SECTION - C

TECHNICAL SPECIFICATIONS OF STORES AND DRAWINGS.

Technical Specifications for

Supply of Bellow Sealed Control Valves and Bellow Sealed ON/OFF Valves

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Technical specifications for Bellow sealed Control and ON/OFF valves

Supply of Bellow sealed Control and ON/OFF valves with following specifications:

1.1. Control valves: These valves are required to control flow/temperature/pressure as per the experimental requirements in EHCL.

1.2. ON/OFF Valves: These valves are required for flow isolation as per the experimental requirements in EHCL.

2.0 Scope of Supply

2.1 Control valves for main loop (4 Nos.)

1) VC-001 –It is placed at the bypass line of the TSM and used to control the helium flow across TSM.
2) VC-002 –It is placed at the bypass line of the electrical heater and used to control the temperature of hot helium at TSM inlet by mixing cold helium (from circulator discharge) and hot helium (from recuperator outlet).
3) VC-003 –It is also placed at the bypass line of the electrical heater and used for fast cooling of TSM and connecting pipes by mixing cold helium (from circulator discharge) directly with hot helium (from recuperator outlet).
4) VC-004 –It is placed at the bypass line of the circulators.

2.2 Control valves for PICS (3 Nos.)

1) VC -101 – It is placed at the upstream side of the connecting line from PICS to main loop and used to control the helium pressure.
2) VC- 102– It is placed at the upstream side of connecting line from PICS to main loop and used to control the helium pressure.
3) VC- 103 – It is placed at the downstream side of connecting line from PICS to main loop and used to control the helium pressure.

2.3 ON/OFF valves (17 Nos.) – These valves are used for isolation of helium flow as highlighted in fig.1 and fig.2 of Main loop and PICS respectively.

2.4 Vendor shall provide list of recommended spares (gasket set and stem gland packing) required for 5 years of operation for each valve.

Note:

- Appendix-1 explains the operating conditions of EHCL and operational philosophy of control valves in PICS. It also presents the typical pressure drop and differential pressure across each valve.
- Appendix-2 presents the datasheets of each control valve and ON/OFF valves.
- Appendix-3 presents the technical compliance sheet (for each valve) and is required to be filled by vendor completely.

3.0 Requirements

3.1 Applicable Codes and Standards

The following Standards, Codes and Regulations whichever is applicable in their latest edition including their addenda should form the basis for design, fabrication, inspection, testing and acceptance of equipments.

1) American Society of Mechanical Engineers (ASME)

A. ASME-B16.10: Face-to-Face and End-to-End Dimensions of Valves
B. ASME B16.34: Valves Flanged, Threaded, and Welding End
C. ASME VIII: Rules for construction of pressure vessels – Division 1

2) Fluid Control Institute (FCI)

A. FCI 70.2: Control valve seat leakage classification

3) Instrumentation, Systems, and Automation Society (ISA)

A. ISA S75.01.01: Flow Equation for sizing control valves
B. ISA S75.02: Control valve capacity test procedures
C. ISA-75.08.05: Face-to-Face Dimensions for Butt-weld-End Globe-Style Control valves (ASME Classes 150, 300, 600, 900, 1500, 2500)
D. ISA S75.11: Inherent flow characteristics and rangeability of control valve
E. ISA S75.19: Hydrostatic testing of control valves
F. ISA 26: Dynamic Response Testing of Process Control Instrumentation

4) Manufacturer's Standardization Society (MSS)

A. MSS-SP-117: Bellow seals for Gate and Globe valves

5) International Electrotechnical Commission (IEC)

A. IEC 60534: Control valve aerodynamic noise prediction method

6) International Organization for Standardization (ISO)

A. ISO 15848-1: Industrial valves-Measurement, test and qualification procedures for fugitive emissions

Note: If the vendor has capability to supply the items for a set of standards equivalent to that mentioned above, the same shall be indicated in the quotation. The equivalence shall be explained to IPR and subsequently decision shall be taken by IPR for acceptance for use of alternative standards.

3.2 Technical requirements of Control valves

Technical specifications of the control valves for the EHCL loop should be as per the process parameters listed in Table-1 and accessories for the same as per Section 3.3.

Table 1: Process parameters of control valves

S.No.	Valve tag no.	Pipe size, mm	Design temp. ,C	Operating pressure, MPa	Design pressure, MPa	Air fail action
1.	VC-001	50	450	8.0	10.0	Open
2.	VC-002	25	100	8.3	10.0	Close
3.	VC-003	50	100	8.3	10.0	Close
4.	VC-004	50	100	8.3	10.0	Close
5.	VC-101	25	50	10.0	20.0	Close
6.	VC-102	25	50	8.8	20.0	Close
7.	VC-103	25	50	8.4	20.0	Close

3.3 Accessories for control valves

a) Valve positioner (Smart type)

i. Valve positioner shall be installed on the control valve body.
ii. Valve positioner shall be of two-wire configuration with input control signal of

4-20 mA DC.

iii. The Dead band and Hysteresis should be less than 0.5% of span. The linearity shall be 0.25 % of calibrated span.
iv. Positioner shall have input pneumatic supply connections of ¼" NPT (M/F).
v. Valve positioner housing shall be of aluminium.
vi. Preferred make of smart positioner are SIEMENS, Flowserve, SAMSON etc.

b) Position Feedback Transmitter

i. Position feedback transmitter shall be a 24 VDC loop powered transmitter with two-wire configuration.
ii. Position feedback transmitter shall provide an output signal of 4-20 mA DC corresponding to 0-100% of valve travel. Transmitter housing shall be of aluminium.
iii. Preferred make are SIEMENS, SAMSON etc.

c) Air Filter Regulator

i. Air filter Regulator shall have 40 micron filter or better.
ii. Pressure at the inlet of regulator shall be 3.5-4 bar (g). Inlet connection shall be ¼" NPT (M/F).
iii. Preferred make are SITECNA, YTC, SHAVO, SAMSON etc.

