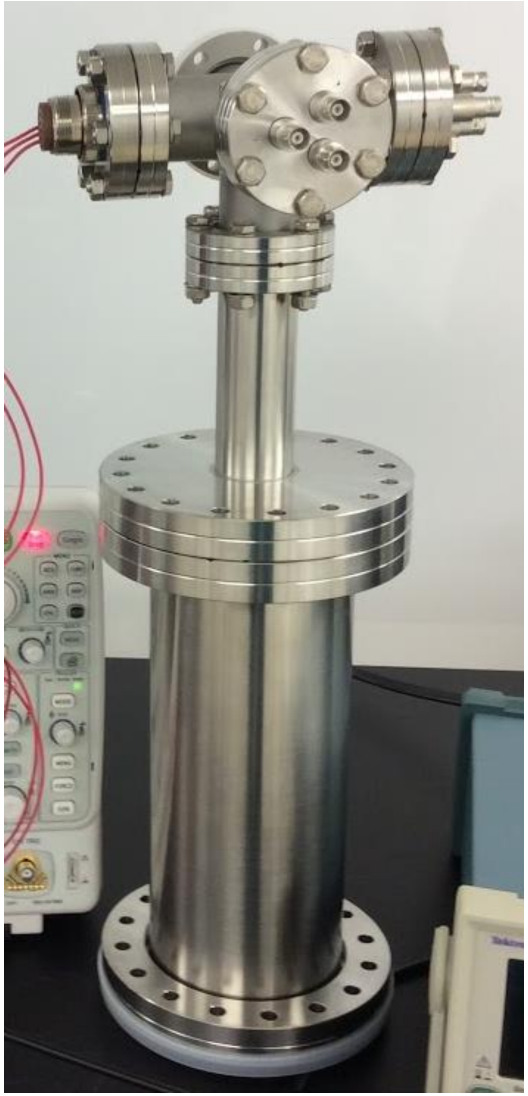
Test Cryostats for Detector Development



Mitchell Wagner
Test Cryostats for Detector Development
Ringber Caslte, 20/10/15

Overview

- Introduction
- Types of cryostat designs
- New Designs
- Summary

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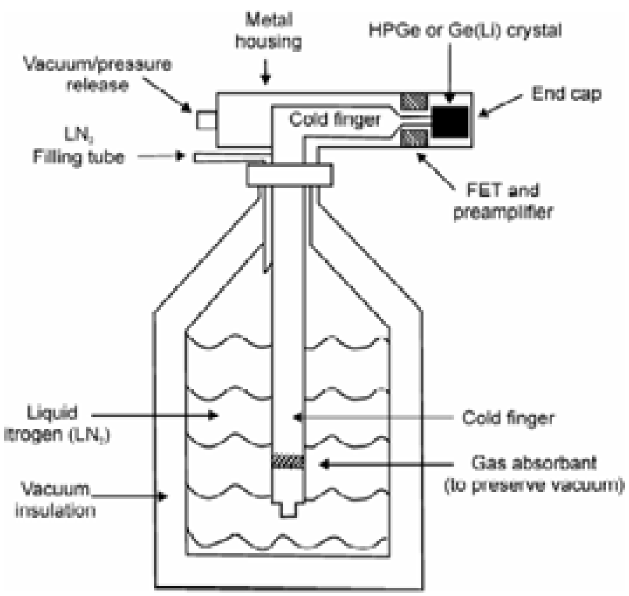
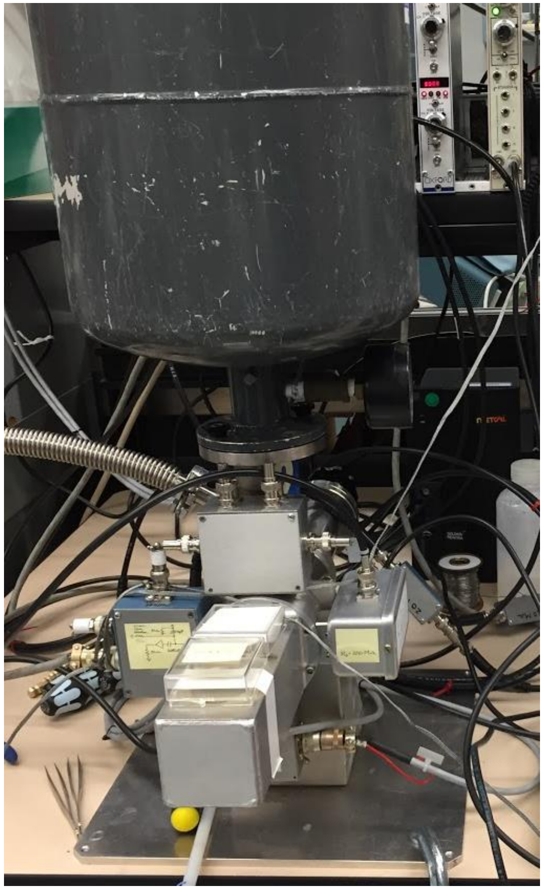
Introduction

