

**TECHNICAL SPECIFICATION OF
PNEUMATICALLY-ACTUATED CRYOGENIC GLOBE VALVES**

Valve :

Type	:	Pneumatically-Actuated Extended stem Bellow sealed Cryogenic globe valve (PA-ESBSGV)
Tag number	:	As per Table 2A
Quantity	:	As per Table 2A
Pattern	:	Globe
Application	:	Shut-off/ isolation/ on-off
Actuation	:	Pneumatic actuator
Normal position	:	As per Table 2A
Fluid medium	:	As per Table 2A
Working temperature range	:	As per Table 2A
Nominal size (mm)	:	As per Table 2A
Maximum Allowable Working Pressure (MAWP)	:	As per Table 2A
Valve coefficient	:	To be specified by the bidder in the quotation
<u>Permissible leakage rate across body</u>	:	1E-7 Pa-m ³ /s (1E-6 mbar l/s.) of GHe
<u>Permissible leakage rate across Seat:</u>	:	1E-6 Pa-m ³ /s (1E-5 mbar l/s.)
Guaranteed operation	Cycle of :	5000

End connection

- BW: Butt welding ends as per ASME B 16.9/ 16.25. Pipe stubs as per ASME B 36.19/ 36.10 of 100 mm length each shall be butt-welded to the body on either side, the ends of which shall be prepared for butt welding. The butt welding ends shall be suitable to mate with the interfacing pipe & schedule as per Table 2A.

Style of construction:

Body	:	With full port (standard bore) and in-line end connections
Bonnet	:	Bolted or screwed to body with metal seals/ spring energized seals (such as Helicoflex, Enerseal, etc)/ any other suitable seals. The body bonnet joint shall be located on top of the stem extension such that the seal experiences near-ambient temperature. The stem extension shall be as per design code. The stem shall be of non rotating type.
Stem	:	Non-rotating, rising stem.
<u>Stem (dynamic) seal</u>	:	By bellows with redundant gland packing. Between the bellows seal and the redundant gland packing, a <i>tell-tale</i> indicator pressure gauge shall be provided.
Stem extension length (For ESBSG Valves)	:	As per BS 6364 or equivalent
Plug	:	Renewable (replaceable) from stem
Seat	:	Renewable from body with seat insert. (Alternatively Seat may be integral with body provided that it is harder than the plug insert)
Shut off mode	:	Bi-directional shut off

Flow direction	: Flow-to-open (Flow-under-plug) and all the valves shall have Bi-directional shut-off.
<u>Material of construction:</u>	
Body and bonnet	: ASTM A 182 F 304/304L/ 316/316L/ 321 For \leq DN40 ASTM A 351 CF 3/ 3M For \geq DN50
Stem, plug, seat	: ASTM A 479 304/316/304L/ 316L/ 321
Bellows	: Stainless steel 316L/ 316Ti/ 321/ Hastelloy C 276/ Inconel 600/ 625/Incoloy
Gland packing	: PTFE/ Glass-filled PTFE/ PEEK/PCTFE (Kel-F)
Plug & seat insert	: PCTFE(Kel-F)/ Polycarbonate
Pipe stub	: Seamless pipe-ASTM A 312 TP 304L/316L
Bolts	: ASTM A 193 B 8
Nuts	: ASTM A 194 Gr 8
Design code	: BS5352 / BS 6364/ API 6-D/ ASME B16.34 or equivalent
Test code	: BS6755 / BS5155/ API 598/API 607 ASME B 16.34 or equivalent

Note:

1. The valves shall be either inherently anti-static or provided with anti-static features.
2. Alternative materials, if chosen as per manufacturer's standards, for any of the above parts the same shall be subject to approval by the purchaser.

