

Fermilab Pressure Vessel Specification

COUPP Outer Vessel

November 7, 2011

1. General

Fermilab requests a quote on the pressure vessel shown in drawings #9213.400-ME-489383 and #9213.400-MD-489312 and built according to the requirements specified in this document.

The pressure vessel will be designed to meet both United States and Canadian (Province of Ontario) code requirements. The seller shall work with the Technical Standards and Safety Authority (TSSA) in Toronto, Ontario, Canada to meet the requirements necessary to attain a Canadian Registration Number (CRN). The vendor will be responsible for the completion of mechanical design details not shown in the drawing and will be responsible for completing and documenting all required code calculations, copies of which will be provided to Fermilab on request.

The pressure vessel will be made of 316L stainless steel from a specific vendor (**OUTOKUMPU Stainless Inc**) that has been selected by Fermilab due to the reliable trace element composition of their product.

The seller shall furnish all labor, equipment and materials and shall perform all work necessary to design, fabricate, assemble, test, certify and deliver the vessel to SNOLAB in Ontario, Canada, in accordance with this specification. Full shipping information will be provided.

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 buyer for resolution.

STEP, IGES or Parasolids files of Fermilab's design drawing are available upon request.

2. Vessel Design Requirements:

The following are the design conditions for the vessel:

Contents: Propylene Glycol

Orientation: Vertical Vessel

Insert weight carried by 24 inch top flange: 450 lb.

Maximum Allowed Working Pressure: Internal 450 psig, External 20 psig

Fatigue cycled: internal pressure 0-250 psig, 2.5 million cycles

Minimum Temperature: -20 F

Maximum Temperature: 200 F

Material: 316L stainless steel

Code Requirement: ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2.
ASME U stamp National Board registration is required.
Canadian Registration Number for the Province of Ontario is required.

Code Stamp plates to be located on outer surface

3. Vessel Dimensions

3.1 The dimensions and sizes shown in drawings #9213.400-MD-489312 , #9213.400-ME-489383 and in this specification are the dimensions and sizes required. The drawing does not show dimensions for features not important to Fermilab. The

vendor may determine sizes and dimensions not shown on the drawings as required by the ASME code and as required to meet fabrication requirements.

- 3.2 The vessel has unusual requirements on the alignment of the flanges to the body and on the flatness of the side flanges. The alignment specifications are shown in Table 1. The seller will be responsible for any machined alignment features, weld preparations or other modifications to the design that may be required to meet the alignment specifications.

Item	Requirement
Top Flange	Perpendicular to cylinder axis within 0.020 inch
Side Window flanges	Perpendicular to cylinder axis within 0.015 inch
Side Window flanges	Window axis to top flange dimension within 0.015 inch
Flange flatness	0.003 inch

Table 1: Flange alignment and flatness requirements.

4. Welding Specification

- 4.1 Welding shall be done in accordance with all applicable codes such as the ASME Boiler and Pressure Vessel Code Section IX and AWS D1.6, Structural Welding Code for Stainless Steel.
- 4.2 All welding shall be done by the Argon shield, fusion arc weld process and/or TIG process. All welds shall be internally purged with 100% argon during the time of welding and post weld treatment.
- 4.3 Vendor shall determine the sequence of welding to minimize distortion and assumes responsibility for any stress relieving and straightening necessary.
- 4.4 All TIG welding shall be performed using either of the following electrode options to minimize the introduction of radioactive constituents into welds:
- 4.2.1 Option 1: Use a non-thoriated pure-tungsten electrode
 - 4.2.2 Option 2: Use a 2% ceriated tungsten electrode (Manufacturer: Techniweld Products Corp., <http://www.techniweld.com/products/index.html>)
- 4.5 Any weld filler material shall be approved by Fermilab.

5. Material Specification

- 5.1 The vessel and any components attached to it will be constructed from 316L stainless steel. All 316L Stainless Steel material used in the fabrication of this vessel shall be purchased from the following source:

OUTOKUMPU Stainless Inc.
425 N. Martingale Road, Suite 1600
Shaumburg, IL 60173
Suggested contact: Tony Stewart, Sr. Inside Sales Representative
Phone: 1-800-349-0023

- 5.2 Fabricator shall ensure that all the OUTOKUMPU 316L purchased for this fabrication can originate from melt sources in the United Kingdom or Sweden only. Sourcing material from multiple melt sources/mill runs for different material thicknesses is acceptable, provided that the fabricator shall maintain material

quantities used for construction of the vessel from each mill run. Certified Material Test Reports (CMTR's) shall be traceable to specific parts and components of the vessel. CMTR documentation shall provide traceability of material back to heat or lot number. Traceability documentation shall be maintained by Fabricator at fabricators facility and provided to Fermilab with deliverables upon completion of fabrication.

- 5.3 Fabricator shall maintain Certified Material Test Reports (CMTR) for all OUTOKUMPU 316 L materials purchased from distributor. Fabricator shall physically segregate and maintain traceability of all material purchased for this fabrication.
- 5.4 Upon receipt of stainless steel, the Fabricator shall send 2 to 3 pounds of sample material from each mill run to Fermilab. Samples shall be 4 inches x 4 inches or smaller.
- 5.5 Fermilab requires that cigarette smoking adjacent to machining operations be prevented to minimize the risk of contamination to the material from airborne smoke constituents.

