



The US Particle Accelerator School Vacuum Hardware

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Bellows serve several functions within an accelerator vacuum system



- Make up for transverse offsets in beamline hardware
- Provide installation personnel with sufficient flexibility to install hardware.
- Reduce stresses on adjacent vacuum joints.
- Provide adequate expansion and/or contraction ability during thermal cycles.

When working with a bellows manufacturer, you will need to provide him the following information:



- Bellows free length
- Bellows maximum extended length
- Bellows minimum compressed length
- Bellows maximum transverse offset
- Maximum number of cycles



Types of Flexible Bellows

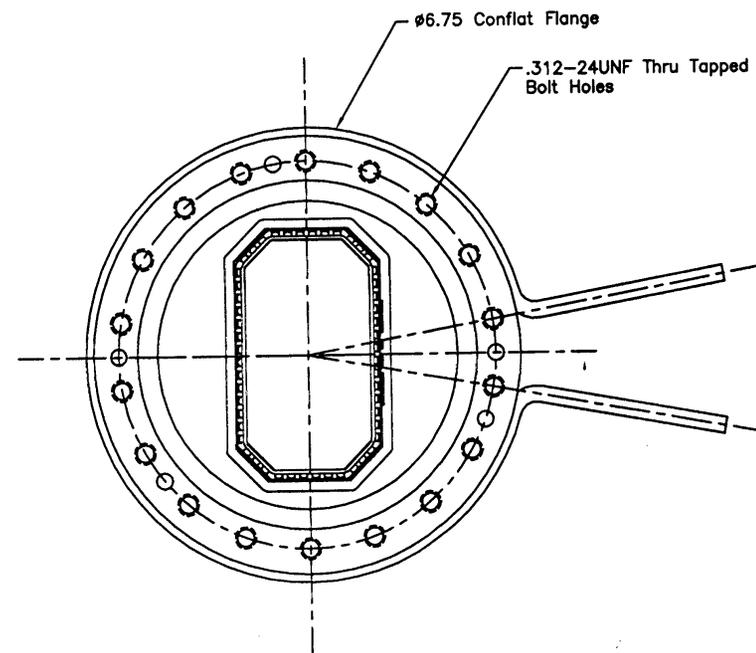
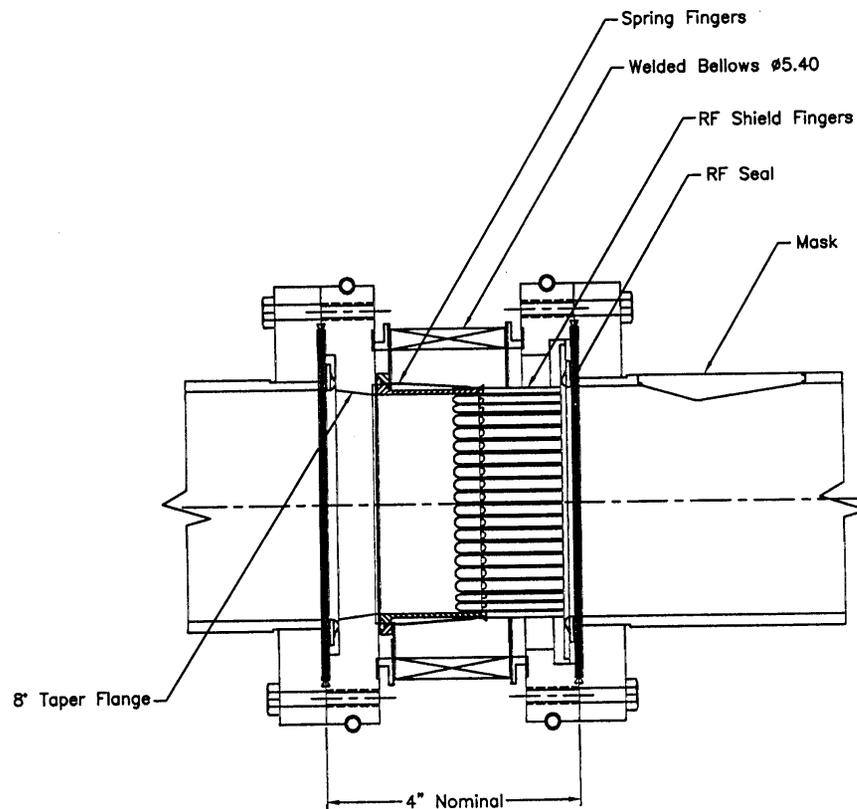