Technical specifications of the ON/OFF valves for the EHCL loop should be as per the process parameters listed in Table-2 and accessories for the same as per Section 3.5.

3.4 Technical requirements of ON/OFF valves

The process parameters of ON/OFF valves for main loop and PICS are listed in Table-2.

Table 2: Process parameters of ON/OFF valves

S.No.	Valve tag no.	Pipe size, mm	Design temp. , C	Operating pressure, MPa	Design pressure, MPa	Air fail action
1.	VG -001 & VG -002	50	450	8.0	10.0	Open
2.	VG -003 & VG -004	50	200	8.0	10.0	Open
3.	VG -005 & VG -006	50	100	8.0	10.0	Open
4.	VG -011 & VG -012	25	100	15.0	20.0	Close
5.	VG -101 & VG -106	25	50	15.0	20.0	Close
6.	VG -102 & VG-104					
7.	VG -103 & VG -105					
8.	VG -107					
9.	VG-108					
10.	VG-109					

3.5 Accessories for ON/OFF valves

a) Solenoid Valve

i. 24 VDC operated solenoid valves shall be installed on the ON/OFF valves for actuation through instrument air.
ii. Installation arrangement of solenoid valves shall achieve specified air-failure position of ON/OFF valve as mentioned in Table-2 when solenoid is de-energized.
iii. Material of construction for solenoid valve body and wetted parts shall be Stainless steel.
iv. Preferred make are ASCO, ROTEX, SAMSON etc.

b) Limit Switches

i. Limit switches with operating voltage of 24 VDC shall be provided with ON/OFF valves to indicate open and close position.
ii. Necessary mounting accessories, if any, shall be provided for limit switches.
iii. Preferred make are ROTEX, HONEYWELL, SAMSON etc.

c) Air Filter Regulator

i. Air filter Regulator shall have 40 micron filter or better.
ii. Pressure at the inlet of Air Filter Regulator shall be 3.5-4 bar (g). Inlet connection shall be ¼" NPT (M/F).
iii. Preferred make are SITECNA, YTC, SHAVO, SAMSON etc.

Note:

a. All required valves mentioned above shall be bellow sealed and pneumatically operated.
b. Minimum duty cycle for each valve shall be 25000 cycles.
c. All valves to have manual hand-wheels of SS316 material.
d. All valves can be oriented in vertical, horizontal or angle position.
e. All ON/OFF valves shall be bi-directional.
f. All instruments, instrument accessories and enclosures shall be suitable with respect to maximum temperature of 50 C for indoor applications.
g. Response time of 1" and 2" valve shall be ~3-4 s and ~4-5 s or better, respectively. For VC-101/102/103 and VC-004, the response time shall be $\leq$2 sec. If required, volume booster may be used in control valve to get the desired response.
h. Instrument and Instrument item enclosures shall have IP codes as per IEC 60529: Degrees of protection unless otherwise specified indoor located transmitters shall be suitable for code "IP-32".
i. The typical pressure drops/differential pressure of control and ON/OFF valves is mentioned in Appendix-1.
j. Vendor shall provide detailed ordering code and technical catalogue/brochure for all the offered accessories for Control valves and ON/OFF valves.
k. The vendor shall select the Cv value of the valves on the higher side, as indicated in the datasheets.
l. Air fail supply failure modes for the valves mentioned above is described as:
    a) "Fail Open": Actuator drives valve fully open.
    b) "Fail Closed": Actuator drives valve fully closed.

3.6 Detailed technical requirements

3.6.1 Valve Body

1) All control and ON/OFF valves shall be globe, top guided type.
2) All control and ON/OFF valves shall have butt welded end connections.
3) All control and ON/OFF valves body and other pressure retaining components shall be forged body.
4) Valve body rating shall be in accordance with ANSI B16.34. The end connections of the valves shall be suitable for butt welding to the corresponding piping of main loop and PICS.
5) Material of valve body shall be SS 316L for compatibility with piping material (i.e. SS 316L) of EHCL.
6) Face to face dimensions of the control valves shall be as per ANSI/ISA-S75.08.05.
7) Seat leakage shall be chosen in accordance with process requirements and shall conform to ANSI / FCI 70.2. For high temperature service (> 200 C) only metal seated valves shall be used.
8) Flow direction shall be clearly indicated on the valve body.

3.6.2 Trim

1) All the parts of valve trim (including disc, seat, stem, glands, bushings and sleeves) shall be of SS 316L.
2) Trim inherent characteristic shall be selected to achieve, as far as feasible, a linear installed characteristic over the minimum to maximum required controllable range.