- We need cryostats for detector testing
- Should be cheap and built with commercially available parts
- Need a high detector turn around
- Possibility for surface scanning
- Should be able to be used for more than just Ge detectors

Three types of common cryostat designs

1. Cooling Finger
2. Gravity Fed
3. Direct dump





Test stand at LBNL

Cryostats compared

Type	Cooling Finger	Gravity Fed	Dip-in
Temp Range	>100 K	>= 77 K	>= 77 K
Calibration	Easy	Easy	Hard
Construction	Hard	Hard	Easy

First design – dip in

- Commercially available
- Inside vacuumed and then filled with nitrogen
- Total Cost: $2311

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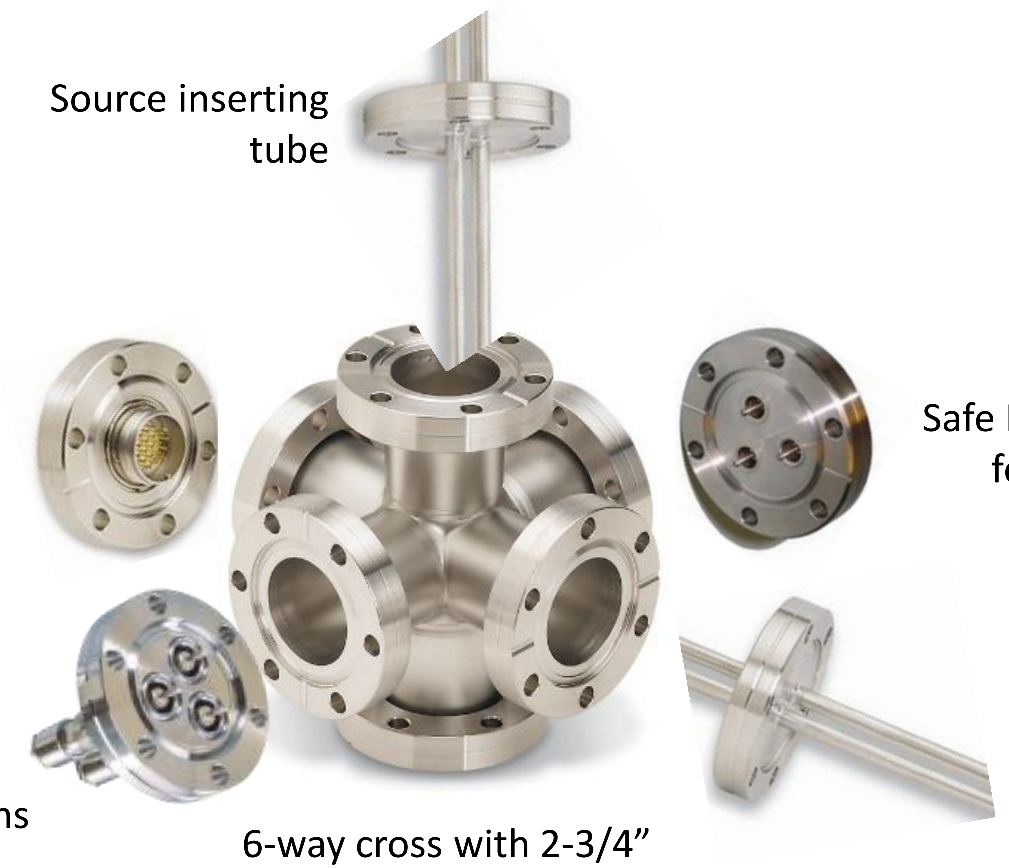
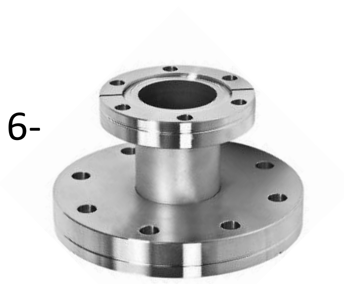
Dissection of dip in design



Cont.