Welded

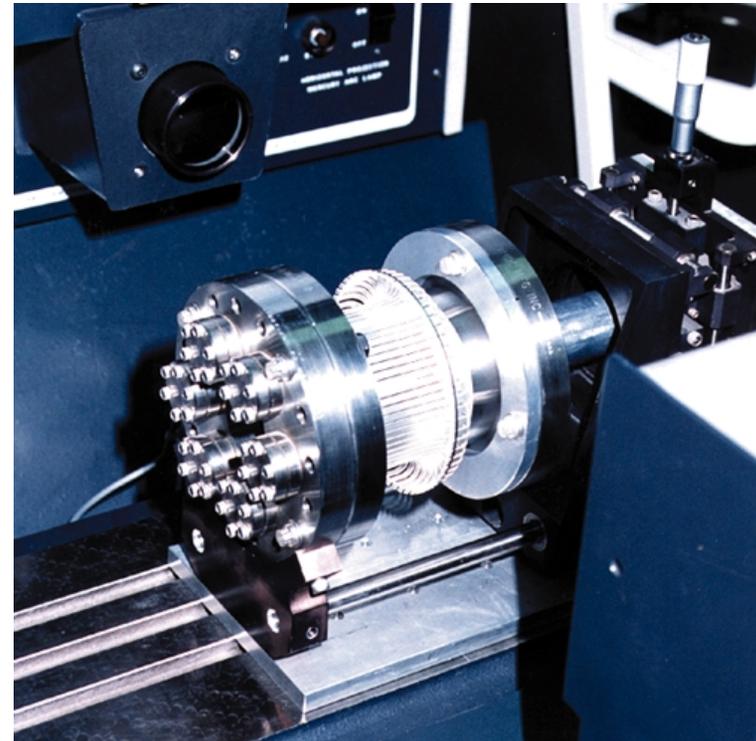
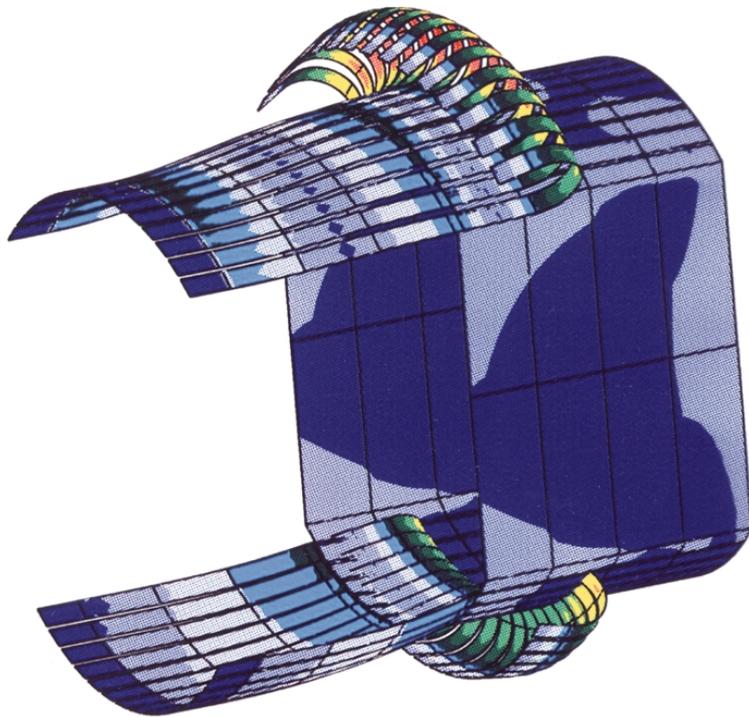


Formed

Bellows in Storage Rings Require RF Fingers



Another Example of an RF Shielded Bellows





Vacuum Valves for Accelerators

- All-metal Gate Valves
- All-metal Angle Valves
- RF All-metal Gate Valves
- Fast Closing Valves



RF All-metal Gate Valve

- Used as beamline isolation valves
- Pneumatic actuated only
- 316L stainless steel body
- Elastically deformed metal seals
- Max. operating temperature 200°C
- Bellows sealed





UHV Gate Valves

- Used as pump isolation valves
- Manual or pneumatic actuators
- 304L stainless steel construction
- Bellows sealed
- Viton seals
- Max. operating temperature 200°C





All-metal Angle Valves

- Used as roughing, purge, or vent valves
- Manual or pneumatic actuators
- 304L stainless steel construction
- Elastically deformed metal seals
- Max. operating temperature 300°C
- Bellows sealed





