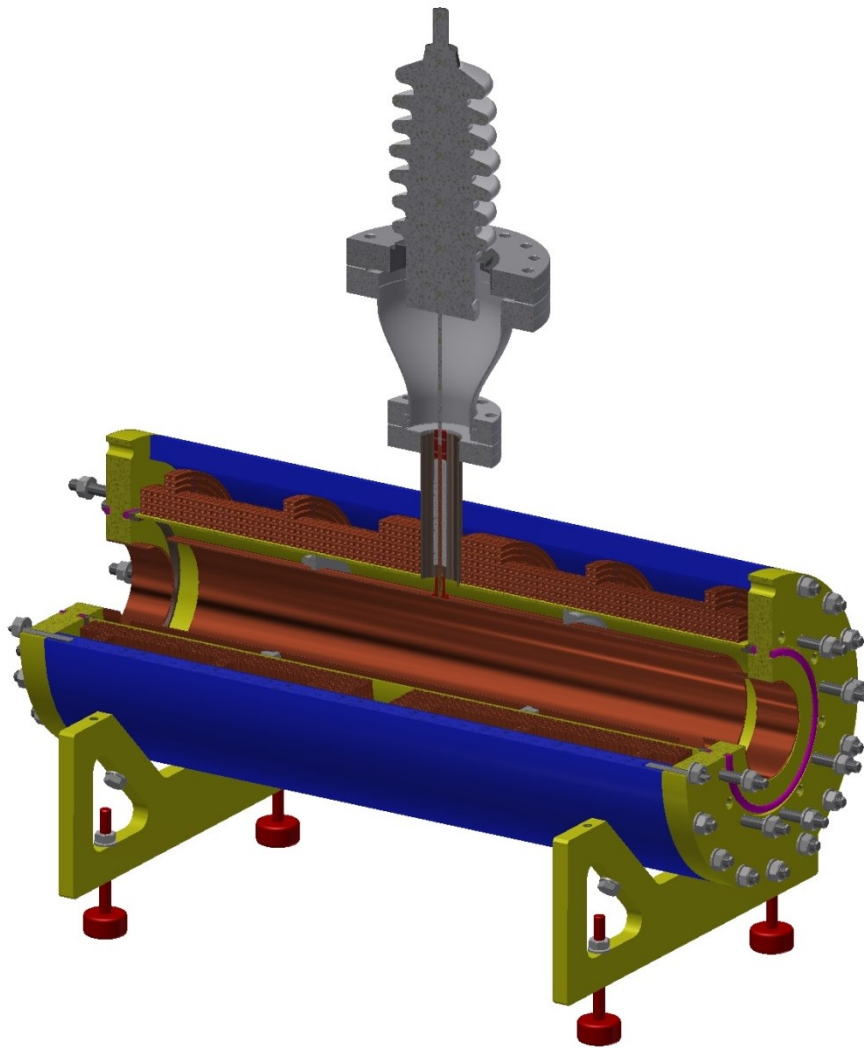


Gabor Lens

Production Readiness Review

P. Savage, Jan 2015



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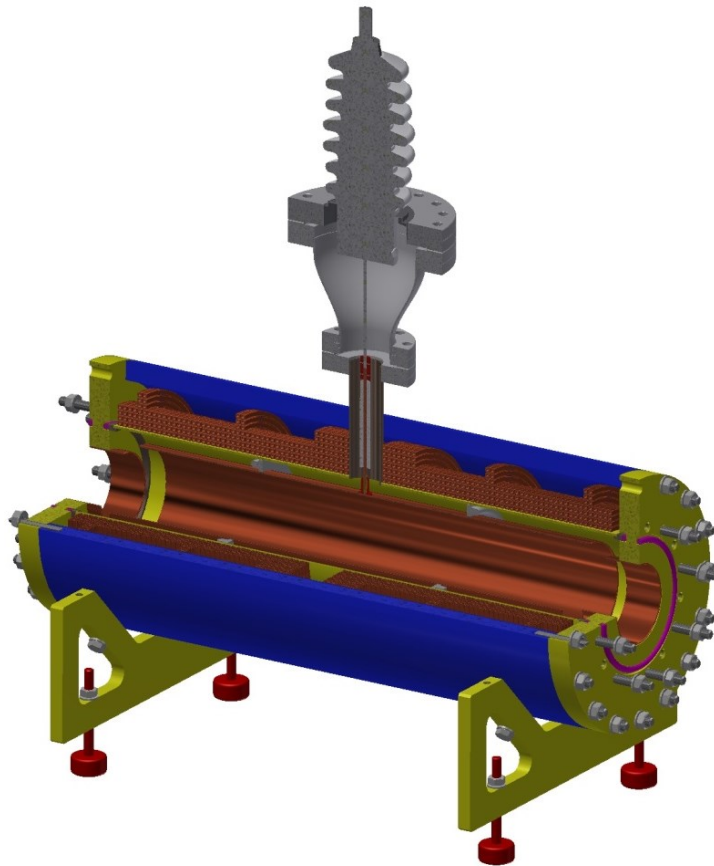
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Lens Overview



