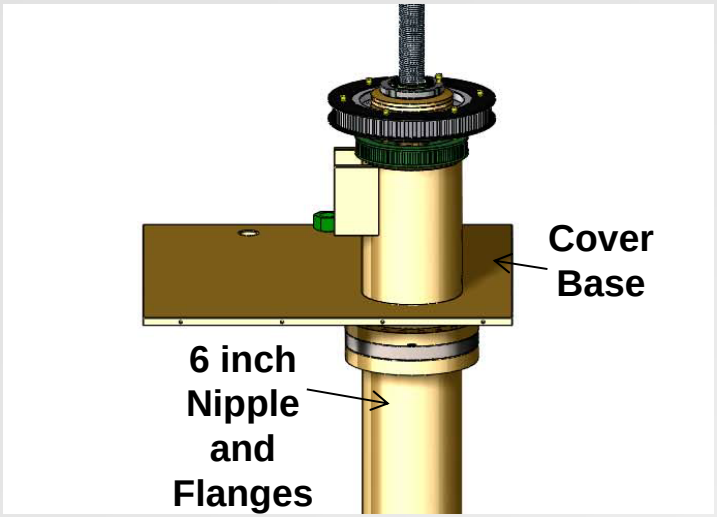
Proposal for Sealing GV7 Leak

LIGO-G1301238-v3

January 16, 2014

Ken Mason

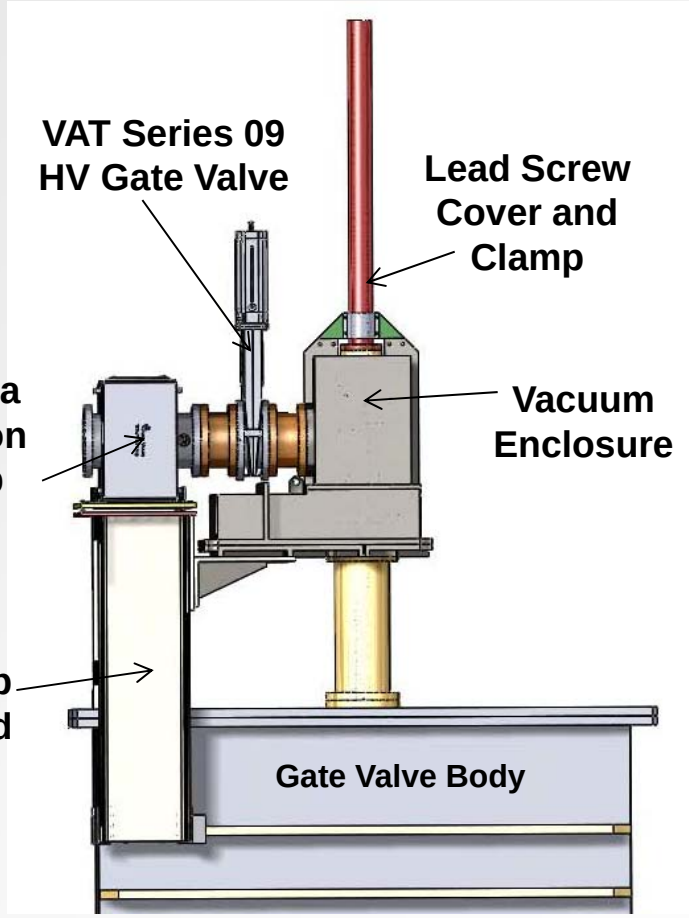
Existing Structure



Existing GNB valve with cover and drive motor removed. Split collar added to prevent shaft from dropping.
Cover base shown cannot be removed.

Other Design Requirements:
- Cannot weld to existing structure.
- Cannot cut or grind off anything.
- Cannot torque or loosen existing seals.
- Ball screw must remain locked in up position.
- Vacuum loads shall not stress the existing structure.

