



Fermilab

**Particle Physics Division
Mechanical Department Engineering Note**

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Title: Microboone Filter Skid Specification

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Filter Skid Specification

1. General Requirements

In this specification the filter vessel skid shall be referred to as the *DEVICE*. Fermi National Accelerator Laboratory (Fermilab) shall be referred to as the *CUSTOMER*. The fabricator of the filter skid shall be referred to as the *SELLER*.

The *CUSTOMER* is in the process of building a liquid Argon purification system. This document is a specification for a filter skid containing two vacuum jacketed cryogenic filter vessels and external piping. The *CUSTOMER* will install filter material into the vessels to remove oxygen and water from liquid Argon.

The following drawings are part of this specification:

3974.220-MD-486016
3974.220-MC-486020
3974.220-MC-486021
3974.220-MD-486036
3974.220-MD-489563
3974.220-MD-489564
3974.220-MD-489570
3974.220-ME-489577
3974.220-MC-489580
3974.220-MC-489582
3974.220-MD-489597
3974.220-MD-489644
3974.220-MC-489652

For reference, the appendix of this document has a flow schematic and valve list of the filter skid.

Any conflicts between the requirements of this specification and those of any referenced drawings, specifications, or codes shall be brought to the attention of the *CUSTOMER* for resolution.

The *SELLER* shall furnish all facilities, equipment, special tooling, consumables, and material, except where explicitly excluded in this specification, and perform all work and services necessary to engineer, design, fabricate, assemble, test and deliver to the *CUSTOMER* a fully functional *DEVICE*, in strict accordance with this specification and the appropriate drawings and part lists.

The *CUSTOMER* shall have the option of witnessing the tests and inspections required in this specification. The *CUSTOMER* shall have free entry at all times to observe fabrication and testing of the *DEVICE* and its components. The *CUSTOMER* shall have all reasonable access to the fabrication facilities to confirm that the vessels are being fabricated and tested in accordance with this specification.

2. Pressure Vessel Requirements

Drawing 486036, shows the design requirements for two identical ASME code U-stamped pressure vessels that will be part of the filter skid.

3. Filter Vessel Outer Jacket Requirements

The outer 24" vacuum jacket of Drawing 489597 must be designed, fabricated and code stamped in accordance with the requirements on that drawing.

Item 1 on drawing 489564 and item 2 on drawing 489563 are specified as ASME B16.9 pipe caps. If the SELLER's proposal is for a different type of head, the SELLER must maintain the intended functionality of the DEVICE. The SELLER must then provide marked-up CUSTOMER drawings or other documentation showing all required changes in the CUSTOMER drawings. The CUSTOMER must approve all changes prior to fabrication.

4. Piping Requirements

All argon piping must be fabricated in accordance with ASME B31.3 piping code for normal fluid service. This includes (but is not limited to) random radiography of at least 5% of the piping butt welds.

5. Welding

The following requirements must be met for all welding on pressure vessels, argon piping and vacuum components. In general these requirements do not apply to structural welds. In particular these requirements do not apply to the welds on of the frame, drawing 486016.

(a) All weld joint preparation and welding techniques shall be done in accordance with the ASME Boiler and Pressure Vessel Code (BPVC), Section VIII and IX and/or Chapter V of the ASME B31.3 code.

(b) The SELLER shall conduct the tests required to qualify Welding Procedure Specification (WPS) as required by Section VIII and IX of the ASME BPVC and/or Chapter V of the ASME B31.3 code.

(c) The SELLER shall conduct the tests required to qualify Welders as required by Section VIII and IX of the ASME BPVC and/or Chapter V of the ASME/ B31.3 code.

(d) The SELLER shall maintain records in accordance with paragraph UW-48 Section VIII Division I ASME BPVC of all welders and welding operators working on the DEVICE and the welds made by each so that all the data

will be available for the *CUSTOMER*.

(e) All welding shall be done by the Gas Tungsten Arc Weld process, using welding quality argon gas for the inert shield.

(f) All welds shall be internally purged with welding quality argon gas during the time of welding and post welding treatment.

(g) Welds that show evidence of a lack of purge will be deemed unacceptable.

(h) All welding shall be done in such a manner that the weld surface is smooth and free of irregularities. No mechanical process shall be used to achieve the smooth appearance. No visible metal chips or foreign material may be detectable inside any component of the *DEVICE*. All external surfaces in the weld area shall be cleaned of slag, and other deposits.

(i) No production work shall be done until both the WPS and welders or welding operators have been qualified in accordance with the Section VIII paragraphs UW-28 and UW-29 and Section IX of the ASME BPVC.

6. Cleaning Requirements

No dye penetrants may be used. No markers with fluorinated ink may be used on any part.