3.6.3 Bonnet and Sealing

1) For all control valves, the dynamic seal shall be made of welded metallic bellows.
2) Valve bonnet and bellows shall be of SS 316L material.
3) Valve sealing shall be of grafoil for high temperature service (> 200 C) and PTFE for low temperature service (< 200 C).

3.6.4 Actuator

1) Actuators shall be single action pneumatic diaphragm operated type / piston cylinder type. Actuators shall be designed to withstand maximum shutoff differential pressure existing across the valve during operation, as well as to overcome frictional forces.
2) Signal failure shall exhibit the same characteristics as air supply failure.
3) Actuator shall be designed with consideration of available maximum pneumatic air supply of 7 bar (g).
4) Stainless steel tubing and compression fittings (NPT thread) shall be used for instrument air connections on the valve up to and including the instrument air filter pressure regulator.

4.0 Scope of work

4.1 Quality Assurance

1) Vendor to supply detailed QA plan along with the quotation. The QA plan shall show review, hold point, witness for the specific jobs, witness final and important tests/inspections.
2) The vendor (and it`s subcontractor, if any) has to be compliant with the ISO 9001:2008 (or ISO 9001:2015) standard.

4.2 Design

List of design documents to be supplied by vendor

1) Duly filled up data sheets for each valve
2) Control valve characteristic curve
3) Detailed general arrangement drawing

4.3 Procurement and fabrication

List of document to be supplied by vendor

1) Material test certificates: These certificates shall include details of IGC test, chemical composition and mechanical tests etc as per the relevant ASME/ASTM standards.
2) Test certificates for bellow: Vendor shall provide test certificates for following:
   a. Hydro-test of bellows
   b. Helium leak test of bellows (acceptance criteria < 1 x 10^{-6} Std. cc/sec)
   c. Fatigue cycle test on bellows (Min. Cycle-25000). If the vendor of bellows has already performed such test, copy of the certificate to be produced.
3) NDT test reports:
   a. UT of forge valves as per the relevant ASME standards
   b. LPT on machined surface and welding surface as per the relevant ASME standards

4.4 On-shop tests

All the control and ON/OFF valves shall be subjected to on-shop tests as mentioned in table-3.

Table 3: List of on-shop test for valves

Sr. No.	Type of tests	Codes & Standards/Methodology	Remarks
1.	Hydrostatic shell test	ASME Sec. VIII Div. I/ISA 75.19	Pressure test shall be performed on each valve body upto 1.5 times the valve design pressure.
2.	Seat leakage test	FCI 70-2	Seat leakage test shall be performed on each valve seat considering Class IV leakage as per FCI 70-2 (Test type A). Leak rate shall be $\leq 10^{-5}$ Pa.m^3/s.
3.	Hot helium leak test across the valve body	ISO 15848-1/ASME V	Leak test shall be performed with helium on each valve body at their respective service conditions as mentioned in table-1 and table-2 and the leak rate shall be $<10^{-7}$ Pa.m3/s.
4.	Static performance test (Step response method)	As per QAP	Dead band < 0.5% of input span, Hysteresis < 0.5% of output span, Linearity < 0.25% of total span, Overshoot < 10% of total span and Checking of parameters T_{63}/T_{86}/Settling time/rise time
5.	C_v test	ISA 75.02	Cv test procedure for compressible fluids to be carried out as per ISA 75.02
6.	Functional Test	As per QAP	Opening/closing of valves and Correct settings of limit switches / positioner and transmitter
7.	Dimensional Check	Approved fabrication drawings	Dimensional and orientation check

List of reports to be supplied by vendor

The following reports have to be submitted to IPR for review and acceptance:

a. Hydrostatic shell report
b. Seat leakage test report
c. Valve body leak test report
d. Static performance test report
e. C_v test report
f. Functional test report

Note:

1. Vendor shall start fabrication only after approval of the documents mentioned in section 4.1, 4.2 and 4.3 by IPR.
2. If any of the tests mentioned above are carried out with equivalent standards/procedures, the same should be indicated by the vendor in the quotation.
3. These tests shall be performed by the vendor under witnessing of IPR representatives nominated by IPR. Invitation for witnessing of the specified tests shall be sent to IPR at least 30 working days in advance.

4.5 Packaging and shipping

4.5.1 Each valve shall have tag plate with the following details:

a. Tag number as per data sheet
b. Vendor's name or trade mark
c. Valve model no. and serial no.
d. Valve body maximum pressure rating (nominal for flange class)
e. Valve body nominal pipe size and body material
f. Trim material and size

4.5.2 All openings shall be suitably plugged to prevent ingress of any impurities.

4.5.3 All equipment shall be duly marked with the tag number at the packing box. Sufficient quantity of desiccant material shall be stuffed in pervious sachets to safeguard against ingress of moisture.

Note: The dispatch clearance will be provided after IPR approval provided that all the on-shop tests are successfully completed as mentioned in section 4.4.

Appendix-1

A. EHCL operating conditions

1. Operating cases for testing of TSM in EHCL

The different operating cases for testing of TSM is indicated in Table-4.