6. Legs and Stand Requirements

The vessel will be provided with two sets of bolted-on support legs of different dimensions:

- 6.1 The "long legs" are shown in Drawing #9213.400-ME-489383. These legs are the intended permanent support for the vessel while it is in service. The material selection and welding requirements for these legs shall be the same as those for the vessel. The vendor is responsible for insuring that the design and fabrication of the stand meet applicable code requirements.
- 6.2 The "short legs" are shown in Drawing #9213.400-MD-489312. These legs are intended to be used as temporary fixtures to make the vessel more accessible for assembly of the flanges and other attached items than it would be at the full height of the "long legs". The short legs do not have any special material requirements since they are not part of the final assembly.

7. Cleaning and Passivation

- 7.1 After all welding and grinding has been completed, the vessels shall be cleaned to remove all weld slag, weld splatter, oils, greases, ink, paint, dirt, and grit.
- 7.2 All internal and external surfaces of the finished vessel will have a bright and clean appearance without discoloration from welding.
- 7.3 The stainless steel surfaces of the vessel and legs will be passivated to insure that they will not corrode under long term immersion in heated deionized water (the vessel will be installed inside a pool of water). The vendor will employ one of the passivation techniques recommended by ASTM A967-99 or an equivalent procedure recommended by the vendor and approved in writing by Fermilab. A chemical test for free iron, chosen from the options presented in ASTM A967-99 will be performed to check that passivation has been successful.

8. Pressure Testing

- 8.1 The vessel shall be pneumatically or hydraulically tested in accordance with ASME Section VIII requirements. Fluid used for pressure testing shall be water.

9. Pneumatic Leak Checking

- 9.1 Pneumatic leak testing shall take place after all pressure testing has been completed.
- 9.2 The vessel will be pressurized to at 250 psig with an inert gas and leak checked using “Snoop” or an equivalent product (<http://www.swagelok.com/products/leak-detectors-lubricants-sealants/snoop-liquid-leak-detector.aspx>)
- 9.3 Any leak noticed by Snoop soap bubbles shall be repaired.
- 9.4 A pressure of 250 psig shall be held for a minimum of 8 hrs with no more than a 1% pressure drop.
- 9.5 Upon request, Fermilab representatives will be allowed to witness the leak check.

10. Inspection Requirements

- 10.1 Fermilab or its authorized inspector shall be allowed entry to all parts of the building used for fabricating and testing these vessels. The subcontractor shall afford the inspector all reasonable facilities to satisfy him that the vessels are being fabricated and tested in accordance with this specification.
- 10.2 Fermilab intends to inspect the vessel and its documentation at the vendor’s plant before shipment. A written statement that the vessel has been inspected and found to meet specifications will be required before shipping.

11. Shipping

- 11.1 The vessel shall be prepared for shipping by installing a blind flange or plug over every vessel port and installing shipping restraints as needed to prevent damage to the vessel due to shipping loads.
- 11.2 The outer vessel shall be wrapped in plastic to keep the vessel clean during shipment.

12. Information Required after Order is Placed.

Fermilab requires the following design documentation to be provided and approved in writing before the vendor begins fabrication of the vessel or purchasing of materials. The design documentation must be provided to Fermilab within a maximum of 8 week after award. Fermilab will review the documentation and provide comment for no more than two weeks.

- 12.1 Fabrication drawings shall be provided showing final dimensions and any modifications to the original Fermilab design. Fabrication drawing CAD files in a mutually agreed upon format are required.
- 12.2 Copies of code calculations required by ASME and Canadian codes are required.
- 12.3 A statement of the method that will be used to passivate the vessel surfaces.
- 12.4 A statement of the welding techniques which will be used.
- 12.5 Fermilab retains the right to cancel the purchase of the vessel if satisfactory design documentation cannot be provided. In the case of cancellation, Fermilab agrees to reimburse the vendor for reasonable engineering costs not to exceed 20% of the contact price of the vessel.

13. Review by Licensed Professional Engineer and the TSSA

- 13.1 The vendor will have the drawing package reviewed and stamped by a licensed professional engineer who is experienced in the design of boilers and pressure vessels and who is registered or licensed in Ontario, Canada.
- 13.2 Upon approval of the design package by Fermilab, the vendor will submit drawings and other design information to the Technical Standards and Safety Authority (TSSA) in Toronto, Canada. TSSA approval will be obtained before commencement of fabrication.

14. Final documentation will be required at completion of the order.

Fermilab requires the following documentation be provided at the completion of the order, before the vessel is shipped from the vendor's site.

- 14.1 Material Certificates of Conformance
- 14.2 Material Certification Test Reports
- 14.3 Weld Procedures
- 14.4 Welder Qualification Records
- 14.5 Weld Filler Metal Documentation
- 14.6 Leak Testing results
- 14.7 Pressure testing results
- 14.8 ASME National Board Registration.
- 14.9 Photograph of vessel code stamp plate.
- 14.10 Canadian Registration number for the province of Ontario.
- 14.11 Shipping Restraint removal procedure, if applicable