Straight reducing nipple with 6-inch and 2.75-inch CF flanges



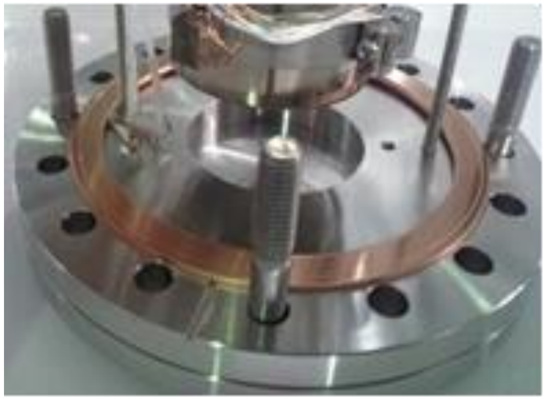
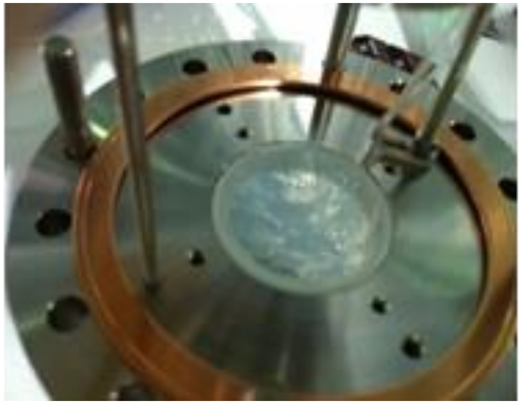
10 inch long nipple with 6-inch CF flanges, 10 cm inner diameter, large enough to house both the detector and calibration system

Stainless steel, thermally separates the cold bottom and warm top.

6-inch CF Al (better thermal conductivity) flange, to which detector can be mounted