Gabor Lens	
Material	Various
Length	540mm
O.D.	219,1mm
Weight	80kg approx

Figure 1: 3D sliced view of assembled Gabor Lens

Outer tube

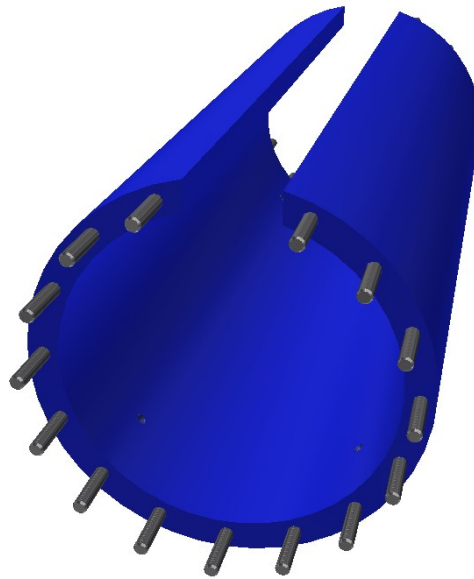


Figure 2: Outer tube

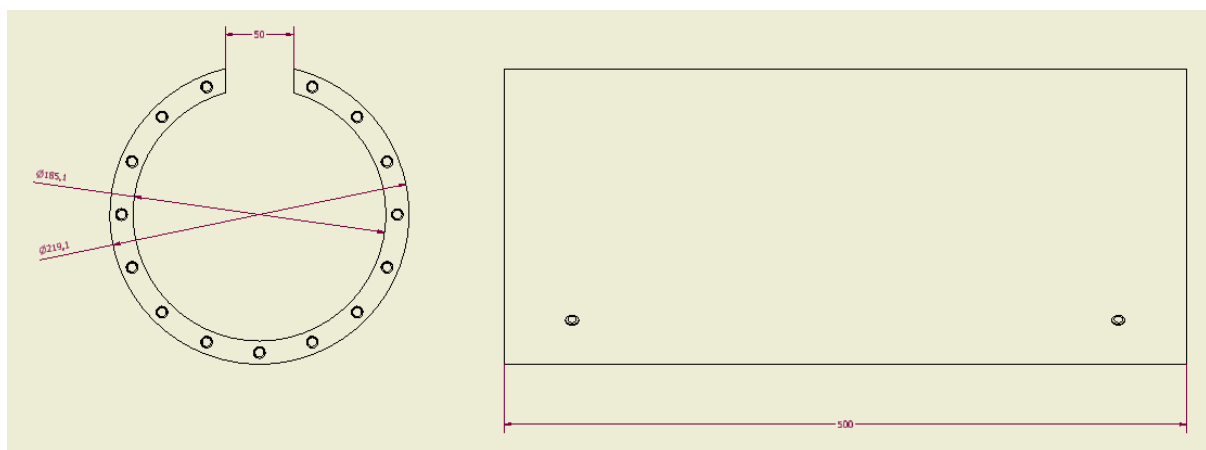


Figure 3: Outer tube key dimensions

Outer tube	
Material	Steel (EN8)
Quantity	1
Manufacture	Physics dept (if possible)
O.D.	219,1mm
Wall	17mm
Length	500mm
Potential material supplier	Steel express
Supplied size	O.D. 219,1mm 19mm wall*
Status	To be manufactured