PNEUMATIC ACTUATOR

- Type : Linear actuator, piston/ diaphragm type, single acting, spring return, fail-safe
- Normal position : As per Table 2A
- Command gas : Gaseous Nitrogen at 0.6 to 0.7 MPa(g)
(Wherever the command gas is less than 0.55 MPa (g) suitable filter regulator shall be installed for each valve. The actuator & Air filter Regulator shall be suitably connected with tubings.)
- Failure position : **Close**- Normally closed valves
Open- Normally open valves
- Response time (for both opening and closing strokes) : As per Table 2A
If required, flow (volume) booster, necessary tubings and quick exhaust valve shall be incorporated to achieve the specified response time.
- End connection for command gas : Suitable NPT (F) to ASME B 1.10.1.
- Material : Carbon steel (enamel-painted)
- Test (along with valve assembly) : The response time taken for opening and closing of the valve shall be evaluated.

STATUS SWITCHES

The valve shall be provided with a pair of non-contact type proximity status switches to indicate the "Open/Close" status of the valve. The status switches shall be mounted on the valve with such proper arrangement that does not require any adjustment/alignment for the specified cycles of operation of the valve.

Type	Cylindrical Inductive Type Proximity Sensor (switch) in accordance with NAMUR
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Sensing Distance	The sensing distance shall be suitably selected by the valve manufacturer according to the valve stroke length.	
Electrical Configuration	DC, 2 wire	
Nominal Voltage	8 V	
Operating Voltage	5 – 24 V	
Switching Frequency	0 to 500 HZ	
Reverse Polarity	Shall be Protected against reverse polarity	
Short-Circuit protection	Shall be Protected for short circuit	
Current Consumption	Not Sensing	≥ 3 mA
	Sensing	≤ 1 mA
Indication of switching state	LED	
Connection Type	2 metre long PVC Cable	
Ambient Temperature	- 25 ⁰ C to 80 ⁰ C	
Housing Material	Stainless Steel	
Protection Degree	IP 67	
Safety Aspects	Shall be intrinsically safe for Hydrogen (IIC) ambience	
Hazardous area Certification	The switches shall be intrinsically safe for Hydrogen environment in conformance with Ex ia IIC T6,Zone 1 of IEC/ATEX.The certificate of conformance to this effect from the accredited agency shall be provided.	

Note:

1. Copy of Certificate matrix (including Make & Model) of the status switch shall be provided to the Department prior to procurement of status switches for its approval.

Suggested Make:

- a. PEPPERL & FUCHS - Germany
- b. OMRON – USA
- c. Rockwell Automation – USA
- d. LongVale Ltd – UK
- e. Euroswitch - UK
- f. Cario Gavazzi
- g. IFM electronic

Tests:

- a. Material test certificates: The material test certificates, detailing the physical and chemical properties, of the principal pressure-bearing parts shall be provided.
- b. Dimensional Inspection: All valves have to be subjected to dimensional inspection as per the approved drawings.
- c. Welding joint test (wherever applicable): All butt welding joints in the valve (including the joints between the body and the pipe stubs) shall be subjected to dye-penetrant test and radiographic test with X-rays or gamma rays to 2% sensitivity as per Section IX, ASME. All the butt welding joints & socket welding joints shall be subject to dye-penetrant test.
- d. Bellows Cyclic life test: 3 Sample bellows drawn from each batch of the same size and type shall be subject to (destructive) cyclic life (proto-type) test as per BS 5352/ relevant standards. If the Manufacturer of the bellows has already performed such test, copy of the certificate may be produced.
- e. Ultrasonic test: 100% ultrasonic test shall be conducted for the pipe stubs.
- f. Soundness test for castings (wherever applicable): All the castings shall be subject to soundness test with radiographic or ultrasonic technique for flaw detection.
- g. Pre-assembly hydraulic shell pressure test: The valve shell, prior to assembly with the bellows, in partially open position, shall be subjected to pressure test with Water (with suitable corrosion inhibitor) at 1.5 times the maximum rated working pressure of the particular pressure rating class of the valve.
- h. Pneumatic shell pressure test: The valve, upon final assembly including the bellows, in partially open position shall be subjected to pressure test with dry air or GN2 at 1.1 times the maximum rated working pressure of the particular pressure rating class.
- i. Pneumatic seat pressure test: The valve, in closed position, shall be subjected to pressure test at 1.1 times the maximum rated working pressure of the particular pressure rating class of the valve.
- j. MSLD shell leakage test: The valve in open position, the global leakage rate across body shall be measured with gaseous Helium Mass Spectrometer Leakage Detector (MSLD) to establish the

