

**TECHNICAL SPECIFICATION OF
CRYOGENIC GLOBE CONTROL VALVE**

The control valve shall comprise valve, actuator and smart positioner interconnected with SS tubing's.

Valve Type

Type	: Pneumatically-actuated Extended stem Bellow sealed Cryogenic globe Control valve: ESBSGCV
Tag number	: As given in Table 3A
Quantity	: As given in Table 3A
Pattern	: Globe
Application	: Opening variable from 0 to 100 %
Actuation	: By pneumatic actuator
Fluid medium	: As given in Table 3A
Working temperature range	: As given in Table 3A
Orifice diameter/ valve co-efficient (Cv)	: To be calculated and given by the bidder along with quotation
Nominal size of valve	: To be given in the quotation by the bidder
Inlet nominal pipe size x schedule number	: As given in Table 3A
Outlet nominal pipe size x schedule number	: As given in Table 3A
Maximum Allowable Working Pressure (MAWP) & Shut off pressure	: As given in Table 3A
<u>Operating conditions:</u>	
▪ Inlet temperature	: As given in Table 3A
▪ Inlet pressure	: As given in Table 3A

▪ Outlet pressure	:	As given in Table 3A
▪ Flow rate	:	As given in Table 3A
Flow characteristic	:	Equal percentage
Permissible Helium leakage rate across body	:	$\leq 1E-7$ Pa.m ³ /s of GHe (1E-6 mbar l/s) of GHe
<u>Permissible leakage rate across seat</u>	:	Bubble tight
Guaranteed cycle of operation	:	5000
End connection	:	As given in Table 3A

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
Stem extension length	:	As per BS 6364
<u>Stem (dynamic) seal</u>	:	By bellows with redundant gland packing. Between bellows seal and the redundant gland packing, a tell-tale indicator pressure gauge port with suitable plug shall be provided.

Plug	: Renewable (replaceable) from stem
Seat	: Renewable from body with seat insert.
Flow direction	: Flow-to-open (Flow-under-plug) and all the valves shall have Bi-directional shut-off

Material of construction:

Body and bonnet	: ASTM A 182 F 304L/ 316L/ 321/304/316 (or) ASTM A 351 CF 3/3M/CF 8/8M
Stem, plug, seat	: ASTM A 479 304L/ 316L/ 321/304/316
Bellows	: Stainless steel 316L/ 316Ti/ 321/ Hastelloy C 276/ Inconel 600/ 625/ Incoloy
Gland packing	: PTFE/ Glass-filled PTFE/ PEEK
Plug insert	: PCTFE (Kel-F)/Polycarbonate
Pipe stub (end connection)	: ASTM A 312 TP 304L/316L
Bolts	: ASTM A 193 B8
Nuts	: ASTM A 194 Gr 8
Design Code	: ASME B16.34 or equivalent
Test Code	: ASME B 16.34/FCI 70.2 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.

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. Bellows cyclic life test: 3 Sample bellows drawn from each batch of the same size and type shall be subjected 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.**
- 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 socket welding joints shall be subjected to dye-penetrant test (DPT).
- d. Functional Test: Each valve has to be subjected to functional test for free operation of valves to the full stroke length.
- e. Soundness test for castings (wherever applicable): All the castings/Forgings/pipe/Machined pressure bearing components shall be subjected to soundness test with radiographic or ultrasonic technique for flaw detection.
- f. Pre-assembly hydraulic shell pressure test: The valve shell, prior to assembly, 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.
- g. 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.
- h. Pneumatic Seat Pressure test: The valve, in closed position, shall be subject to pressure test at 1.1 times the maximum rated working pressure of the particular pressure rating class of the valve.
- i. 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.

- j. Ultrasonic test: 100% ultrasonic test shall be conducted for the pipe subs.

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, valve coefficient, material of construction, etc, shall be legibly and indelibly engraved on the body of the valves.

ACTUATOR

Type	: Linear actuator, piston/ diaphragm type, single acting, spring return, fail-safe
Normal position/ Failure position	: As given in Table 3A
Command gas	: Gaseous Nitrogen at suitable pressure supplied by the positioner.
Response time (for both full opening and closing strokes)	: As given in Table 3A If required, flow (volume) booster 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)

Response time (for both full opening and closing strokes) : The response time taken for opening and closing of the valve shall be evaluated.

Cv type test : Cv type test certificate shall be provided.

SMART VALVE POSITIONER:

- a. Type : Microprocessor-based smart valve positioner integrated with valve position transmitter (Feed back module)
- b. Travel length : 3 to 100mm for linear motion
- c. Position sensing : Contact type/ Inductive type
- d. Auto positioning : The positioner shall have provision to carry out auto tuning, which is selectable by hand-held communicator or by local switches
- e. Positioner characteristic : Equal percentage
- f. Positioner Input :
 - Input : 4 to 20 mA, 2 wire
Power supplied by the 4 to 20 mA current only. No external power supply.
 - Input range : Range shall be configurable through hand held communicator or by local switches
 - Voltage drop : 10 V DC maximum at 20mA
 - Minimum current : 3.6 mA
 - Communication : HART protocol, digital signal superimposed on the 4 to 20 mA current signal
 - Reverse polarity protection : Reverse polarity shall not damage the positioner
 - Command gas supply : Gaseous Nitrogen at 0.55 ± 0.1 MPa(g). (If the positioner or actuator is designed for lesser pressure, suitable pressure regulator along with filter shall be integrated with control valve by the supplier)