* ID needs to be bored to enable coils to fit

Hot Finished Seamless Mechanical Steel Tube. 203.2mm - 660mm											
Hot Finished Seamless Mechanical Steel Tube EN 10297-1											
O.D. mm	Wall Thickness mm	O.D. mm	Wall Thickness mm	O.D. mm	Wall Thickness mm	O.D. mm	Wall Thickness mm	O.D. mm	Wall Thickness mm	O.D. mm	Wall Thickness mm
203.2	6.3	260.0	60.0	311.0	12.5	368.3	30.0	431.8	76.2	546.0	30.0
203.2	9.5	260.0	70.0	311.0	25.0	368.3	35.0	445.0	20.0	546.0	40.0
203.2	12.5	260.0	80.0	311.0	38.1	368.3	40.0	445.0	25.0	546.0	50.0
203.2	19.0	260.0	90.0	311.0	50.8	368.3	45.0	445.0	30.0	546.0	60.0
203.2	25.0			311.0	57.2	368.3	50.0	445.0	35.0		
203.2	38.1	273.0	6.3			368.3	60.0	445.0	40.0	550.0	80.0
203.2	50.8	273.0	7.1	323.9	6.3	368.3	65.0	445.0	55.0		
		273.0	9.5	323.9	7.1	368.3	80.0	445.0	60.0	558.8	20.0
219.1	5.0	273.0	12.7	323.9	9.5			445.0	65.0	558.8	25.0
219.1	6.3	273.0	16.0	323.9	12.7	381.0	12.5	445.0	70.0	558.8	35.0
219.1	7.0	273.0	19.0	323.9	14.2	381.0	20.0			558.8	40.0
219.1	9.5	273.0	25.0	323.9	19.0	381.0	25.0	457.2		558.8	45.0
219.1	12.5	273.0	34.9	323.9	25.0	381.0	38.1	457.2	12.7	558.8	50.0
219.1	19.0	273.0	41.2	323.9	28.6	381.0	50.0	457.2	19.1	558.8	60.0
219.1	25.0	273.0	50.0	323.9	31.8	381.0	63.5	457.2	25.0	558.8	70.0
219.1	35.0	273.0	60.0	323.9	35.0	381.0	76.2	457.2	35.0	558.8	85.0
219.1	40.0	273.0	85.0	323.9	41.2			457.2	40.0	558.8	110.0

Pancake coils

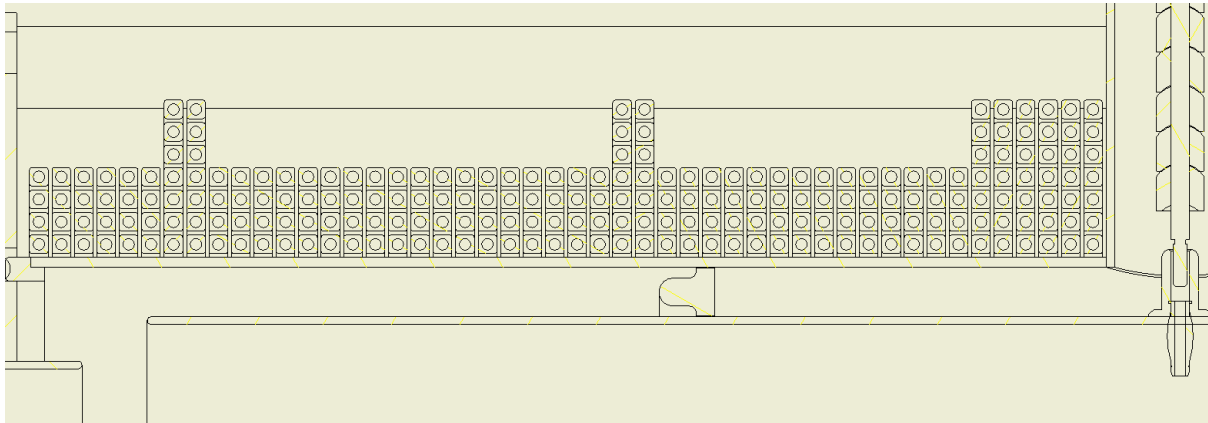


Figure 4: Showing one half, drawing view of pancake coils.