Fast Closing Valve

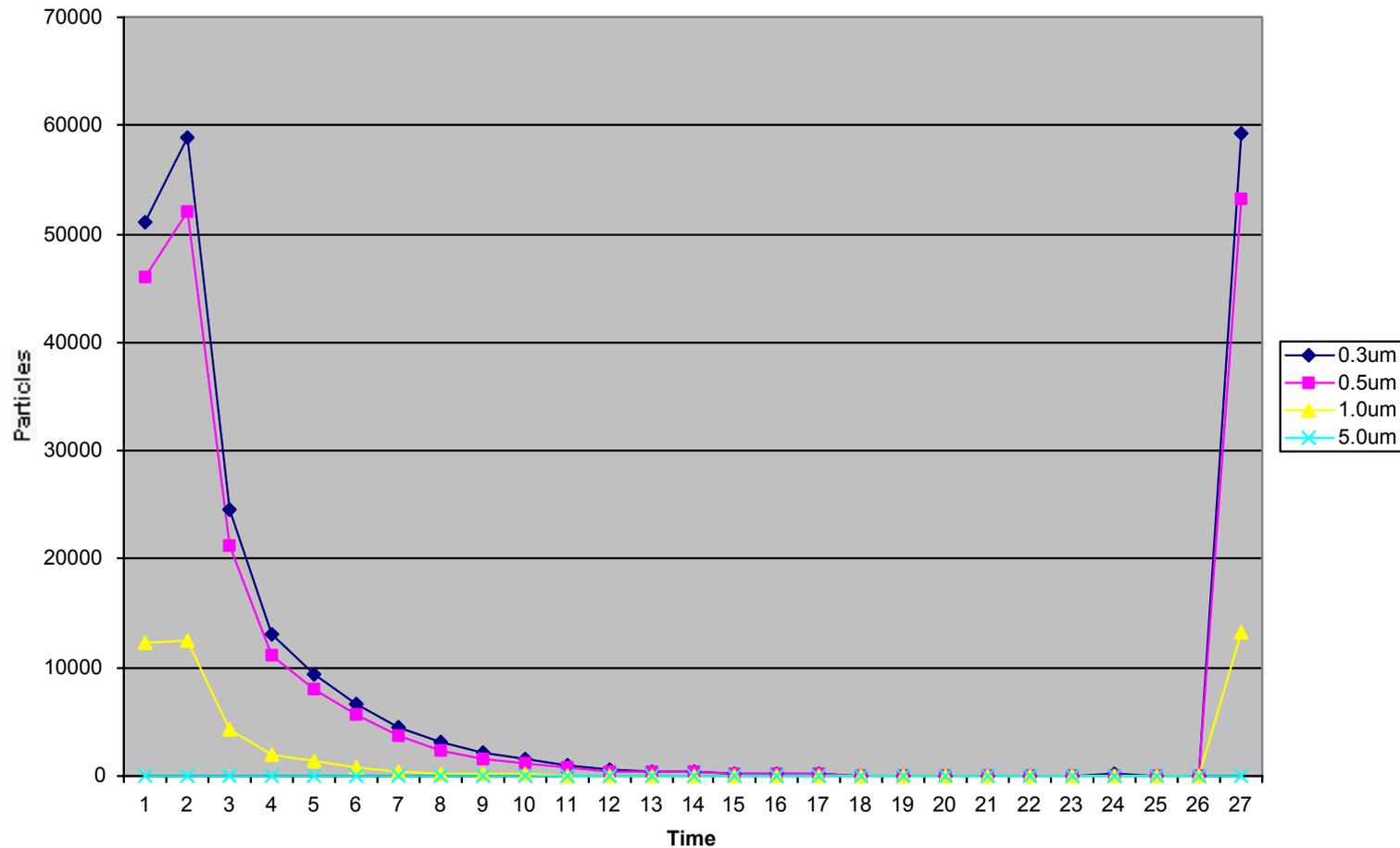
- Designed to provide vacuum safety for accelerator systems.
- Detects pressure rise in milliseconds
- Closes leak tight in milliseconds



Particle Generation Should be a Concern When Operating Vacuum Gate Valves!