Bottom flange design

- All flanges are CF (Conflat)
- Seal mechanism is a knife-edge that is machined below flange's flat surface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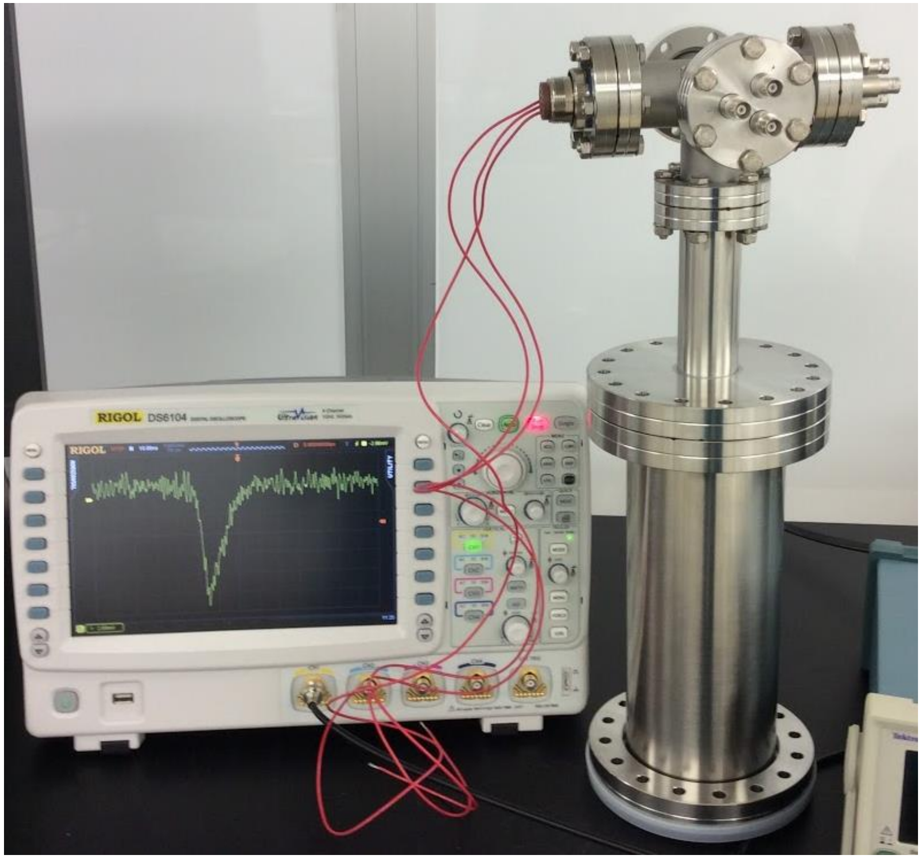
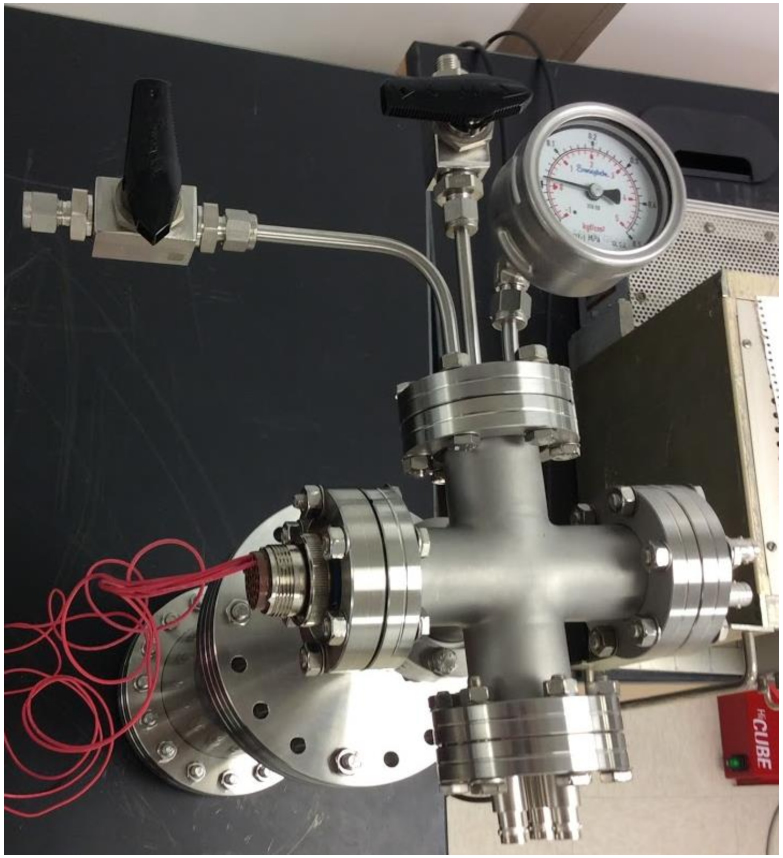
Constructed cryostat for PMT testing





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Second design – gravity fed

- Two different designs with varying amounts of customization
- One with surface scanning capabilities inside the cryostat

  -Requires customized parts
- One without surface scanning

  -All commercially available

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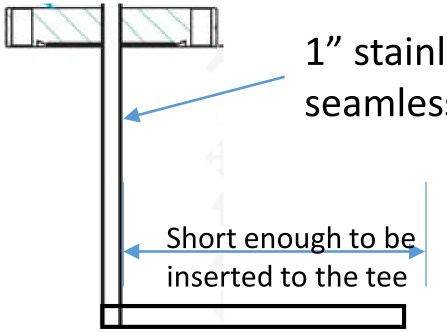
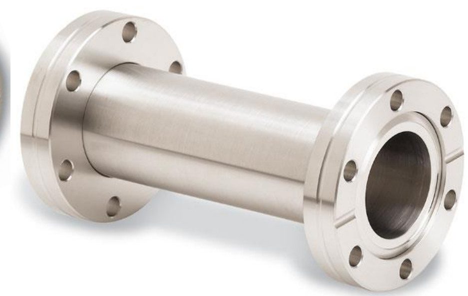
Dip in with no surface scanning