Table 1: (From left to right) Numbers of revolutions/pairs for half of Gabor Lens

Number of revolutions	Number of pairs
4	3
7	1
4	9
7	1
4	7
7	3

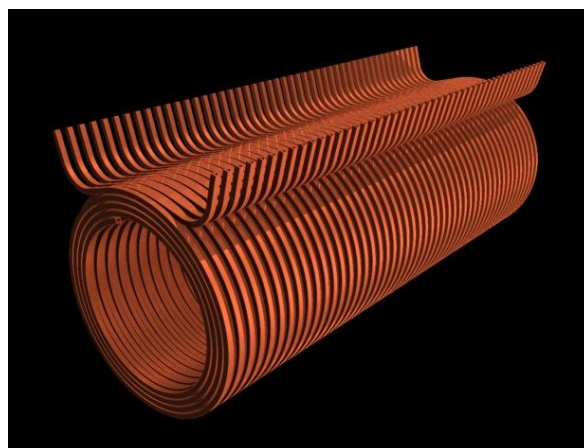


Figure 5: Schematic showing coils with input and output tails that must exit through 50mm gap in outer tube

Conductor area: 10.87 mm²

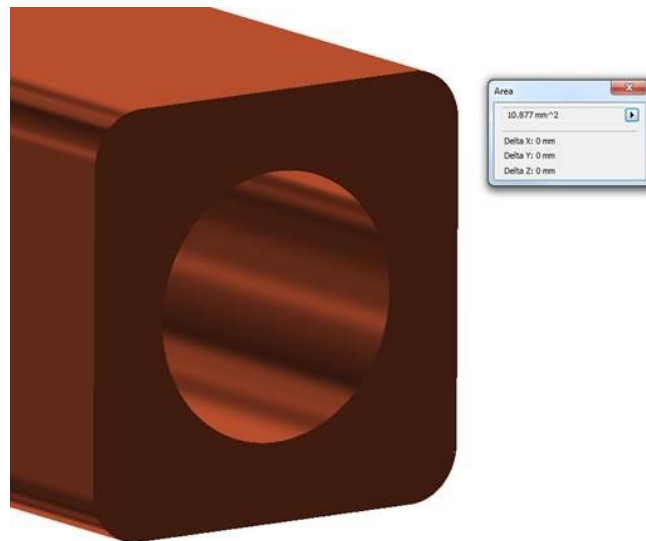


Figure 6: Copper conductor cross-sectional area

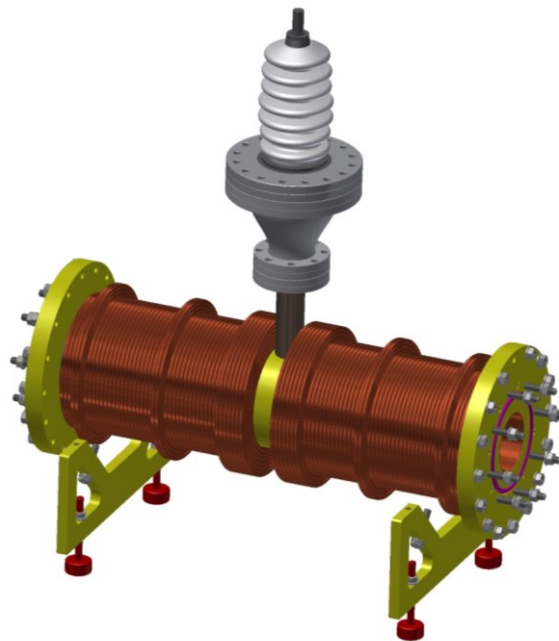


Figure 7: Gabor Lens without outer tube

Coils	
Square to round connectors	To be developed
Insulation scheme	To be developed
Production technique	To be developed
Electrical connection (busbars?)	To be developed
Status	To be manufactured