All internal surfaces inside of pipes, pressure vessel, vacuum jackets or vacuum vessel must be cleaned in the following manner:

(a) Each component and subassembly shall be thoroughly cleaned at every stage of all scale, spatter, flux, foreign materials, etc.

(b) Cleaning agents shall be suitable for the materials of construction, and shall be neutralized if necessary.

(c) Weld spatter shall be removed by wire brushing using stainless steel brushes.

(d) Each assembly shall be cleaned to provide an inner surface of all pipes and tubes free of grease, flux, moisture, dirt, and other foreign materials by vapor degreasing or suitable wash.

(e) Final cleaning of each inner surface should be performed using ethyl alcohol and lint free cloth.

(f) After final cleaning, surfaces shall be visibly inspected and wiped down with a lint free white cloth. In order to be considered free of contamination, no discoloration shall appear on the lint free white cloth.

(g) After cleaning, each section shall be blown dry with clean dry nitrogen until no moisture remains.

7. Inspection, Examination And Tests

The following tests and inspections are required.

- (a) The *SELLER* shall perform all examinations required by ASME B31.3, including materials tests and non-destructive examinations.
- (b) The *SELLER* shall conduct leak tests to assure leak tightness of all vacuum and argon circuits. No leaks should be detected on the most sensitive scale of the leak detector (minimum sensitivity 1×10^{-9} std cc helium per sec) during the leak testing.
- (c) Pressure vessels shall be pneumatically pressure tested with dry inert gas in accordance with paragraphs UG-100 and UW-50 of the Division I, Section VIII of the ASME BPVC.
- (d) All piping circuits shall be pneumatically pressure tested with dry inert gas in accordance with paragraph 345.5 of the ASME B31.3 piping code.
- (e) The *SELLER* shall perform all examinations required by ASME BPVC Section VIII Division I, including materials tests, non-destructive examinations and pressure tests.
- (f) All RTD wires on subassembly 489563 must be inspected after the subassembly is complete. Identification labels on ends of each wire must be inspected to ensure they are intact and correct with respect to the RTD locations shown on drawing 489563. Each RTD has three wires; the electrical resistance of all combinations of those three wires must be measured and recorded to ensure electrical continuity. For each wire, the electrical resistance with respect to the stainless steel components of the subassembly must be measured to ensure no electrical short to ground.

8. Information Required Before Fabrication

The following items are subject to approval by the *CUSTOMER* prior to the onset of any *DEVICE* fabrication:

- (a) Final drawings of the inner vessels, shown on drawing including parts and subassemblies that satisfy ASME code requirements.
- (b) Final Drawings of Outer Jacket if different from specification drawings.
- (c) Written leak testing procedure. Include details of final leak tests.

After the completion of the subassembly on drawing 489563 the results of the electrical test section 7-f must be submitted to the *CUSTOMER*. The *CUSTOMER* may choose to inspect the subassembly. The *CUSTOMER*'s written approval must be obtained before the subassembly is installed into the assembly on drawing 489597.

9. Information Required With Quote

The following information is required with a quote.

- (a) ASME code required wall thickness of pressure vessel defined in section 2.
- (b) ASME code required wall thickness of filter vessel outer vacuum jacket defined in section 3.
- (c) Time for delivery of *DEVICE* to the *CUSTOMER* after receipt of order.
- (d) Type of head to be used for Item 1 on drawing 489564 and item 2 on drawing 489563 which are specified on *CUSTOMER* drawings as ASME B16.9 pipe caps. Refer to section 3.

10. Acceptance Test

Within 12 weeks of receipt of the *DEVICE* to the *CUSTOMER*, the *CUSTOMER* shall conduct a leak test of all helium and vacuum circuits of the *DEVICE*. Measured helium leaks greater than 1×10^{-9} std cc helium per sec shall be defined as a failure to pass the test.

11. Shipping

The following are required for shipping of the *DEVICE* to the *CUSTOMER*.

- (a) All openings shall be sealed against the penetration of moisture, dirt or air.
- (b) All circuits shall be pressurized to 1 psig with dry nitrogen.
- (c) Install all shipping restraints (item 7 drawing 489564) before shipping
- (d) Any external piping or tubing on the skid shall be restrained as needed to prevent excessive vibration during shipping
- (e) The *DEVICE* shall be shipped in a vertical position

12. Documentation Required With Delivery

The documentation below must be delivered to the *CUSTOMER* with delivery of the *DEVICE*:

- (a) Results of all tests and inspections required in section 7.
- (b) The *SELLER* shall provide copies of mill certification reports for all materials supplied by the *SELLER* for all pressure containing or vacuum containing parts. The mill certificates shall include both physical and chemical properties of the materials. For commercial items such as weld rods, electrodes, certificates of compliance shall be supplied in lieu of mill certification reports