Table 4: Envisaged operating cases for TSM

Flow through TSM, kg/s	Operating cases	Heat load on TSM, kW	Inlet temperature to TSM, C
0.4	C1	75	300
	C2	37.5	300
	C3	25	300
	C4	0	300
	C5	0	400
0.3	C1	75	300
	C2	37.5	300
	C3	25	300
	C4	0	300
	C5	0	400
0.2	C1	75	300
	C2	37.5	300
	C3	25	300
	C4	0	300
	C5	0	400

2. Flow regimes of EHCL

The different flow regimes for EHCL are listed below:

1) Flow rate 0.4 kg/s with two circulators operating (0.2 kg/s for each circulator).
2) Flow rate 0.2 kg/s with one circulator operating.
3) Flow rate 0.3 kg/s with two circulators operating and remaining flow bypassed through VC-004 as shown in Fig.1.

B. Operational philosophy of control valves in PICS

PICS is used to maintain pressure and inventory in the main loop by supplying/withdrawal of helium in case of pressure fluctuations in the main loop. Figure-2 presents the circuit diagram of PICS. The pressure fluctuations expected in the main loop ~ 5% of nominal pressure (8.0±0.4 MPa). The function of control valves of PICS are described below:

1) VC-101 and VC-102: When the helium pressure in the main loop goes below the set point (~7.6 MPa), VC-102 opens and supply helium from source tanks to main loop. VC-101 is used to maintain constant helium pressure at VC-102 inlet line (~9.0 MPa) by taking helium from source tank (maintained at ~ 9-10 MPa).
2) VC-103: When the helium pressure in the main loop goes above the set point (~8.4 MPa), VC-103 opens and take helium from main loop and supply to storage tanks (maintained at 6-7 MPa).

C. Typical pressure drop and differential pressure across valves

1. Typical pressure drop across control valves w.r.t different helium flow rates of EHCL are given in Table-5.

Table 5: Expected pressure drop in control valves of EHCL

Valve tag no.	**Flow rate**	**Differential pressure for actuator, MPa**		**Pressure drop, MPa**
		Nominal value	**Design value**	
VC-001	0.45-0.15 kg/s	1.0	10.0	0.15-0.05
VC-002	0.1-0.01 kg/s	1.0	10.0	0.1-0.03
VC-003	0.45-0.15 kg/s	1.0	10.0	0.15-0.05
VC-004	0.2-0.025 kg/s	1.0	10.0	0.5-0.1
VC-101	0.01-0.1 kg/s	2.0	20.0	0.7-1.2
VC-102	0.01-0.1 kg/s	2.0	20.0	0.7-1.2
VC-103	0.01-0.1 kg/s	3.0	20.0	1.4-2.4

2. Typical differential pressure across ON/OFF valves of EHCL are given in Table-6.

Table 6: Expected differential pressure across ON/OFF valves of EHCL

Valve tag no.	**Differential pressure for actuator, MPa**	
	Nominal value	**Design value**
VG -001 & VG -002	1.0	10.0
VG -003 & VG -004	4.0	10.0
VG -005 & VG -006	4.0	10.0
VG -011 & VG -012	3.0	20.0
VG -101 & VG -106	7.0	20.0
VG -102 & VG -104	15.0	20.0
VG -103 & VG -105	9.0	20.0
VG -107	6.0	20.0
VG-108	10.0	20.0
VG-109	9.0	20.0