Central electrode

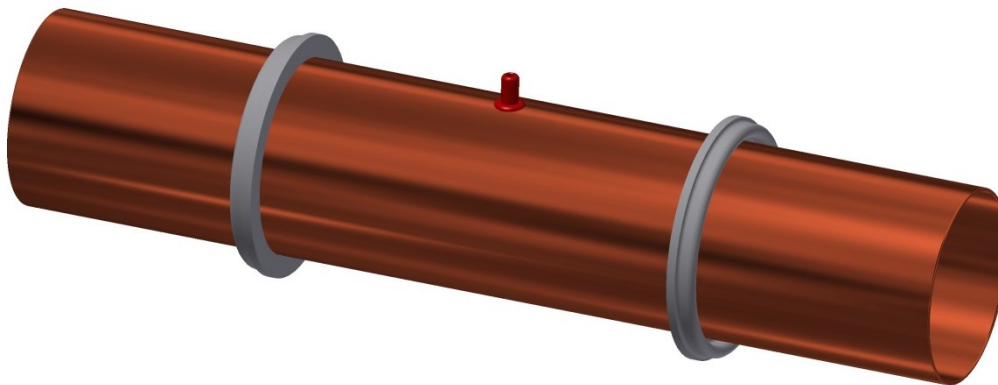


Figure 8: Central electrode plus insulating rings and HV connector

Central electrode	
Material	Copper
Quantity	1
Manufacture	HEP workshop *
O.D.	88,9mm
Wall	1,63mm
Length	444mm
Voltage	60-65kV
Minimum gap to HV	10,6mm
Potential material supplier	Smiths metals
Supplied size	3 ½" O.D. 16 SWG Wall
Function	This anode with a positive voltage provides the axial confinement for the electrons in potential well.
Status	To be manufactured