Proposed Design

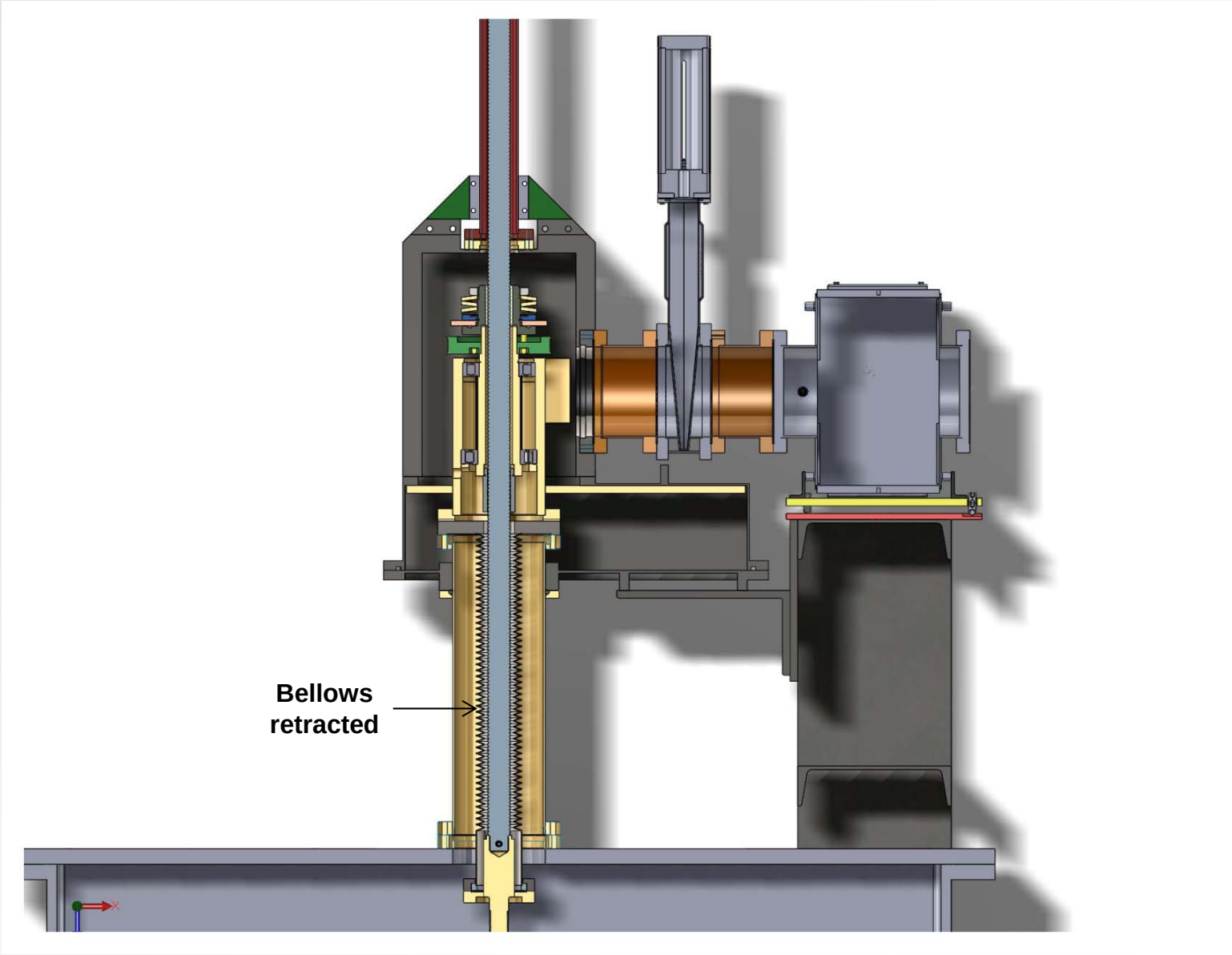


- Ion pump to be mounted inline with vacuum enclosure and have adequate adjustments to mate up with flanges.