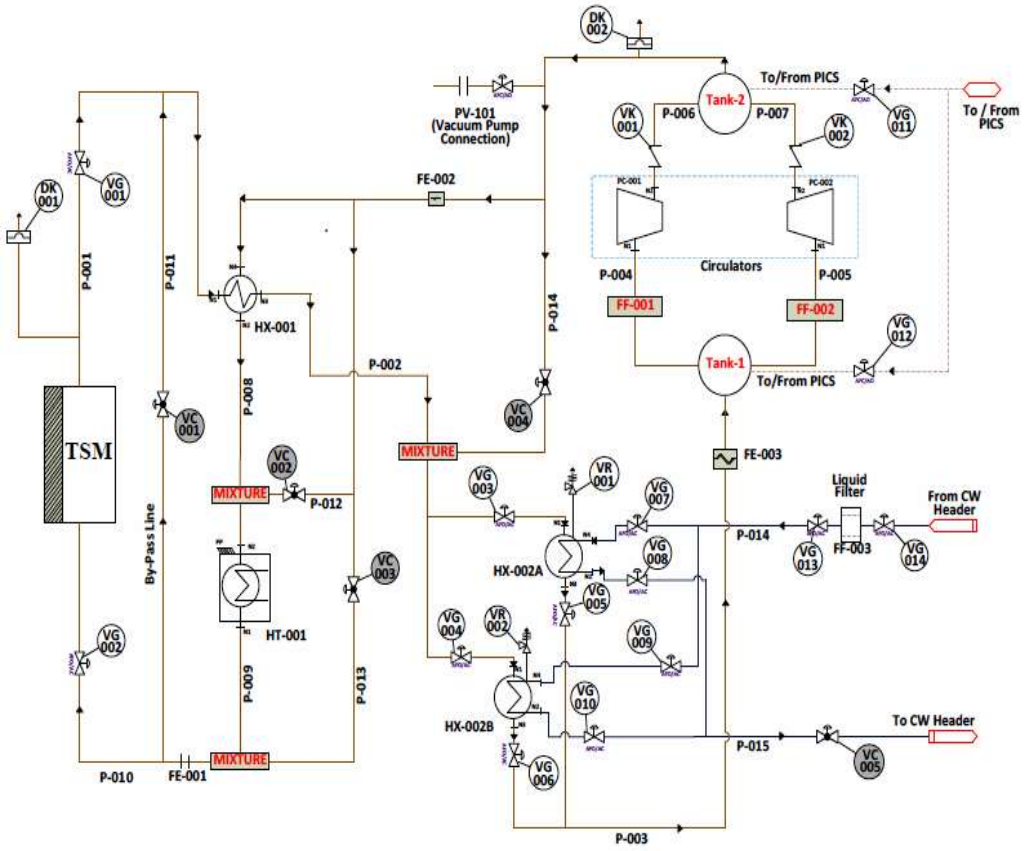

Figure 2: Circuit diagram of Main loop of EHCL

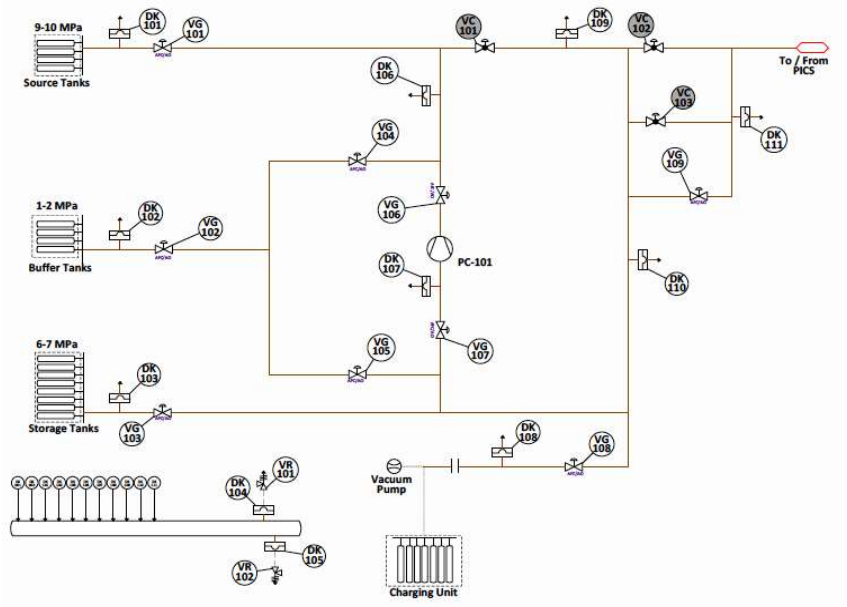

Figure 2: Circuit diagram of PICS of EHCL

Appendix-2

Datasheets of Control and ON-OFF valves

1. **Control valves**

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-001 (Across TSM bypass)	
Process conditions	
Mass flow rate (range	0.15-0.45 kg/s
Pressure differential (range)	0.05-0.15 MPa
Operating temperature and pressure	300-400 C and 8.0 MPa
Design temperature and pressure	450 C and 10.0 MPa
Pipe size	2" 80 Sch
Air fail action	Open
Cv	25-40
Characteristics	Equal percentage
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 1500
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA

Nuts	ASTM A194 Gr. 8MA
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers: • Valve positioner (Smart type) • Current to pressure converter (I to P Converter) • Volume booster (if required) • Position transmitter (2-wire with a transmission facility of 4 to 20 mA) • Air filter regulator • Interconnecting Tubing	
Inspection & Testing	
• Flow characteristics test • Static performance test • Material test • Liquid penetration examination of body, bonnet, plug, stem, fasteners • Intergranular corrosion test for body, bonnet, plug, stem • Hydrostatic test • Seat leak test • Helium leak test • Functional test	

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-002 (Across Heater bypass)	
Process conditions	
Mass flow rate (range	0.01-0.1 kg/s
Pressure differential (range)	0.03-0.1 MPa
Operating temperature and pressure	60-80 C and 8.3 MPa
Design temperature and pressure	100 C and 10.0 MPa
Pipe size	1" 80 Sch
Air fail action	Close
Cv	5-10
Characteristics	Linear
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	

All the control valve accessories mentioned below shall be from reputed manufacturers:

- Valve positioner (Smart type)
- Current to pressure converter (I to P Converter)
- Volume booster (if required)
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA)
- Air filter regulator
- Interconnecting Tubing

Inspection & Testing

- Flow characteristics test
- Static performance test
- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-003 (Across Recuperator bypass)	
Process conditions	
Mass flow rate (range	0.15-0.45 kg/s
Pressure differential (range)	0.05-0.15 MPa
Operating temperature and pressure	60-80 C and 8.3 MPa
Design temperature and pressure	100 C and 10.0 MPa
Pipe size	2" 80 Sch
Air fail action	Close
Cv	20-30
Characteristics	Linear
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	

All the control valve accessories mentioned below shall be from reputed manufacturers:

- Valve positioner (Smart type)
- Current to pressure converter (I to P Converter)
- Volume booster (if required)
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA)
- Air filter regulator
- Interconnecting Tubing

Inspection & Testing

- Flow characteristics test
- Static performance test
- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-004 (Across circulator bypass)	
Process conditions	
Mass flow rate (range)	0.025-0.2 kg/s
Pressure differential (range)	0.1-0.5 MPa
Operating temperature and pressure	60-80 C and 8.0 MPa
Design temperature and pressure	100 C and 10.0 MPa
Pipe size	2" 80 Sch
Air fail action	Close
Cv	5-20
Characteristics	Equal percentage
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers:	