MDC Valve





Vacuum Feedthroughs



Electrical Power



Instrumentation



Rotary Motion



Linear Motion



Electrical Feedthroughs

- Coaxial
- Power
- High Current
- High Voltage
- Breaks
- RF Power





Instrumentation Feedthroughs

- **Multi-pin (10 or 20 pin configuration)**



- **Type-D Subminiature Connectors**





Rotary Motion Feedthroughs

- **Manual or motorized actuation.**
- **UHV compatible**
- **Torque to 50 oz-in**
- **Speeds to 50 rpm**



Linear Motion & Multi-motion Feedthroughs



- The class of feedthroughs span from simple “push-pull” to precision units.
- Manual, motorized, and pneumatic action.
- UHV compatible
- Linear travel ranges from $\frac{1}{2}$ ” to 6”





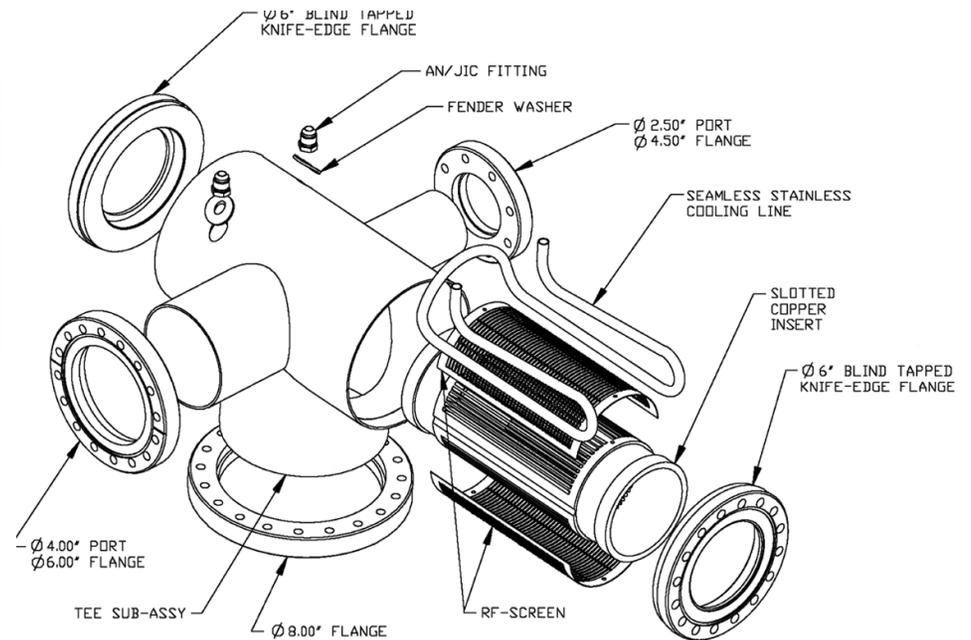
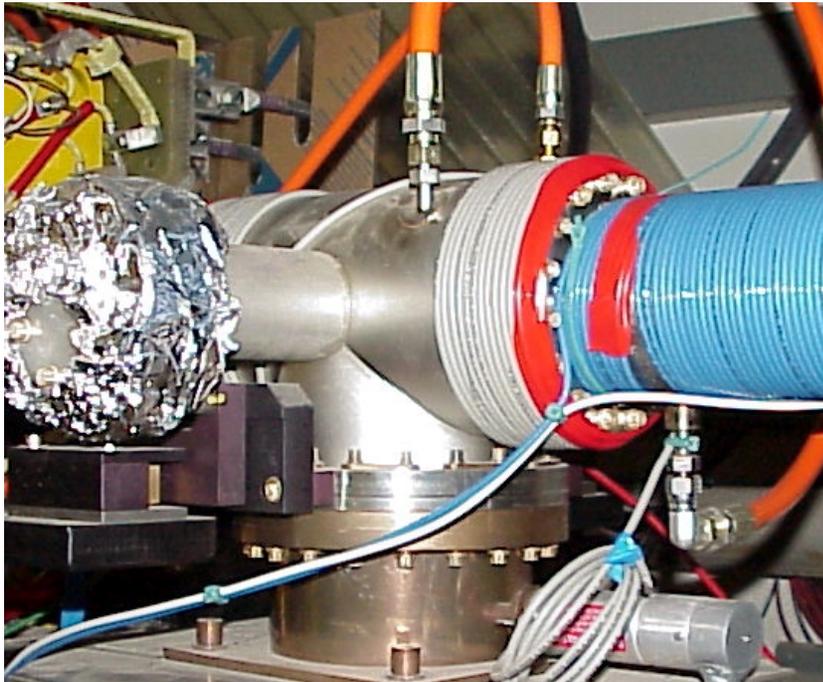
Pump Crosses and Pump Tees

These components must maximize conductance to the pump, while minimizing detrimental effects on the beam.