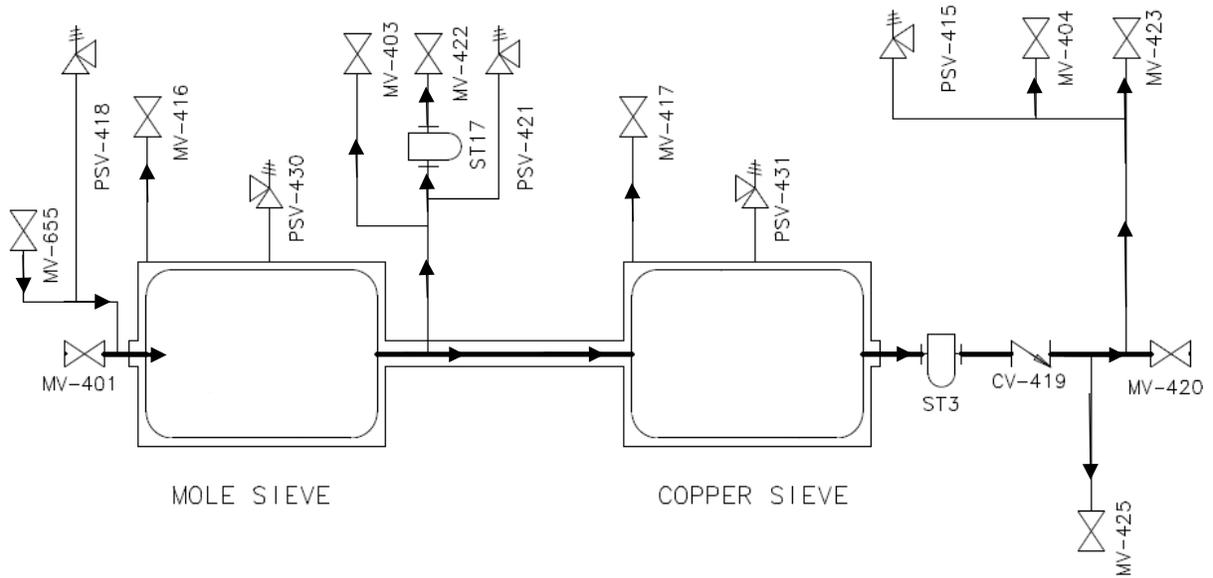
- (c) Copies of the ASME required WPS utilized in welding operations for pressure or vacuum containing parts.
- (d) Copies of Welders' Qualification Records for each welder utilized in welding operations for pressure or vacuum containing parts.
- (e) Copies of all Welding Records as define in section 5-d of this specification for welding operation on the *DEVICE*.
- (f) All engineering calculations and design information for the pressure vessels (defined in section 2) and filter vessel outer vacuum jacket (defined in section 3).
- (g) A complete set of drawings for all assemblies and parts that differ from the specification drawings.
- (h) Copies of all ASME required radiography reports.
- (i) National Board Registration.

13. Items Supplied By The *CUSTOMER*

If requested, the *CUSTOMER* will provide the following to the *SELLER* electronic files of all 2D specification drawings or the 3D model of the *DEVICE*.

The *CUSTOMER* will provide to the *SELLER* all items so indicated on the specification drawings.

Appendix – Flow Schematic



**Tag numbers for reference only. Do not label hardware.*

Tag	#	DWG 489577 Item #	Manufacturer	Part Number
MV	401	6	ACME	CV1500HAROP10QM
MV	403	12	Swagelok	SS-12UG-TW-TF
MV	404	13	Swagelok	6LVV-DPBW4-P
PSV	415	9	Circle Seal	5180B-4MP-60
MV	416	6 (DWG 489564)	ACME	V-1046-31
MV	417	6 (DWG 489564)	ACME	V-1046-31
PSV	418	8	Anderson Greenwood	81BM46-4
CV	419	7	Checkall	USJSSMT0.50SS
MV	420	6	ACME	CV1500HAROP10QM
PSV	421	8	Anderson Greenwood	81BM46-4
MV	422	13	Swagelok	6LVV-DPBW4-P
MV	423	10	Swagelok	SS-4BG-TW
MV	425	11	Swagelok	SS-12UAG-TW-TF
PSV	430	13, 14 (DWG 489564)	Custom Parellel Plate Relief	see drawing 489564
PSV	431	13, 14 (DWG 489564)	Custom Parellel Plate Relief	see drawing 489564
MV	655	12	Swagelok	SS-12UG-TW-TF
ST	3	5	Custom Sintered Metal Filter	see drawing 489570
ST	17	62	Swagelok	SS-4FW-VCR-7