permissible leakage rate values specified above by *hood technique* as per Article 10, Section V, ASME. The leakage test shall be performed by shrouding the entire outside surface of the valve with a plastic bag to hold gaseous Helium at a positive pressure and by evacuating and connecting the inlet/ outlet port to MSLD. Leakage test by detector probe or tracer probe technique is not acceptable.

- k. MSLD seat leakage test: The global leakage rate across seat shall be measured with gaseous Helium MSLD to establish the permissible leakage rate values specified above by *hood technique* as per Article 10, Section V, ASME. The leakage test shall be performed by pressurizing the inlet not less than 25% of Maximum rated working pressure of the particular pressure rating class of the valve with gaseous Helium and by evacuating and connecting the outlet to MSLD. Leakage test by detector probe or tracer probe technique is not acceptable.
- l. Functional Test: Each valve has to be subjected to functional test for verification of free operation of valves to the full stroke length. The response time taken for full opening and closing of the valve shall be evaluated.

Cleanliness

All the interior flow surfaces of the valve shall be degreased and cleaned to Oxygen service standards as per CGA G-4.1 or MIL-C-52211 or ASTM G 93. The valves shall be dispatched with end connection sealed by suitable plastic plugs to avoid contamination during transportation.

Marking

All the valves are assigned tag numbers for the sake of identification. The tag number for each valve, as indicated above, besides size, pressure rating class, material of construction, etc, shall be legibly and indelibly engraved on the body of the valves and its response time.

Quality Assurance Plan (QAP) as per Table 2B

TABLE 2A: LIST OF PNEUMATICALLY- ACTUATED CRYOGENIC GLOBE VALVES

SL.No.	Type of Valve	Tag -No.	Fluid medium	Working Temp (K)	Size (mm)	MAWP, MPa	Pressure Rating Class	End connection	Pipe Schedule of Interfacing pipe	Normal Position	Response Time(s)	Qty (Nos.)
1	PA-ESBSGV	UVP 1004 & 1005	LOX / LN ₂	75 - 323	DN 80	1.4	150#	BW with pipe stub	10S	Closed	≤3	2
2		UVP 1001, 1003, 1006, 1007, 1008, 1010 & 1014	LOX / LN ₂	75 - 323	DN 40	1.4	150#	BW with pipe stub	10S	Closed	≤2	7
3		UVP 1011	LOX / LN ₂	75 - 323	DN 40	1.4	150#	BW with pipe stub	10S	Open	≤2	1
4		UVP 1009	LOX / LN ₂	75 - 323	DN 25	1.4	150#	BW with pipe stub	10S	Open	≤2	1
5		UVP 1012	LOX / LN ₂	75 - 323	DN 25	1.4	150#	BW with pipe stub	10S	Closed	≤2	1
6		UVP 1002 & 1016	LOX / LN ₂	75 - 323	DN 15	1.4	150#	BW with pipe stub	10S	Open	≤2	2
7		UVP 1013 & 1015	LOX / LN ₂	75 - 323	DN 15	1.4	150#	BW with pipe stub	10S	Closed	≤2	2
Note: 1. Pneumatically Actuated Extended stem Bellow sealed Cryogenic globe valve (PA-ESBSGV) 2. LOX- Liquid Oxygen 3. LN2- Liquid Nitrogen											Total Qty	16