*Radius tube ends to reduce likelihood of sparking

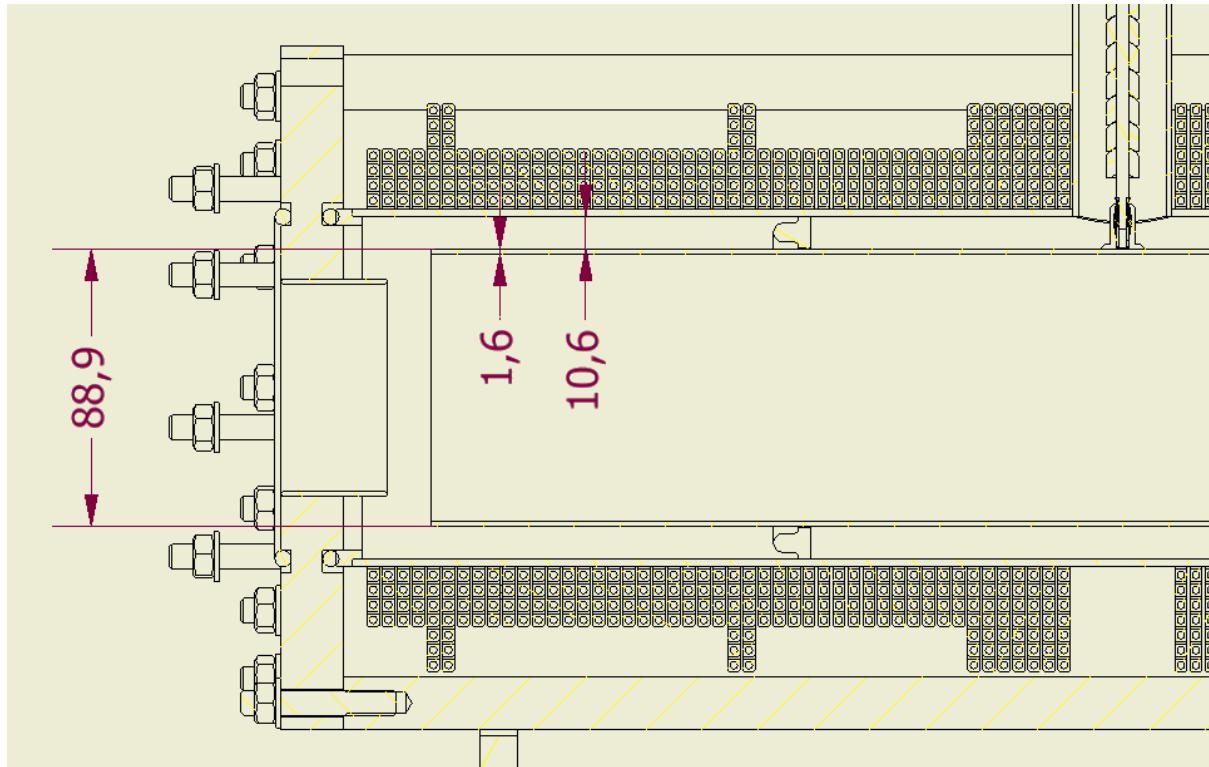


Figure 9: Central electrode key dimensions

Central electrode HV connector



Figure 10: Central electrode HV connector

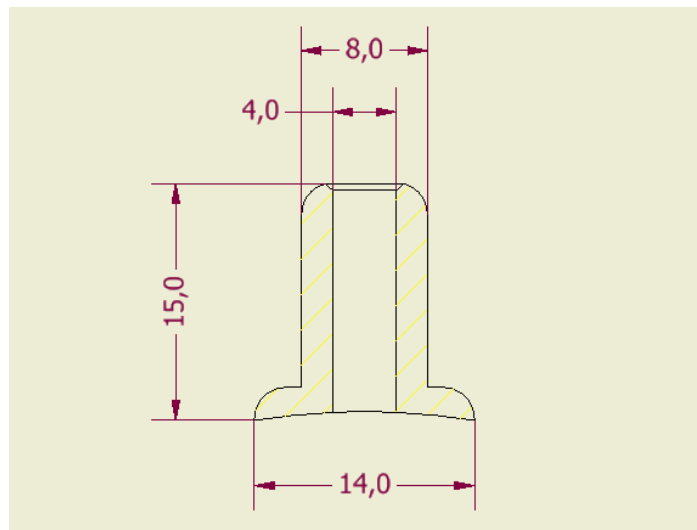


Figure 11: Central electrode HV connector key dimensions

Central electrode	
Material	Copper
Quantity	1
Manufacture	HEP workshop
O.D.	14,0mm
Length	15,0mm
Voltage	60-65kV
Joining	To be soldered to central electrode
Function	To provide a socket for the HV feedthrough extension
Status	To be manufactured

Isolating spacer



Figure 12: Isolating spacer

Isolating spacer	
Material	Ceramic
Quantity	2
Manufacture	External
O.D.	109,7mm
I.D.	89,3mm
Length	-
Function	To maintain the position of the central HV electrode and to electrically isolate it from the vacuum tube.
Status	Supplier/manufacturer to be found

HV Feedthrough

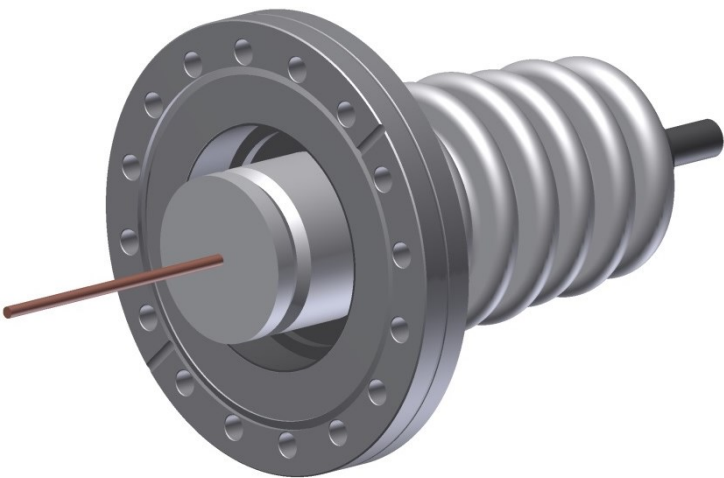


Figure 13: HV Feedthrough shown, Kurt Lesker EFT6012156A

The feedthrough shown in the CAD model uses a DN100CF flange (£880 + VAT). We could use the version that uses the DN63CF flange (£615 + VAT), not shown here because 3D model not available from manufacturer.