- Valve positioner (Smart type)
- Current to pressure converter (I to P Converter)
- Volume booster (if required)
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA)
- Air filter-regulator
- Interconnecting Tubing

Inspection & Testing

- Flow characteristics test
- Static performance test
- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-101	
Process conditions	
Mass flow rate (range)	0.01-0.1 kg/s
Pressure differential (range)	0.7-1.2 MPa
Operating temperature and pressure	25 C and 10.0 MPa
Design temperature and pressure	50 C and 20.0 MPa
Pipe size	1" 40 Sch
Air fail action	Close
Cv	2.5-7.5
Characteristics	Equal percentage
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	4-7 bar
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers:	

• Valve positioner (Smart type) • Current to pressure converter (I to P Converter) • Volume booster (if required) • Position transmitter (2-wire with a transmission facility of 4 to 20 mA) • Air filter-regulator • Interconnecting Tubing
Inspection & Testing
• Flow characteristics test • Static performance test • Material test • Liquid penetration examination of body, bonnet, plug, stem, fasteners • Intergranular corrosion test for body, bonnet, plug, stem • Hydrostatic test • Seat leak test • Helium leak test • Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-102	
Process conditions	
Mass flow rate (range)	0.01-0.1 kg/s
Pressure differential (range)	0.7-1.2 MPa
Operating temperature and pressure	25 C and 10.0 MPa
Design temperature and pressure	50 C and 20.0 MPa
Pipe size	1" 40 Sch
Air fail action	Close
Cv	2.5-7.5
Characteristics	Equal percentage
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	4-7 bar
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers: • Valve positioner (Smart type)	

- Current to pressure converter (I to P Converter)
- Volume booster (if required)
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA)
- Air filter-regulator
- Interconnecting Tubing

Inspection & Testing

- Flow characteristics test
- Static performance test
- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VC-103	
Process conditions	
Mass flow rate (range)	0.01-0.1 kg/s
Pressure differential (range)	0.7-1.2 MPa
Operating temperature and pressure	25 C and 10.0 MPa
Design temperature and pressure	50 C and 20.0 MPa
Pipe size	1" 40 Sch
Air fail action	Close
Cv	2.5-7.5
Characteristics	Equal percentage
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Rangeability	> 30:1
Dead band	Less than 0.5% of input span
Hysteresis	Less than 0.5% of output span
Inaccuracy of the positioning	Less than 1% of input span
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	4-7 bar
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers: • Valve positioner (Smart type)	

- Current to pressure converter (I to P Converter)
- Volume booster (if required)
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA)
- Air filter-regulator
- Interconnecting Tubing

Inspection & Testing

- Flow characteristics test
- Static performance test
- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

2. ON/OFF valves

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VG-001/VG-002 (Across TSM)	
Process conditions	
Mass flow rate (range	0.2-0.4 kg/s
Operating temperature and pressure	300-400 C and 8.0 MPa
Design temperature and pressure	450 C and 10.0 MPa
Pipe size	2" 80 Sch
Cv	25-40
Air fail action	Open
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 1500
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	

- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VG-003/VG-004 (at Cooler Inlet)	
Process conditions	
Mass flow rate (range	0.2-0.4 kg/s
Operating temperature and pressure	100-150 C and 8.0 MPa
Design temperature and pressure	200 C and 10.0 MPa
Pipe size	2" 80 Sch
Cv	25-40
Air fail action	Open
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 1500
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter-regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	
• Material test • Liquid penetration examination of body, bonnet, plug, stem, fasteners	

- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VG-005/VG-006 (at Cooler Outlet)	
Process conditions	
Mass flow rate (range)	0.2-0.4 kg/s
Operating temperature and pressure	50-60 C and 8.0 MPa
Design temperature and pressure	100 C and 10.0 MPa
Pipe size	2" 80 Sch
Cv	25-40
Air fail action	Open
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Body	
Size	50 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	½" NPT (M)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter-regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	
• Static performance test • Material test	

- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VG-011/VG-012 (at PICS interface)	
Process conditions	
Mass flow rate (range)	0.01-0.1 kg/s
Operating temperature and pressure	25 C and 15.0 MPa
Design temperature and pressure	50 C and 20.0 MPa
Pipe size	1" 40 Sch
Cv	5-15
Air fail action	Close
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 900
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	½" NPT (M)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter-regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	
• Material test	

- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

General requirement	
Material of construction	Stainless steel 316L with relevant ASTM grade
Fluid medium	Helium gas
Applicable code	ASME B16.34/ISA/FCI-70.2/MSS SP-117/EJMA
Type	Globe valve (Bellow sealed)
VG-101/VG-102/VG-103/VG-104/VG-105/VG-106/VG-107/VG-108/VG-109 (PICS Isolation valves)	
Process conditions	
Mass flow rate (range)	0.01-0.1 kg/s
Operating temperature and pressure	25 C and 15.0 MPa
Design temperature and pressure	50 C and 20.0 MPa
Pipe size	1" 40 Sch
Cv	5-15
Air fail action	Close
Performance	
Leak rate across body	$\leq 10^{-7}$ Pam^3/s
Leak rate across seat	$\leq 10^{-5}$ Pam^3/s
Body	
Size	25 mm
Type	Single seated
Material	ASTM-A 351 Grade CF8M
End connections	Butt welded, CL 1500
Bonnet	
Bonnet material	ASTM-A 351 Grade CF8M
Type	Bolted (Bellow sealed)
Bonnet gasket material	ASTM-A 351 Grade CF8M
Stem packing material	Graphite
Trim	
Type	Unbalanced
Plug and stem material	ASTM-A 351 Grade CF8M
Seat material	ASTM-A 351 Grade CF8M
Actuator	
Type	Diaphragm type pneumatic actuator
Air pressure	7 bar (max.)
Air tubing connection	¼" NPT (M/F)
Threaded fasteners	
Bolts and Studs	ASTM A193 Gr. 8MA
Nuts	ASTM A194 Gr. 8MA
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter-regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	
• Material test	

- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

Appendix-3

Technical Compliance sheet - Technical information to be furnished by the vendor along with technical bid

Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VC-001 (Across TSM bypass)	
Process conditions	
Mass flow rate (range	
Pressure differential (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Cv	
Characteristics	
Performance	
Leak rate across body	
Leak rate across seat	
Rangeability	
Dead band	
Hysteresis	
Inaccuracy of the positioning	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	

Control valve accessories
All the control valve accessories mentioned below shall be from reputed manufacturers: • Actuator: **YES/NO, (Make/model no.):** • Valve positioner (Smart type): **YES/NO, (Make/model no.):** • Current to pressure converter (I to P Converter): **YES/NO, (Make/model no.):** • Volume booster (if required): **YES/NO, (Make/model no.):** • Position transmitter (2-wire with a transmission facility of 4 to 20 mA): **YES/NO, (Make/model no.):** • Air filter-regulator: **YES/NO, (Make/model no.):** • Interconnecting Tubing: **YES/NO**
Inspection & Testing
• Flow characteristics test: **YES/NO** • Static performance test: **YES/NO** • Material test: **YES/NO** • Liquid penetration examination of body, bonnet, plug **YES/NO** • Radiographic examination of cast: **YES/NO** • Ultrasonic examination of forge: **YES/NO** • Intergranular corrosion test for body, bonnet, plug, stem: **YES/NO** • Hydrostatic test: **YES/NO** • Seat leak test: **YES/NO** • Cv test: **YES/NO** • Helium leak test: **YES/NO** • Functional test: **YES/NO**

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Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VC-002 (Across heater bypass)	
Process conditions	
Mass flow rate (range	
Pressure differential (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Cv	
Characteristics	
Performance	
Leak rate across body	
Leak rate across seat	
Rangeability	
Dead band	
Hysteresis	
Inaccuracy of the positioning	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
Control valve accessories	
All the control valve accessories mentioned below shall be from reputed manufacturers:	

- Actuator: **YES/NO, (Make/model no.):**
- Valve positioner (Smart type): **YES/NO, (Make/model no.):**
- Current to pressure converter (I to P Converter): **YES/NO, (Make/model no.):**
- Volume booster (if required): **YES/NO, (Make/model no.):**
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA): **YES/NO, (Make/model no.):**
- Air filter-regulator: **YES/NO, (Make/model no.):**
- Interconnecting Tubing: **YES/NO**

Inspection & Testing

- Flow characteristics test: **YES/NO**
- Static performance test: **YES/NO**
- Material test: **YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners: **YES/NO**
- Ultrasonic examination of stem: **YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem: **YES/NO**
- Hydrostatic test: **YES/NO**
- Seat leak test: **YES/NO**
- Helium leak test: **YES/NO**
- Functional test: **YES/NO**

Authorized Signatory

Official Seal & Date

Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VC-003 (Across recuperator bypass)	
Process conditions	
Mass flow rate (range	
Pressure differential (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Cv	
Characteristics	
Performance	
Leak rate across body	
Leak rate across seat	
Rangeability	
Dead band	
Hysteresis	
Inaccuracy of the positioning	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
Control valve accessories	

All the control valve accessories mentioned below shall be from reputed manufacturers

- Actuator: **YES/NO, (Make/model no.):**
- Valve positioner (Smart type): **YES/NO, (Make/model no.):**
- Current to pressure converter (I to P Converter): **YES/NO, (Make/model no.):**
- Volume booster (if required): **YES/NO, (Make/model no.):**
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA): **YES/NO, (Make/model no.):**
- Air filter-regulator: **YES/NO, (Make/model no.):**
- Interconnecting Tubing: **YES/NO**

Inspection & Testing

- Flow characteristics test: **YES/NO**
- Static performance test: **YES/NO**
- Material test: **YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners: **YES/NO**
- Ultrasonic examination of stem: **YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem: **YES/NO**
- Hydrostatic test: **YES/NO**
- Seat leak test: **YES/NO**
- Helium leak test: **YES/NO**
- Functional test: **YES/NO**

Authorized Signatory

Official Seal & Date

Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VC-004 (Across circulator bypass)	
Process conditions	
Mass flow rate (range	
Pressure differential (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Cv	
Characteristics	
Performance	
Leak rate across body	
Leak rate across seat	
Rangeability	
Dead band	
Hysteresis	
Inaccuracy of the positioning	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
Control valve accessories	

All the control valve accessories mentioned below shall be from reputed manufacturers