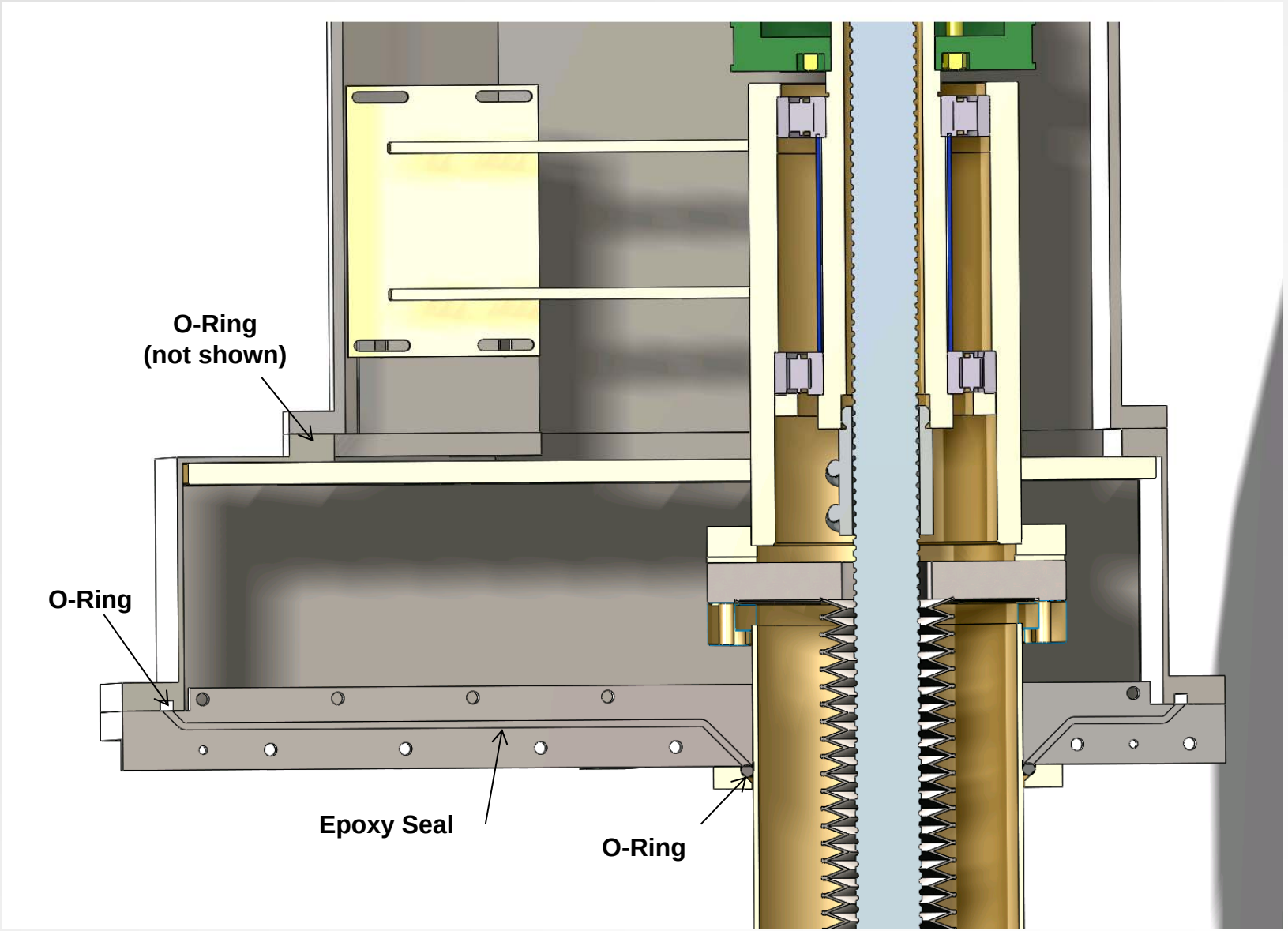
Section View of Valve Actuator and Proposed Design

Currently we have vacuum on inside of bellows and atmosphere on outside of bellows.

Proposed design will enclose the entire actuator assembly.



Lower Box Seal

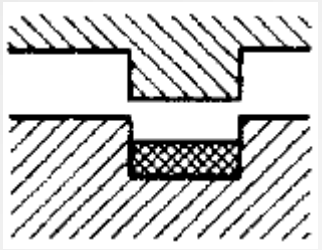


The lower box seal consists of 3 seals. The seal to the 6 inch tube and sealing the two plates must be made in place. The seal to the box enclosure will be a standard ¼ " o-ring.

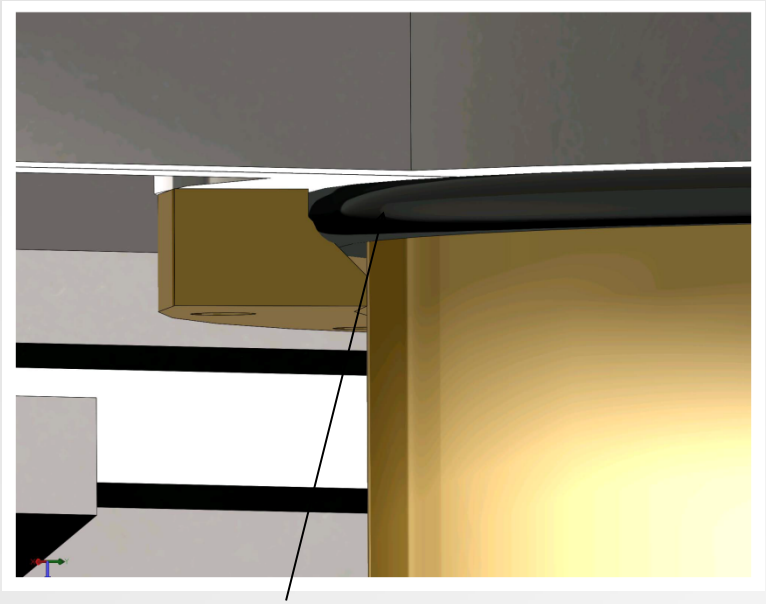
Lower Box Seal Detail

The lower seal plate has three seals.

