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Magnet Division Procurement Specification

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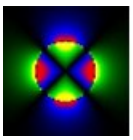

Superconducting Magnet Division

# Procurement Specification For ILC Service Cryostat 4K Cryogenic Valves

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**Revision History**

Rev A: Initial Release 1/12/10

## 1. Scope

This specification defines the three (3) cryogenic control valves for installation on the ILC Service Cryostat under construction at Brookhaven National Laboratory. Two of the valves will be used for helium service. The third valve will be used for liquid nitrogen. While the third valve is to be used for LN2, the valve shall be of same/similar geometry as that of the two helium valves due to piping layout in the cold box.

## 2. Process Design Requirements

2.1. The process design requirements are given in Attachments 1, 2 & 3.

2.2. All valves shall be designed for minimum heat leak to process.

2.3. All valves are required to be designed to operate between 4K and 400K

2.4. Pressure rating of the valve is either 10 or 20 bar (~ 150 or 300 psig) as given in Attachments 1, 2 & 3.

2.5. Design pressure shall be vacuum to full pressure rating.

2.6. Depending on the control function, the vendor shall propose either equal percentage or linear plug for BNL to choose.

## 3. Materials Of Construction

3.1. All material shall be new and proven for 4 K application.

3.2. Selection of materials used shall prevent the occurrence of galling between mating parts

3.3. Selection of materials used shall prevent the occurrence of galvanic corrosion

3.4. Epoxy or other similar materials shall not be used

3.5. All piping shall be seamless or welded stainless steel

## 4. Mechanical Design Requirements

4.1. All fixed permanent joints shall be welded

4.2. No mechanical joints are allowed to the vacuum space and suitable for cold box installation.

4.3. All seals, joints and welds shall be suitable for design temperature, pressure and full vacuum

4.4. The valve will be subjected to temperature cycling and shall be capable of withstanding 10,000 cycles from 400K to 4K without loss of leak-tight integrity

4.5. The valve shall be helium mass spectrometer leak tested for external leakage and shall have a leak rate less than $1x10^{-9}$ atm. cc/s at 1 atm differential pressure

4.6. The valve shall be designed for helium bubble tight closure at a differential pressure equal to the design pressure across the valve seat in either direction

4.7. The valve shall incorporate soft seating with easily replaceable plugs and seats

4.8. Special tools for installation and maintenance along with price shall be given in the proposal

4.9. The valve and all internal surfaces shall be clean for helium refrigeration application

## 5. Type Of Valves To Be Furnished:

5.1. Valve operators shall be instrument air actuated. Instrument air provided by the buyer is regulated between 60 to 80 PSIG. All the mounting brackets and attachment to valve shall be provided.

5.2. Due to the tight space above the cold box, an actuator of the smallest possible projected area is required. *The maximum diameter for the operator shall not exceed 4 inches, or 6.5 inches with feature for externally mount positioner*.

5.3. Control valves shall be equipped with air-operated actuators, positioners, filter/regulator sets, and I/P (current to pneumatic) transducers. These devices shall be tubed and assembled on the valve actuator by the valve supplier. The instrument air supply connection to the valve assembly shall be 1/4 FNPT. I/P transducers shall be 4-20 mA with load impedance less than 350 ohms. The electrical enclosure for the solenoid connections shall be NEMA 1 and provided with provision for flexible conduit connection.

## 6. Interface Type And Installation Of The Valves

6.1. The following valves will be installed inside a coldbox, and thus require a coldbox cuff/neck. These valves shall be designed for low heat leak to process and the heat leak value shall be provided for these valves with the proposal.

## 7. Documentation

7.1. The following shall be provided:

7.1.1. Data sheets with valve and interface dimensions.

7.1.2. Outline drawings including the operator shall be furnished with the proposed submittal offer.

7.1.3. Max. allowable forces, moments and deflections induced by piping at the valve body.

7.1.4. The proposed valve data

7.1.5. The proposed actuator data

## 8. QA Deliverables

1) Certified Material Test Reports (CMTR's) for pressure boundary materials
2) Pressure Test report
3) Seat test report
4) Leak check test report
5) Certificate of Conformance
6) Information Listed in Attachment 4

## Attachment 1 - Specification for Valve AOV1

| | |
|---|---|
| Service | Helium |
| Function | Liquid helium fill / JT |
| Valve type | Angle pattern with butt weld end |
| Control | Maintain liquid level |
| Operator | Normally closed |
| Control type | Continuous control throttling |
| Actuator | Diaphragm/Spring or Piston/Spring |
| Positioner | Vendor propose |
| Pressure rating [bar] | 20 |
| Design Pressure | Vacuum to full pressure rating |
| Design Temperature [K] | 4 – 400 |
| Seat leakage | Bubble tight at max. pressure differential |
| Valve leakage to vacuum | 1 x $10^{-9}$ atm-cc/s at max. pressure differential |
| Seal type | Bellow, or packing rings with proven application |
| Vacuum boundary interface | Cold box cuff / neck |
| Max. heat leak to 4.5 K [W] | < 1.4 |
| Max. valve size [in] | ½" OD |
| Min. length of valve inside vacuum [in] | 18 |