1” stainless steel seamless tube

Customized 6” CF flange with 2 BNC, 2 SHV, 1 multi-pin, 2 VCR tube feedthroughs

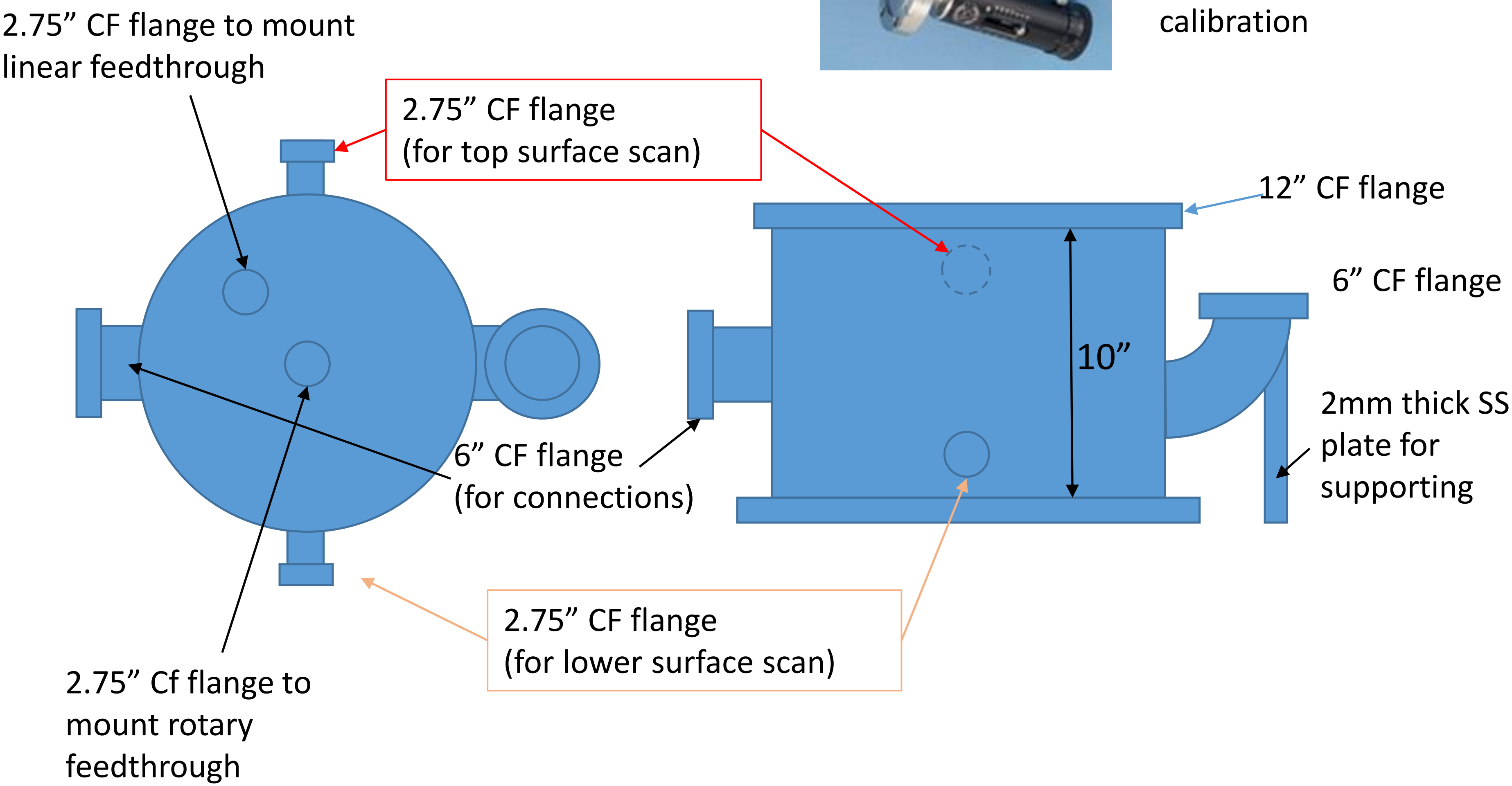
Standard tee with 6” CF flanges



Detector sits here

Surface scan design

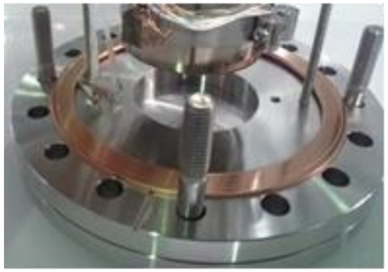
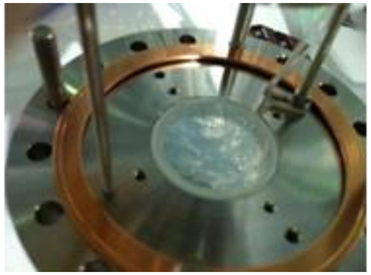
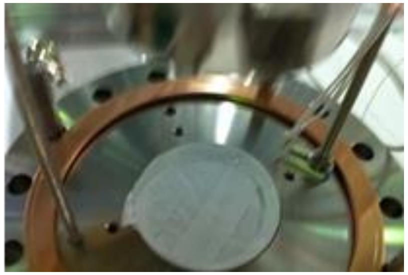
Rotary, linear or tube feedthroughs for calibration



Summary

- Cryostats will be able to achieve low temps quickly and efficiently
- The cryostats are cheap and easy to build
- Can be easily modified since most parts are commercial standards
- These cryostats can be adapted for testing scintillators such as CsI and NaI

Bottom Flange design

The CF (ConFlat) flange is the most widely used for high vacuum and UHV applications. Many gauges, instruments, accessories and feedthroughs are available on this flange system.
The seal mechanism is a knife-edge that is machined below flange's flat surface. As the bolts of a flange-pair are tightened, the knife edges make annular grooves on each side of a soft metal gasket. The extruded metal fills all the machining marks and surface defects in the flange, yielding a leak-tight seal. The CF seal operates from 760 torr (10^{13} mbar) to <1 x 10^{-13} torr (<1.3 x 10^{-13} mbar), and