

Technical Specification Summary

Title	Technical Specification Summary for Second Target Station Pulsed Dipole Ceramic Vacuum Chambers
Authors	Austin Chaires
Project Manager	Austin Chaires

ABSTRACT

This document provides a summary of the technical requirements for producing a ceramic vacuum chamber for Oak Ridge National Laboratory's Second Target Station project for potential Seller interest and budgetary quotation.

REVISIONS

Revision	Date	Description
0.3	4 FEB 2022	Removed chamber 2 design and all associated requirements along with updating language. Changed all units to SI (US customary units) format. Modified requirements: removed radiographic examination and electrically conductive coating of the interior surface, and lowered the value of the positive pressure load. Clarified some requirements and reformatted.
0.2	3 NOV 2021	Updated for clarification.
0.1	29 OCT 2021	Changed all units to US customary units (SI) format. Corrected grammar.

TABLE OF CONTENTS

Abstract.....	1
Table of Contents.....	1
1. Scope.....	1
2. Product Description	2
3. Acronyms & Definitions	2
4. High-Level Requirements Description	3

1. SCOPE

This document provides a summary of the technical requirements for producing a ceramic vacuum chamber. The quantity required is 8 plus one test unit.

Requested information from the Seller for this budgetary quote should include costs and schedule duration separated into phases including design and engineering, fabrication, testing and inspection, and delivery planning and execution. Pricing that does not fall into these categories is also required to be listed and described. The Seller may propose alternate solutions or exceptions. The Seller may subcontract part of the work defined by this specification and the contract/purchase order.

2. ACRONYMS & DEFINITIONS

Company	Oak Ridge National Laboratory (ORNL) or its representatives.
Seller	The company under contract to produce a service and or units for the buyer.
STS	Second Target Station. An Oak Ridge National Laboratory’s Spallation Neutron Source project.
Unit	A single complete product or package set produced by the Seller.

3. PRODUCT DESCRIPTION

The chamber design incorporates a ceramic tube, connected to Kovar™ rings connected to stainless steel flanges (see Figure 1).

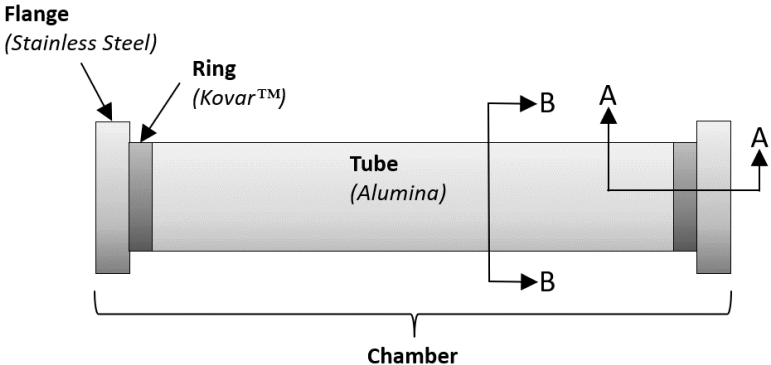


Figure 1 - Generic Construction of Chamber.

The tube’s cross-sectional envelope is shown in Figure 2.

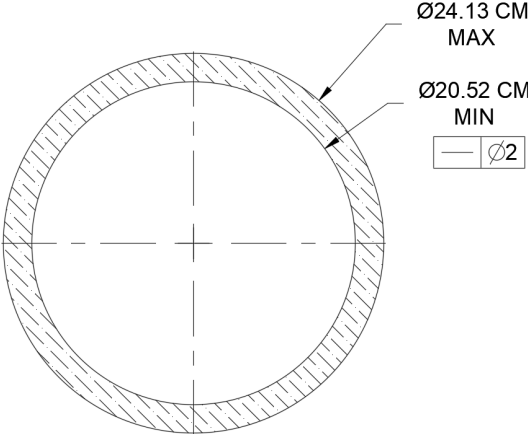


Figure 2 - Cross-sectional View B-B (refer to Figure 1).

The minimum tube length is ~80 cm (~31.5 in) and the chamber's maximum length is ~100 cm (~39.4 in) flange to flange.