| | | **Off-design** | | |
|---|---|---|---|---|
| | **Baseline** | **#1** | **#2** | **#3** |
| Mass flow [g/s] | 6 | 10 | 3 | 5 |
| **Inlet** | | | | |
| Pressure [bar] | 1.25 | 1.25 | 1.4 | 10 |
| Temperature [K] | 4.45 | 4.45 | 4.453 | 4.8 |
| Density [g/cc] | 0.12 | 0.12 | 0.117 | 0.145 |
| Phase | Liquid or Supercritical | | | |
| **Outlet** | | | | |
| Pressure [bar] | 1.2 | 1.2 | 1.2 | 1.2 |
| Temperature [K] | 4.407 | 4.407 | 4.407 | 4.407 |
| Density [g/cc] | - | | | |
| Phase | two phase | | | |
| Vapor fraction [%] | 1.43 | 1.43 | 5.78 | 24.1 |

## Attachment 2 - Specification for Valve AOV4

| | |
|---|---|
| Service | Helium |
| Function | Flow control |
| Valve type | Angle pattern with butt weld end |
| Control | Maintain temperature on 5 K heat shield |
| Operator | Normally closed |
| Control type | Continuous control throttling |
| Actuator | Diaphragm/Spring or Piston/Spring |
| Positioner | Vendor propose |
| Pressure rating [bar] | 10 |
| Design Pressure | Vacuum to full pressure rating |
| Design Temperature [K] | 4 – 400 |
| Seat leakage | Bubble tight at max. pressure differential |
| Valve leakage to vacuum | $1 \times 10^{-9}$ atm-cc/s at max. pressure differential |
| Seal type | Bellow, or packing rings with proven application |
| Vacuum boundary interface | Cold box cuff / neck |
| Max. heat leak to 4.5 K [W] | < 1.4 |
| Max. valve size [in] | ½" OD |
| Min. length of valve inside vacuum [in] | 18 |

| | **Baseline** | **Off-design** |
|---|---|---|
| Mass flow [g/s] | 1.21 | 2.5 |
| **Inlet** | | |
| Pressure [bar] | 1.188 | 1.188 |
| Temperature [K] | 4.4 | 4.4 |
| Density [g/cc] | 0.121 | 0.121 |
| Phase | Liquid | |
| **Outlet** | | |
| Pressure [bar] | 1.15 | 1.15 |
| Temperature [K] | 4.4 | 4.4 |
| Density [g/cc] | 0.12 | 0.12 |
| Phase | Liquid | Liquid |

## Attachment 3 - Specification for Valve AOV5

| | |
|---|---|
| Service | Nitrogen |
| Function | Flow control |
| Valve type | Angle pattern with butt weld end |
| Control | Maintain temperature on 80 K heat shield |
| Operator | Normally closed |
| Control type | Continuous control throttling |
| Actuator | Diaphragm/Spring or Piston/Spring |
| Positioner | Vendor propose |
| Pressure rating [bar] | 10 |
| Design Pressure | Vacuum to full pressure rating |
| Design Temperature [K] | 4 – 400 |
| Seat leakage | Bubble tight at max. pressure differential |
| Valve leakage to vacuum | $1 \times 10^{-9}$ atm-cc/s at max. pressure differential |
| Seal type | Bellow, or packing rings with proven application |
| Vacuum boundary interface | Cold box cuff / neck |
| Max. heat leak to 4.5 K [W] | < 1.4 |
| Max. valve size [in] | ½" OD |
| Min. length of valve inside vacuum [in] | 18 |

| | **Baseline** | **Off-design** |
|---|---|---|
| Mass flow [g/s] | 7.69 | 4.0 |
| **Inlet** | | |
| Pressure [bar] | 1.5 | 1.5 |
| Temperature [K] | 80 | 80 |
| Density [g/cc] | 0.8 | 0.8 |
| Phase | Liquid | |
| **Outlet** | | |
| Pressure [bar] | 1.49 | 1.49 |
| Temperature [K] | 80 | 80 |
| Density [g/cc] | 0.8 | 0.8 |
| Phase | Liquid | Liquid |

## Attachment 4 – Data To Be Provided By Vendor

### Valve Data

Tag Name: _____
Model N0.: _____
Valve Size: _____
CV: _____
Heat Leak: _____
Design Max. Press. _____
Design Max. Temp. _____

Type (Globe / Angle): _____
Body End Conn. _____
(IN/OUT) IPS
Body Matl. _____
Packing Matl. _____
Packing Type _____

Plug Matl. _____
Seat Matl. _____
Stem Matl. _____
Recommended
Spare Parts _____

### Actuator Data

Tag Name: _____
Model N0.: _____
Type: _____
Size: _____
Actuator Dia _____
Stroke _____
Seating Force _____
_____

Recommended
Spare Parts _____