TABLE 2B: QUALITY ASSURANCE PLAN FOR PNEUMATICALLY- ACTUATED CRYOGENIC GLOBE VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Test performed by	Test witnessed & certified by	Record reviewed by
1.	Material test	Specimen from raw materials	Chemical composition and physical properties	1 per heat/ lot	Relevant standard	Relevant material specification	Material certificate	Vendor or Third party laboratory	-	Vendor, Inspector
2.	Bellows cyclic life test (wherever applicable)	Bellows	Cyclic life under fatigue	3 per batch of same size and type	BS 5352	BS 5352	Test certificate	Sub-vendor	-	Vendor, Inspector
3.	Welding joint test (wherever applicable)	Socket welding joints	Absence of surface defects	100 %	Dye penetrant test	Relevant standard	Test certificate	Vendor	-	Inspector
		Butt welding joints	Absence of defects	100 %	Radiographic test	ASME, Section IX	Test certificate	Vendor	-	Inspector
4.	Soundness test for castings (wherever applicable)	Castings	Absence of defects	100 %	Radiographic or ultrasonic test	Relevant standard	Test certificate	Vendor	-	Inspector
5.	Ultrasonic test for pipe stub (Wherever applicable)	Pipe of size \geq DN 25	Internal flaw detection	100%	ASTM E 213	ASTM E 213	Test certificate	Sub-Vendor/vendor	-	Vendor/ Inspector

TABLE 2B: QUALITY ASSURANCE PLAN FOR PNEUMATICALLY- ACTUATED CRYOGENIC GLOBE VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Test performed by	Test witnessed & certified by	Record reviewed by
6.	Eddy current test for pipe stub (Wherever applicable)	Pipe of size \leq DN 20	Internal flaw detection	100%	ASTM E 426	ASTM E 426	Test certificate	Sub-Vendor/vendor	-	Vendor/ Inspector
7.	Dimensional check	Valve	Dimensions	100 %	Metrology	Relevant standard/ Purchaser-approved drawing	Test report	Vendor	-	Inspector
8.	Pre-assembly hydraulic shell pressure test	Valve before assembly with bellows	Structural integrity under stress	100 %	1.5 times maximum rated working pressure	BS 6755 Part 1/BS 5155/ API 598/ API 607/ ASME B 16.34	Test certificate	Vendor	Inspector	Inspector
9.	Final Pneumatic shell pressure test	Valve after assembly with bellows	Structural integrity of body under stress	100 %	1.1 times maximum rated working pressure	BS 6755 Part 1/BS 5155/ API 598/ API 607/ASME B 16.34	Test certificate	Vendor	Inspector	Inspector
10.	Pneumatic seat pressure test	Valve in closed position	Structural integrity of seat under stress	100 %	1.1 times maximum rated working pressure	BS 6755 Part 1/BS 5155/ API 598/ API 607/ASME B 16.34	Test certificate	Vendor	Inspector	Inspector

TABLE 2B: QUALITY ASSURANCE PLAN FOR PNEUMATICALLY- ACTUATED CRYOGENIC GLOBE VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Test performed by	Test witnessed & certified by	Record reviewed by
11.	MSLD shell leakage test	Valve in open position	Leakage rate across body	100 %	ASME, Section V, Article 10	Purchase order specification	Test certificate	Vendor	Inspector	Inspector
12.	MSLD seat leakage test	Valve in closed position	Leakage rate across seat	100 %	ASME, Section V, Article 10	Purchase order specification	Test certificate	Vendor	Inspector	Inspector
13.	Cleanliness	Valve	Cleanliness for Oxygen service	100 %	CGA G - 4.1/ASTM G 93	CGA G - 4.1/ASTM G 93	Certificate	Vendor	-	Inspector
14.	Response time test	Valve	Response time	100%	Vendor's standard	Purchase order specification	Test certificate	Vendor	-	Inspector
15.	Hazardous area certification	Electrical and electronic parts	Compatibility with environment	IEC/ATE X	IEC/ATEX	IEC/ATEX and Purchase order specification	Test certificate	Accredited agency	-	Vendor, Inspector

Note: 1. Inspector : Third Party inspection agency.