The internal pressure range of the chamber includes a minimum vacuum pressure of 1.2×10^{-6} Pa and a minimum positive pressure of 1.7×10^4 Pa (~2.5 psi) (See Figure 3).

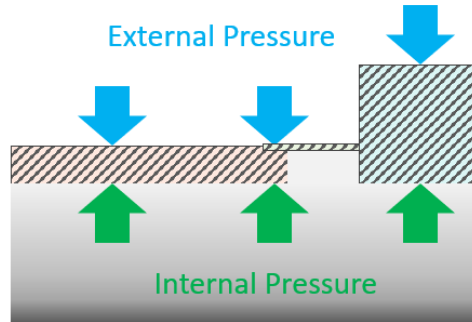


Figure 3 - Cross-sectional View A-A (refer to Figure 1).

The ring's dimensional features will be designed by the Seller, as well as the joints to the metalized surface of the ceramic tube and the weld to the stainless-steel flanges. The flanges are 304 or 316 stainless steel standard off-the-shelf DN200 ConFlat flanges.

4. SUMMARY OF TECHNICAL REQUIREMENTS

4.1 Design Work

The Seller will provide the dimensions, tolerances, and annotations for the details of these designs:

- Minimum thickness of the ceramic tube,
- Ceramic metallization per ASTM F44 for the Kovar™ ring braze joint,
- Kovar™ ring features,
- Braze joint of the Kovar™ ring to the metalized surface of the ceramic tube,
- Weld joint of the stainless flanges to the Kovar™ ring,
- Packaging design for shipping and storage.

Performance requirements must be considered in all design work and be demonstrated analytically and/or by testing in some specific cases to be defined by the Company. At a minimum, the following loads and/or combinations listed in Table 1 will be reviewed:

Table 1 – Loads and Load Combinations with Required Validation Methods

Load & Load Combinations	Analytical	Testing
Vacuum Pressure Load of 1.197×10^{-6} Pa <i>The load is applied to the chamber's internal surface.</i>	—	Yes
Positive Pressure Load of 1.72×10^4 Pa <i>The load is applied to the chamber's internal surface.</i>	Yes	—

Axial Tension Load of 2x estimated chamber weight <i>The load is applied to the flanges and places the chamber under pure tension.</i>	Yes	—
Perpendicular Bending Load of 2x estimated chamber weight <i>The load is applied to the flanges, constrained along the tube, and placed the chamber.</i>	Yes	—
Impact Load + Vacuum Pressure Load <i>The Impact Load is a 2.3 kg spherical object dropped from a height of 1 m onto the ceramic tube.</i>	Yes	—

4.2 Materials

- Alumina (>95% purity & 100% dense) for the tube along with material certification.
- 304 or 316 Stainless Steel DN200 flanges.
- Kovar™ for the ring.
- Seller selected alloy for brazing the ring to the ceramic metalized surface (e.g. Copper alloy preferred).
- Seller selected welding material for the ring to the flange joint.

4.3 Fabrication

- Parts deburred and sharp edge chamfering.
- Only aqueous based machining lubricants are to be used.

4.4 Cleanliness and Handling

- Cleaning, testing, and open storage in an isolated area that can be qualified as an ISO 9 cleanroom with a positive pressure system.
- Seller proposed cleaning solutions and methods to be used.
- Bakeout of 200°C for 48 hours.

4.5 Serialization & Labelling

- Unique and labeled per SAE AS478.
- Lift point locations.

4.6 Acceptance testing and inspections

- Records of instruments including calibration dates and product description minimum,
- Vacuum Pump-down with helium leak rate not exceeding 1.33×10^{-7} Pa-L/s ($\sim 1 \times 10^{-9}$ Torr-L/s),
- Records of measurement for critical dimensions.
- First article inspections shall include all standard acceptance testing and inspections with the addition of measurements for the features designed by the Seller as well as all dimensions specified by the requirements.

4.7 Packaging

- Seller proposed container design considering the shipping options.

- Each unit must be backfilled with dry nitrogen gas and blanked off. Then, nitrogen-filled plastic wrapping.
- Seller to propose a shipping plan that includes origin or destination options.