within the temperature range -196° C to 450° C (depending on material). Flange sizes in North America are determined by outside diameter (O.D.). In Europe and much of Asia, the internal diameter (I.D.)—actually the nominal I.D. of the largest tube that can be welded to a bored flange—is used.

Aluminum Features:

- Lightweight and non-magnetic for applications sensitive to magnetic materials
- Good thermal conductivity
- Lower residual radioactivity than flanges manufactured from ferrous materials
- General properties of aluminum and the surface preparation of these flanges yield low outgassing rates
- Knife-edges of flanges coated with CrN for added hardness
- CrN coating maximum temperature on the knife edges is 150°C
- Aluminum flanges require the use of aluminum gaskets
- easy to machine

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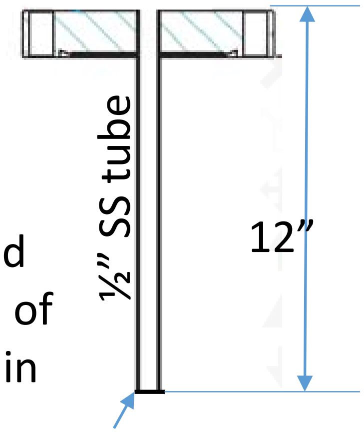
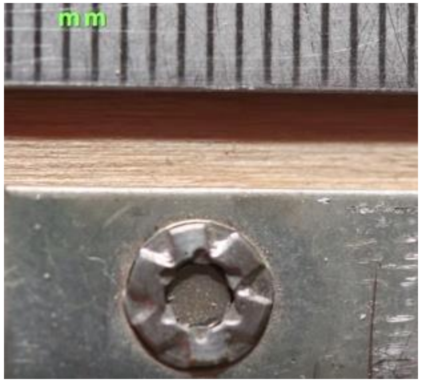
Radioactive sources

~0.3 μg AmO_2

- cannot be digested, safe
- <~37 kBq, intensity is enough



SS plate welded on the bottom of the tube, as thin as possible, as long as it can hold 1e-8 torr vacuum



Very small, can be put into a plastic zip bag and placed directly into the chamber

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Gravity fed design