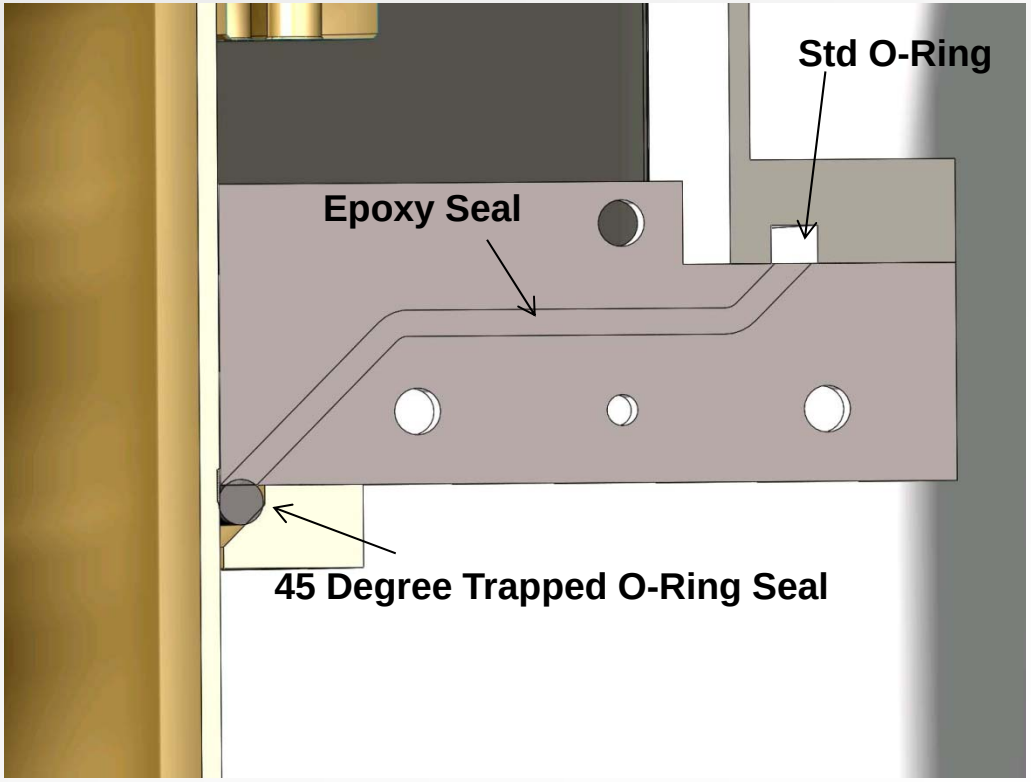
1. **¼ inch Std. O-ring from lower box to the two seal plates.**
2. **Epoxy trapped in machined area connecting the two.**
3. **¼ inch O-ring from two seal plates to 6 inch tube modeled after Cajon Ultra-Torr fittings.**



Epoxy Seal Between Plates with .02 gap.

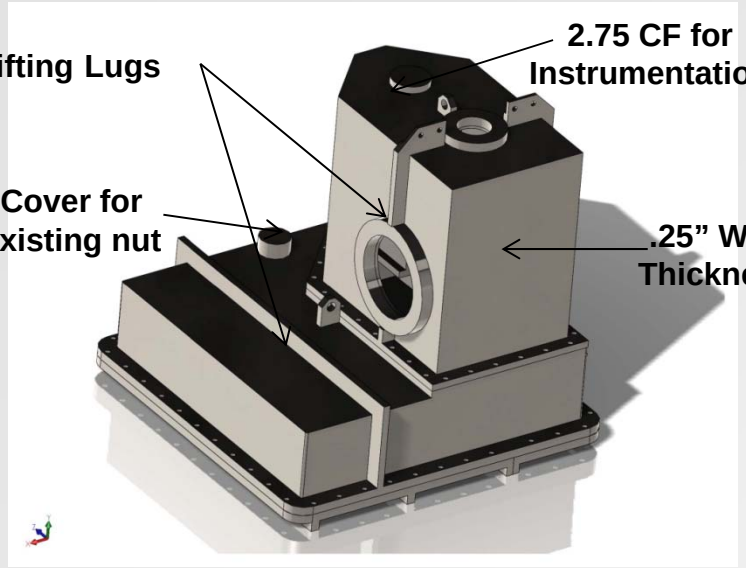


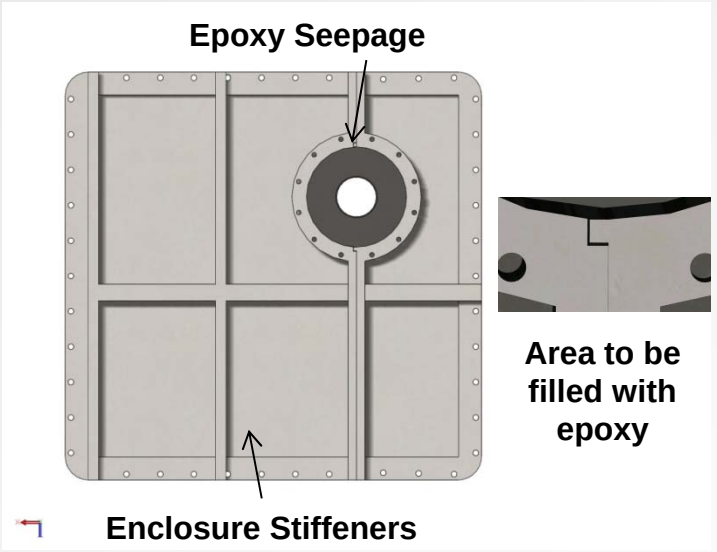
O-Ring seal will be cut and bonded in place on the tube