- Actuator: **YES/NO, (Make/model no.):**
- Valve positioner (Smart type): **YES/NO, (Make/model no.):**
- Current to pressure converter (I to P Converter): **YES/NO, (Make/model no.):**
- Volume booster (if required): **YES/NO, (Make/model no.):**
- Position transmitter (2-wire with a transmission facility of 4 to 20 mA): **YES/NO, (Make/model no.):**
- Air filter-regulator: **YES/NO, (Make/model no.):**
- Interconnecting Tubing: **YES/NO**

Inspection & Testing

- Flow characteristics test: **YES/NO**
- Static performance test: **YES/NO**
- Material test: **YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners: **YES/NO**
- Ultrasonic examination of stem: **YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem: **YES/NO**
- Hydrostatic test: **YES/NO**
- Seat leak test: **YES/NO**
- Helium leak test: **YES/NO**
- Functional test: **YES/NO**

Authorized Signatory

Official Seal & Date

General requirement	
Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VG-001/VG-002 (Across TSM)	
Process conditions	
Mass flow rate (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Performance	
Leak rate across body	
Leak rate across seat	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Actuator: **YES/NO, (Make/model no.):** • Solenoid valve: **YES/NO, (Make/model no.):** • Air filter regulator**: YES/NO, (Make/model no.):** • Limit switches**: YES/NO, (Make/model no.):** • Interconnecting Tubing**: YES/NO**	
Inspection & Testing	
• Static performance test**: YES/NO**	

- Material test**: YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners**: YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem**: YES/NO**
- Hydrostatic test**: YES/NO**
- Seat leak test**: YES/NO**
- Helium leak test**: YES/NO**
- Functional test: **YES/NO**

Authorized Signatory

Official Seal & Date

General requirement	
Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VG-003/VG-004 (At Cooler inlet)	
Process conditions	
Mass flow rate (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Performance	
Leak rate across body	
Leak rate across seat	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Actuator: **YES/NO, (Make/model no.):** • Solenoid valve**: YES/NO, (Make/model no.):** • Air filter regulator**: YES/NO, (Make/model no.):** • Limit switches**: YES/NO, (Make/model no.):** • Interconnecting Tubing **: YES/NO**	
Inspection & Testing	

- Static performance test**: YES/NO**
- Material test**: YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners**: YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem**: YES/NO**
- Hydrostatic test**: YES/NO**
- Seat leak test**: YES/NO**
- Helium leak test**: YES/NO**
- Functional test**: YES/NO**

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General requirement	
Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VG-011/VG-012 (PICS interface)	
Process conditions	
Mass flow rate (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Performance	
Leak rate across body	
Leak rate across seat	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Actuator: **YES/NO, (Make/model no.):** • Solenoid valve**: YES/NO, (Make/model no.):** • Air filter regulator**: YES/NO, (Make/model no.):** • Limit switches**: YES/NO, (Make/model no.):** • Interconnecting Tubing **: YES/NO**	
Inspection & Testing	

- Static performance test**: YES/NO**
- Material test**: YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners**: YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem**: YES/NO**
- Hydrostatic test**: YES/NO**
- Seat leak test**: YES/NO**
- Helium leak test**: YES/NO**
- Functional test**: YES/NO**

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General requirement	
Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VG-005/VG-006 (At Cooler outlet)	
Process conditions	
Mass flow rate (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Performance	
Leak rate across body	
Leak rate across seat	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Actuator: **YES/NO, (Make/model no.):** • Solenoid valve**: YES/NO, (Make/model no.):** • Air filter regulator**: YES/NO, (Make/model no.):** • Limit switches**: YES/NO, (Make/model no.):** • Interconnecting Tubing **: YES/NO**	
Inspection & Testing	
• Static performance test**: YES/NO**	

- Material test**: YES/NO**
- Liquid penetration examination of body, bonnet, plug, stem, fasteners **: YES/NO**
- Intergranular corrosion test for body, bonnet, plug, stem**: YES/NO**
- Hydrostatic test**: YES/NO**
- Seat leak test**: YES/NO**
- Helium leak test**: YES/NO**
- Functional test**: YES/NO**

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General requirement	
Make	
Model no.	
Material of construction	
Fluid medium	
Applicable code	
Type	
VG-101/VG-102/VG-103/VG-104/VG-105/VG-106/VG-107/VG-108/VG-109 (PICS Isolation valves)	
Process conditions	
Mass flow rate (range)	
Operating temperature and pressure	
Design temperature and pressure	
Pipe size	
Air fail action	
Performance	
Leak rate across body	
Leak rate across seat	
Body	
Size	
Type	
Material	
End connections	
Bonnet	
Bonnet material	
Type	
Bonnet gasket material	
Stem packing material	
Trim	
Type	
Plug and stem material	
Seat material	
Actuator	
Type	
Air pressure	
Air tubing connection	
Threaded fasteners	
Bolts and Studs	
Nuts	
ON/OFF valve accessories	
All the ON/OFF valve accessories mentioned below shall be from reputed manufacturers: • Solenoid valve • Air filter-regulator • Limit switches • Interconnecting Tubing	
Inspection & Testing	
• Static performance test	

- Material test
- Liquid penetration examination of body, bonnet, plug, stem, fasteners
- Intergranular corrosion test for body, bonnet, plug, stem
- Hydrostatic test
- Seat leak test
- Helium leak test
- Functional test

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