- g. Positioner Output :
- Output to actuator : 0 to 100% command gas pressure
 - Indication : 4 ½ digit LCD indicator
 - Feedback : 2-wire, 4 to 20mA output corresponding to valve position.
 - Output range : Shall be configurable through hand-held communicator or by local switches
 - Flow characterization : Equal percentage
 - Gain : Selectable through hand-held communicator or locally adjustable
 - Travel time : Adjustable through hand-held communicator or locally adjustable
- h. Performance specification :
- Resolution (A/D conversion) : >4000 steps
 - Sample rate : 20ms
 - Repeatability : 0.1% of full scale
 - Hysteresis : 0.2% of full scale
 - Command gas consumption : <0.25 Nm³/h
 - Tolerance band/dead band : 0.3 - 10% adjustable
 - Operating temperature : 233 to 358 K (-40 to 85⁰C)
 - Vibration effect : ≤ 0.1% upto 10g and 80Hz
 - EMI effect : Comply with IEC60801
- i. Physical specification :
- Electrical connection : DN15 (1/2 NPT) as per ASME B 1.20.1
 - Pressure gauge : Pressure gauges for supply and output command gas to be provided along with Air filter regulator.
 - Mass : 3 kg approximate
 - Ingress protection class : IP 67
 - Hazardous area : The positioner shall be intrinsically

certification	safe for Hydrogen environment in conformance with EEx ia IIC T6, Zone 1 of IEC/ATEX. The certificate of conformance to this effect from the accredited agency shall be provided.
Make and Model number	: To be specified by the bidder in the quotation
Safe integrity level	: SIL 2
Suggested make	: ABB, Germany SIEMENS Fischer

QUALITY ASSURANCE PLAN: As given in **Table 3B**

TABLE 3A: LIST OF CRYOGENIC GLOBE CONTROL VALVE

Sl.No	Type of Valve	Tag No	Fluid medium	Working Temperature (K)	MAWP (MPa) / Shut off pressure	Pressure Rating Class	End connection	Normal position	Response time (s)	Inlet pipe OD x WT (mm x mm)	Outlet pipe OD x WT (mm x mm)	Data for valve sizing					Qty (Nos.)
												Inlet temperature (K)	Inlet pressure (MPa)	Outlet pressure (MPa)	Max. flow rate (kg/s)	Min. flow rate (kg/s)	
1	ESBSG CV	UVC 1001	LOX	75-323	1.4	150#	DN40,150# SRF Flange	Open	2	48.3 x 2.77	48.3 x 2.77	106	0.4	0.35	3.2	0.81	1
Note: 1. Extended stem Bellow sealed Cryogenic Globe Control Valve- ESBSGCV 2. LOX-Liquid Oxygen															Total Qty	1	

TABLE 3B:QUALITY ASSURANCE PLAN FOR CRYOGENIC GLOBE CONTROL VALVE

Sl. No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
								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)	Butt welding joints	Absence of defects	100 %	Radiographic test	ASME, Section IX	Test certificate	Vendor	-	Inspector, Purchaser
		Socket welding joints	Absence of surface defects	100 %	Dye penetrant test	Relevant standard	Test certificate	Vendor	-	Inspector, Purchaser
4.	Ultrasonic test for pipe stub (Wherever applicable)	Pipe of size ≥ DN 25	Internal flaw detection	100%	ASTM E 213	ASTM E 213	Test certificate	Sub-Vendor/vendor	-	Vendor/ Inspector

Sl. No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
								Test performed by	Test witnessed & certified by	Record reviewed by
5.	Dimensional check	Valve	Dimensions	100 %	Metrology	Relevant standard/ Purchaser-approved drawing	Test report	Vendor	-	Inspector
6.	Pre-assembly hydraulic shell pressure test	Valve before assembly with bellows	Structural integrity of seat under stress	100 %	1.5 times maximum rated working pressure	BS 6755 Part 1/ API 598/ ASME B 16.34	Test certificate	Vendor	Inspector	Inspector
7.	Pneumatic shell pressure test	Valve assembly with bellows	Structural integrity of seat under stress	100 %	1.1 times maximum rated working pressure	BS 6755 Part 1/ API 598 / ASME B 16.34	Test certificate	Vendor	Inspector	Inspector
8.	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
9.	Pneumatic seat leakage test	Valve in closed position	Leakage rate across seat	100 %	ASME B 16.104	Purchase order specification	Test certificate	Vendor	Inspector	Inspector
10.	Cleanliness	Valve	Cleanliness for Oxygen service	100 %	CGA G-4.1 / ASTM G 93	CGA G-4.1 / ASTM G 93	Certificate	Vendor	-	Inspector
11.	Response time test	Valve	Response time	100%	Vendor's standard	Purchase order specification	Test Certificate	Vendor	-	Inspector
12.	Hazardous area certification (if applicable)	Electrical and electronic parts	Compatibility with environment	IEC/ ATEX	IEC/ ATEX	IEC/ ATEX and purchase order specification	Test certificate	Accredited agency	-	Vendor, Inspector
Note: 1. Inspector: Third party inspection agency.										