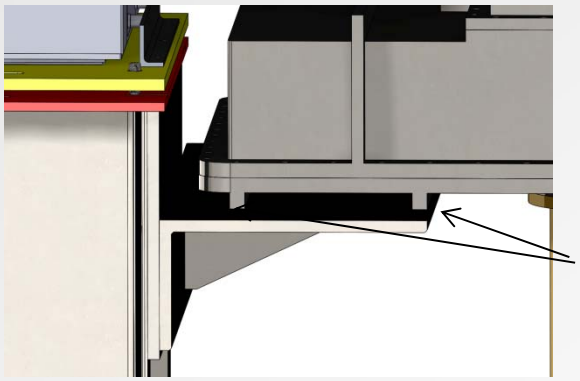
Epoxy will be inserted into the epoxy seal groove and the two plates bolted together. Epoxy will be allowed to seep out on the top and bottom of the plate where it will be smoothed down flush with the plate surface.

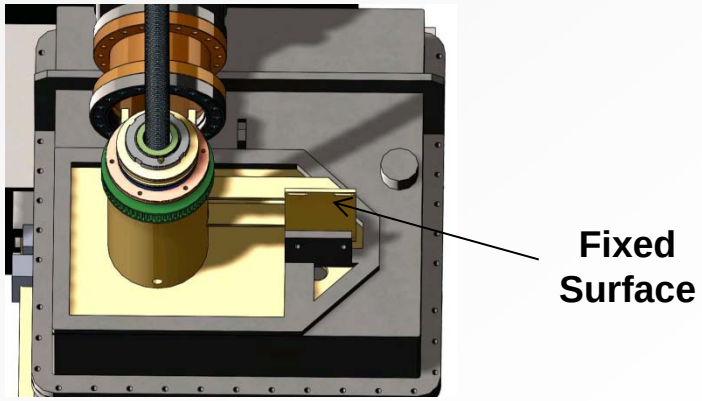
Vacuum Enclosure





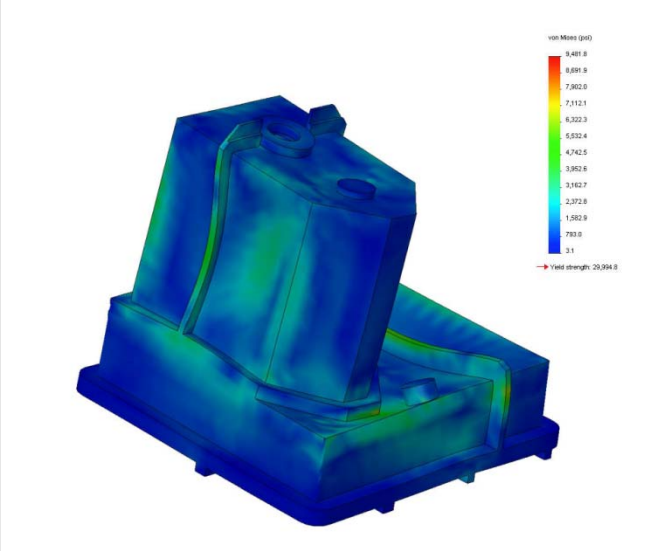
The vacuum enclosure will be of welded construction and made from 304 grade stainless steel. The wall thickness of the upper cover is .25 inches and the remaining parts are .188 inches.