- Pump crosses must provide current return bars for image currents.
- Minimize disturbing wakefields.
- Minimize conduction losses to the vacuum pump.

$$\frac{1}{S_{net}} = \frac{1}{C_{cross}} + \frac{1}{S_{pump}}$$

PEP-II Pump Tee

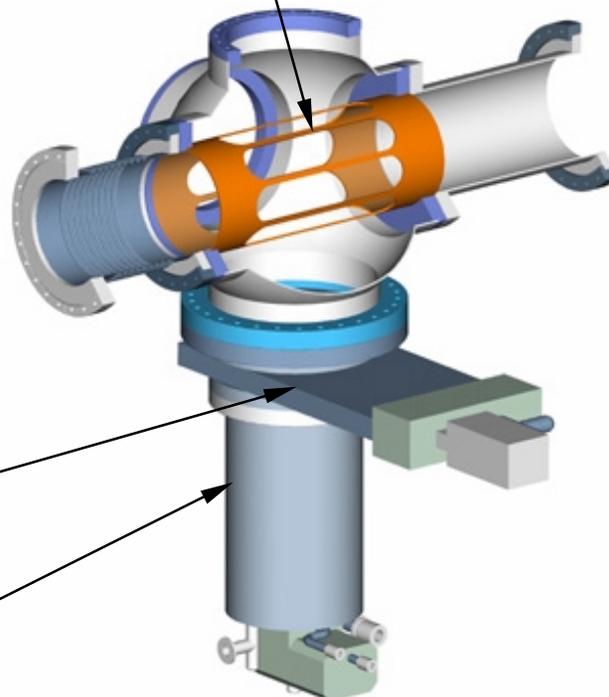




DARHT II Pump Cross



Beampipe w/ Current Return Bars



Pump Isolation Valve

CT-8 Cryo Pump

RF Seals



RF Seals provide current return capability and a smooth bore along the beamline.

There are several approaches to providing RF seals across flange joints:

- "Omega" Seals
- Tecknit Gaskets
- "Gap" Rings
- Flange designs that provide RF sealing capability (VAT Seals, Helicoflex)

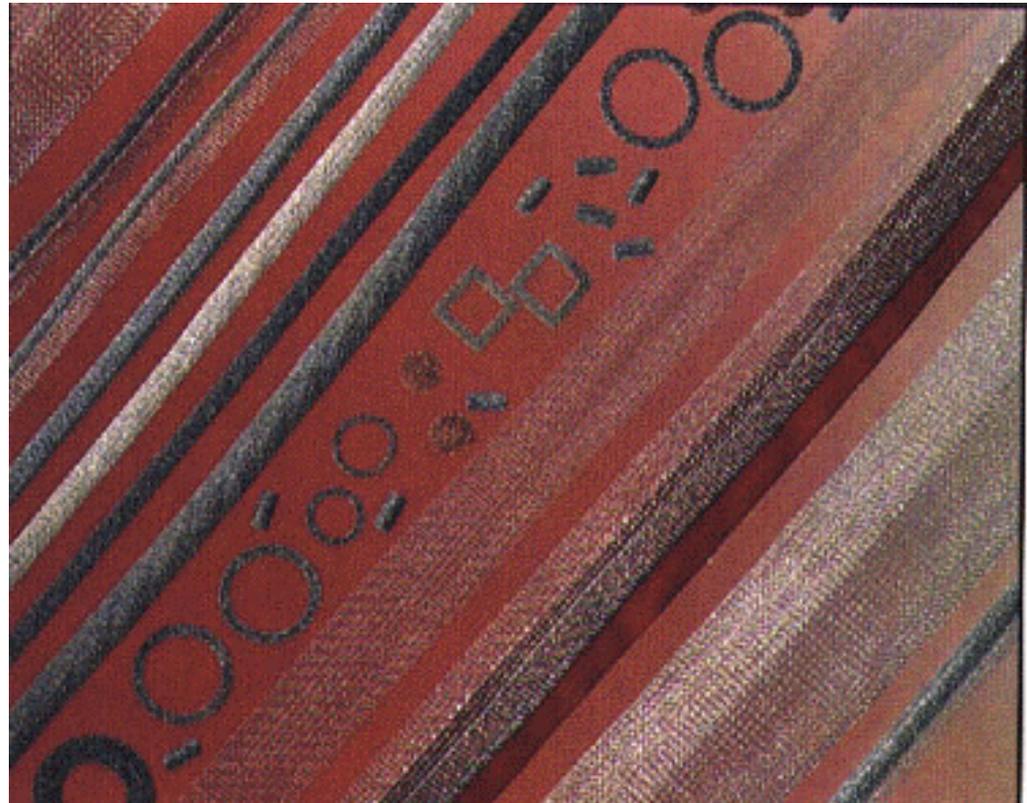
"Omega" Seals





Tecknit Gaskets

- Materials are monel Sn/Cu/Fe, Copper, Aluminum, Phopher Bronze, and Silver-plated Brass wire
- Available in round, double round, round with a fin, and square sections



"Gap" Rings

