standard, as outlined in Table 1.

Table 1. Bending moment test requirements

Sample #	Sample Type	Weight/Mass Required (kg)
3782	¾”	8.2
3783	¾”	8.2
3784	9/16”	8.2
3785	9/16”	8.2
3786	⅜”	2.3
3787	⅜”	2.3

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The weight was applied at a distance of 300 mm from the inlet connection for 15 minutes. Without removing the force, the sample was then subjected to an external leakage and internal leakage test at pressures of 105 MPa and 10.5 MPa.

This process was then to be repeated 3 times with the sample rotated around the primary axis through 90° each time to complete a full 360° rotation.

The sample was then removed and examined for deformation & breakage and subjected to an external and internal leakage test per clause 5.4.2 and 6.4.

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External and Internal Leakage (per ISO 19880-3:2018, Clause 5.4.2 and 6.4)

The samples were subjected to an external and internal leakage test using hydrogen gas as shown in Figure 2. Samples were conditioned at 31.5 MPa and the test temperature for 1 hour before testing.

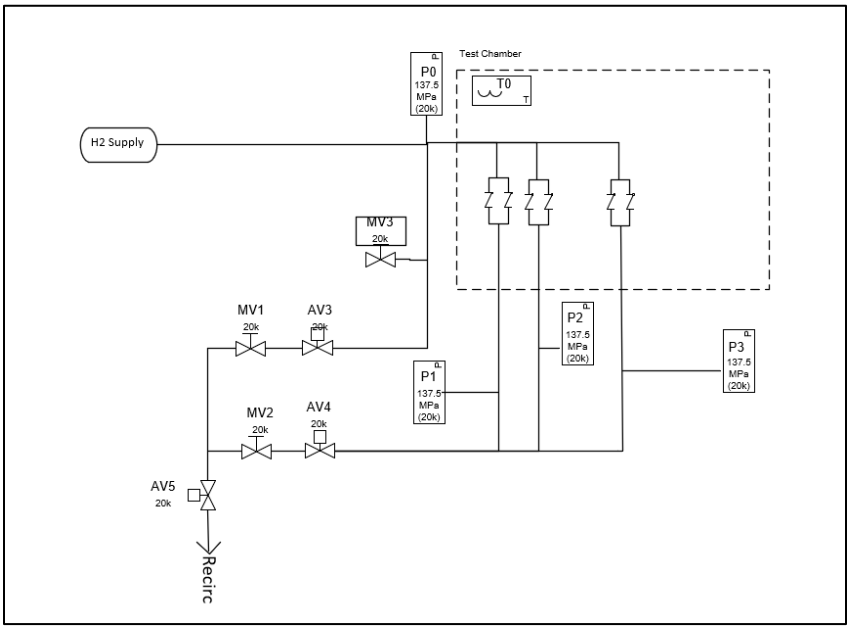

Figure 2. Leakage test schematic

The test temperatures and pressure conditions for the external leakage test were as follows:

1. 85°C (+3/-0°C) @ 105 MPa
2. -40°C (+0/-3°C) @ 105 MPa

The test temperatures and pressure conditions for the internal leakage test were as follows:

1. 85°C (+3/-0°C) @ 105 MPa
2. 85°C (+3/-0°C) @ 10.5 MPa
3. -40°C (+0/-3°C) @ 105 MPa
4. -40°C (+0/-3°C) @ 10.5 MPa

External leakage tests were performed using SNOOP® leak detection agent and a handheld detector, whereas internal leakage tests were performed via the bubble leak test method. The leak rate shall not exceed 10 Ncm^3/h.

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TEST EQUIPMENT AND INSTRUMENTATION

Details of the instrumentation used for the bending moment test are outlined below in Table 2.

Table 2. Bending moment test instrumentation summary

Parameter	PLI Asset No.	Instrument Type	Make and Model	Range
P1	PLI2075	Pressure Transducer	Stellar Technology, GT3200-20000G-118	0 to 137.9 MPa
P2	01031	Pressure Transducer	Stellar Technology, GT3200-20000G-118	0 to 137.9 MPa
T0	35180	Thermocouple	Conax Technologies, T-316SS12-U-MPJ-6	-200°C to 200°C

Details of the instrumentation used for the leakage test are outlined below in Table 3.

Table 3. Leakage test instrumentation summary

Parameter	PLI Asset No.	Instrument Type	Make and Model	Range
P0	PLI2075	Pressure Transducer	Stellar Technology, GT3200-20000G-118	0 to 137.9 MPa
P1	01031	Pressure Transducer	Stellar Technology, GT1800-20000G-317	0 to 137.9 MPa
P2	PLI2074	Pressure Transducer	Stellar Technology, GT3200-20000G-118	0 to 137.9 MPa
P3	PLI2192	Pressure Transducer	Stellar Technology, GT3200-20000G-118	0 to 137.9 MPa
T0	33046	Thermocouple	Omega, TMQSS-125U-6	-200°C to 200°C

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TEST RESULTS

Bending Moment (per ISO 19880-3:2018, Clause 5.9)
Temperature: 20±5°C
Test Date: 2025-01-31 to 2025-02-06
Test Location: Powertech Labs, Surrey, BC
Serial Number: 3782 to 3787

The samples were mounted and pressurized to 5.25 MPa. The appropriate weight was applied, as per Table 1, to the sample for a duration of 15 minutes. An external and internal leakage test were conducted without removing the force.

The samples completed this test three times with the sample rotated around the primary axis 90° each time to complete a full 360° rotation. The force was then removed, and the sample was opened and closed three consecutive times without issue. The samples showed no signs of leakage using a handheld detector and SNOOP® leak detection agent.

External and Internal Leakage (per ISO 19880-3:2018, Clause 5.4.2 and 6.4)
Test Date: 2025-02-12 to 2025-02-14
Test Location: Powertech Labs, Surrey, BC
Serial Number: 3782 to 3787

The samples were subjected to an external and internal leakage test at -40°C and 85°C. The samples showed no signs of leakage using SNOOP® leak detection agent, a handheld detector, and the bubble leak test method. The results are seen in Table 4.

Table 4. Leakage test results for sample # 3782 to 3787

Sample #	Previous test	External Leakage		Internal Leakage			
		85°C	-40°C	85°C		-40°C	
		105 MPa	105 MPa	105 MPa	10.5 MPa	105 MPa	10.5 MPa
3782 & 3783	Bending moment	No leak	No leak	No leak	No leak	No leak	No leak
3784 & 3785	Bending moment	No leak	No leak	No leak	No leak	No leak	No leak
3786 & 3787	Bending moment	No leak	No leak	No leak	No leak	No leak	No leak

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Test Report Number: TR-05589-05-R0

SUMMARY

All tested samples met the criteria of ISO 19880-3:2018, section 6.9 Bending moment test, and thus are considered to have passed the test.

Tested By:	Approved By:
Alan Yen, EIT Project Engineer Hydrogen Industry Technology & Testing	Marcus Treacy, P.Eng Senior Engineer Hydrogen Industry Technology & Testing EGBC Permit to Practice: 1002531
Date signed: 2025-05-16	Date signed: 2025-05-16

Revision	Description of changes	Date
0	Initial issue	2025-05-16

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Andre Fregeau

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Date: 2025.05.16 15:47:09 -08'00'