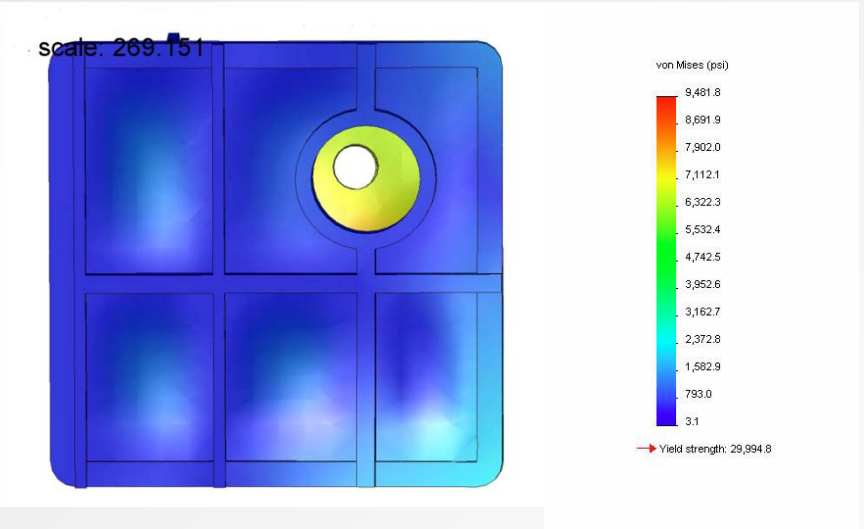




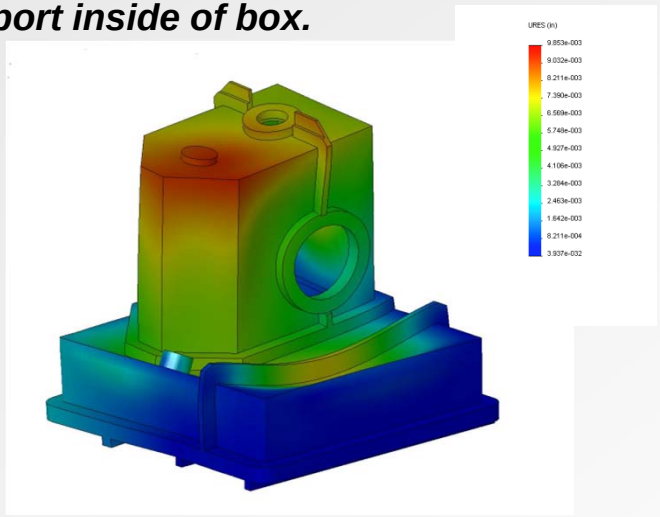
Max deformation of .0098 inches occurs in cover and top of box enclosure. We added several stiffeners to the bottom of the box in the area of the seals to prevent leakage.

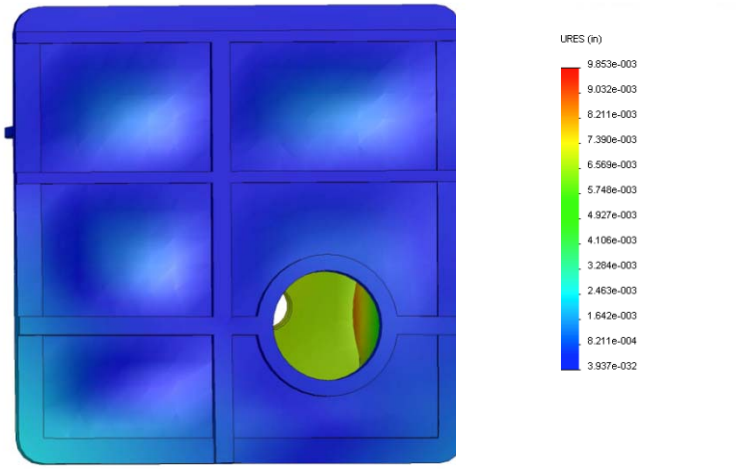
Vacuum Enclosure Analysis





Stress analysis shows max stress of 9,853 psi which is well below the maximum allowable stress of 15,700 psi specified for 304 stainless steel at 200 degree F per ASME Boiler and Pressure Vessel Code . Model assumes fixed constraint of two ribs supported by angle bracket below enclosure and support inside of box.

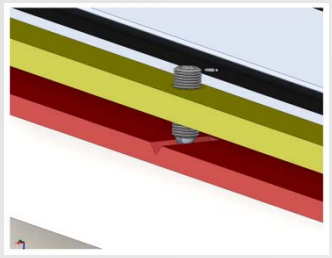


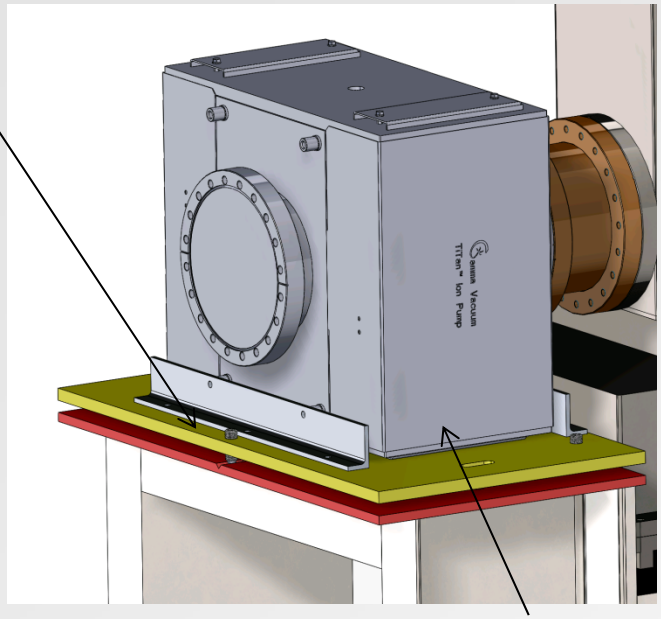


Max deformation of .0098 inches occurs in cover and top of box enclosure. We added several stiffeners to the bottom of the box in the area of the seals to prevent leakage.

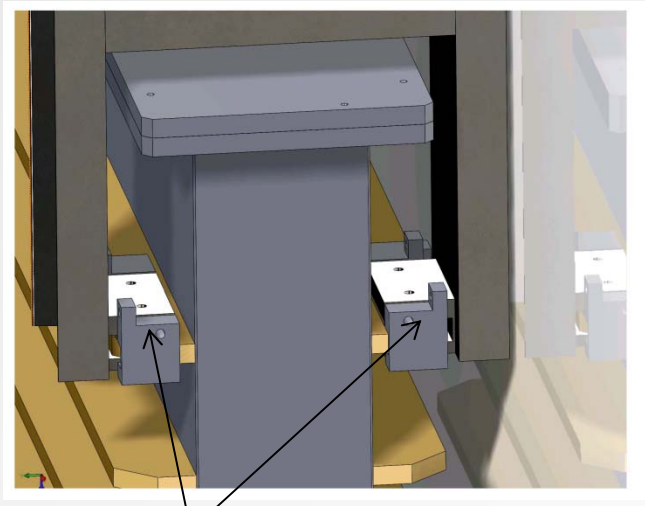
ION Pump Mounting and Ball screw Cover Clamp

Top kinematic plate has (3) set screws set into a v-groove. All grooves face toward the valve. This gives up/down, pitch , and fine x-adjustment

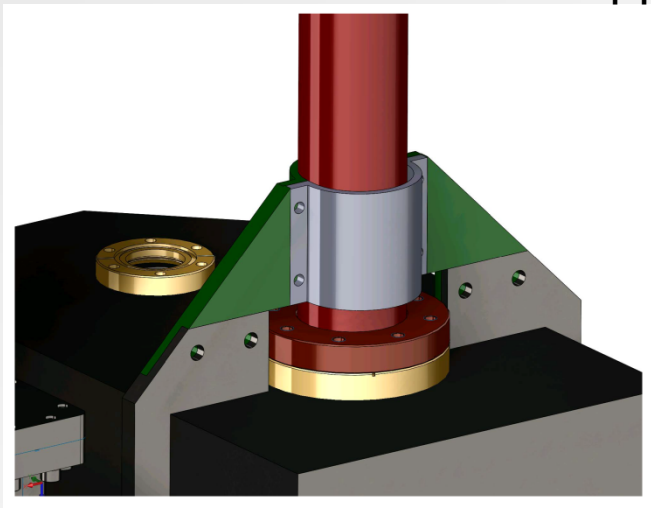




Two locking screws on top plate.



Structure attaches to first stiffener on gate valve. Adjustment blocks provide X, Y. and Yaw adjustment. Four setscrews lock stand in place.



Weights

Vat Gate Valve - 33.3 Lbs
Gamma ION Pump 145 lbs
Vacuum Enclosure w CFs – 227.7 lbs
Pump Mount – 148.5 lbs
All Other – 167.6 lbs

Total Added Weight – 722.3 lbs

The ball screw cover attaches to the top of the cover and is supported with a three piece clamp.

Appendix

VAT Series 09 HV Gate Valve

DN		Ordering numbers				
mm	Inch	ISO-KF [4] ISO-F [3]	JIS	ASA-LP	CF-F metric threads	CF-F UNF threads
50	2	09134-KE01 [4]				
63	2½	09136-PE01 [3]	09136-JE01	09136-TE01	09136-CE01	09136-UE01
80	3	09138-PE01 [3]	09138-JE01	09138-TE01	09138-CE01	09138-UE01
100	4	09140-PE01 [3]	09140-JE01	09140-TE01	09140-CE01	09140-UE01
160	6	09144-PE01 [3]	09144-JE01	09144-TE01	09144-CE01	09144-UE01

Leak rate:	
- Body	$< 1 \cdot 10^{-9}$ mbar ls^{-1}
- Valve seat	$< 1 \cdot 10^{-7}$ mbar ls^{-1}
Pressure range	$1 \cdot 10^{-9}$ mbar to 1.2 bar (abs)
Differential pressure on the gate	≤ 1.2 bar in either direction
Differential pressure at opening	≤ 1.0 bar
Bellows feedthrough	100000 cycles
Cycles until first service	5000 [1]
Temperature [2]	
- Valve body	≤ 120°C (150°C on request)
- Manual and pneumatic actuator	≤ 100°C
- Position indicator	≤ 60°C
- Solenoid	≤ 50°C
Material	
- Valve body	AISI 304 (1.4301)
- Valve gate	AISI 304 (1.4301, 1.4308)
- Bellows	AISI 633 (AM 350)
- Small parts (contacting the media)	A2 Ni Teflon-coated, PEEK
Seal: bonnet, gate	FKM (VITON)
Mounting position	any

09144-UE01 –X (with ISO-KF25 port on side)

Appendix

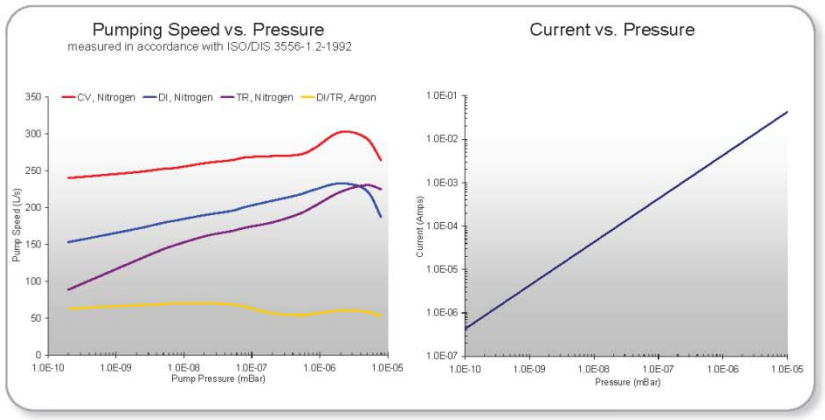
Gamma 300L Ion Pump

Gamma Vacuum

Creating the purest vacuum environments on Earth

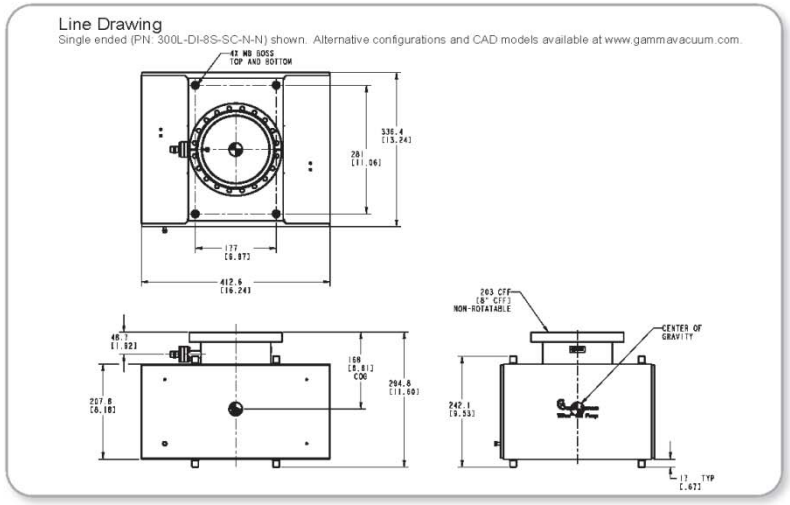
TiTan™ 300L Ion Pump

Specifications	Pumping Element		
	CV (Conventional)	DI (Differential)	TR (Triode)
Pumping Speed, (lis. Nitrogen)	300	240	240
Starting Pressure, (mbar)	< 10^{-4}		< 10^{-2}
Ultimate Pressure, (mbar)	Less than 10^{-11}		
Lifetime, average hours @ 10^{-6} mbar	50,000		
Temperature, max °C (with/without magnets)	250 / 450		
Inlet Flange	DN 150 (8" CFF)		
Weight, kg (lbs)	66 (145)		



1.952.445.4841

www.gammavacuum.com



Standard Options*				
Element Styles	Ports	Feedthroughs	Heaters	TSP/NEG (2nd Port Required)
CV Conventional 100% Titanium	8S Single DN 150 (8" CFF)	SC SAFECONN™ 10kV SHV	N No Heaters	N No TSP/NEG
DI Differential 50% Titanium 50% Tantalum	8D Double DN 150 (8" CFF)	OP Perkin Elmer	110 110-volt 90-130 nominal	TSPA TSP with Ambient Shield
TR Triode Slotted Titanium		OV Old Varian	220 220-volt 200-240 nominal	TSPC TSP with Cryoshroud
		VR Starcell®		NEG NEG SAES® D400-2 or as specified
		FI Fischer		

Options

* Configured part numbers and pricing are available at www.gammavacuum.com. Contact us directly for custom engineered options.

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Our staff and facility are dedicated to one thing; creating the purest vacuum environments on earth.