2	DN63CF	1	1/2-13	3	60	Stainless Steel	199	117	114	173	17.3	3.96	21.8	EFT6012156	£615.00		N/A
2	DN100CF	1	1/2-13	3	60	Stainless Steel	199	117	152	173	19.8	3.96	21.8	EFT6012156A	£880.00		(please login)

HV Feedthrough	
Status	To be ordered

Conical reducer nipple

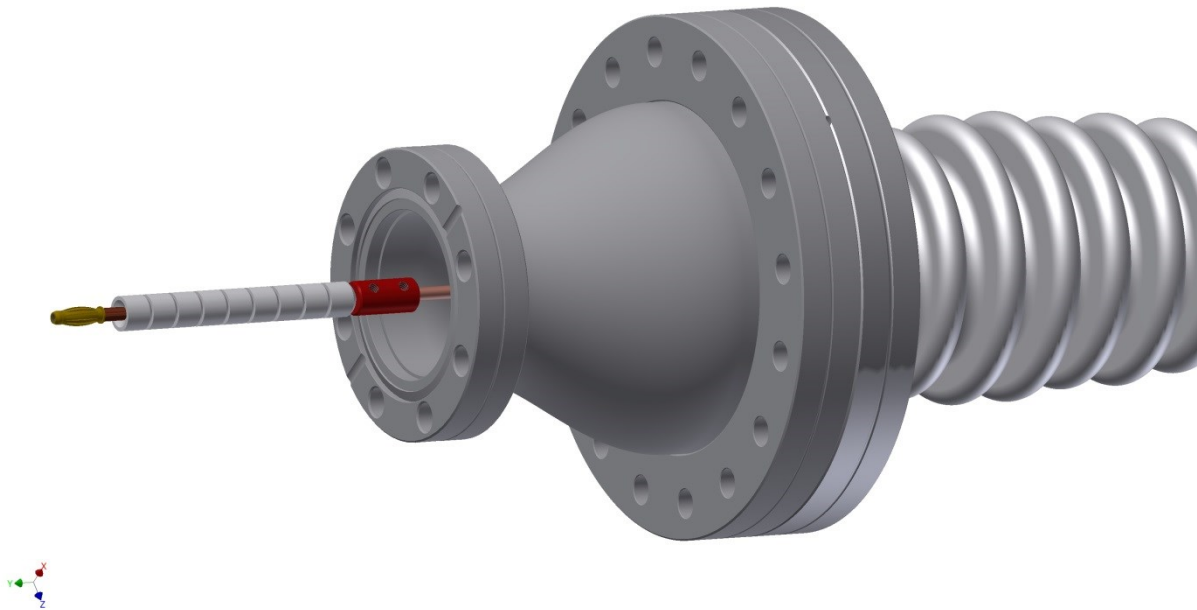


Figure 14: Conical reducer nipple

Conical reducer nipple	
Supplier	Kurt Lesker
Quantity	1
Part no.	CRN600x337
Cost	£213.60
Status	To be purchased

DN50CF 47.5 108.7 DN100CF 3.62 -- CRN600X337 £213.60



(please login)

Conductor extension



Figure 15: Conductor extension

Conductor extension	
Material	Copper
Manufacture	HEP workshop
Quantity	1
O.D.	4mm (nominal)
Length	104mm (To be confirmed when feedthrough purchased)
Thread	M3
Status	To be manufactured

Conductor link

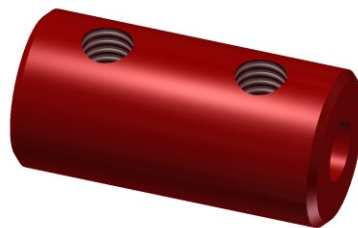


Figure 16: Conductor link

Conductor link	
Material	Copper
Manufacture	HEP workshop
Quantity	1
O.D.	10mm
Length	20mm
Threads	M4
Status	To be manufactured

Banana connector

MC (MULTI CONTACT) 22.1054 PLUG, 50A, GOLD PLATED, SCREW



Manufacturer: MC (MULTI CONTACT)

Order Code: 1085561

Manufacturer Part No 22.1054

 [Technical Data Sheet \(165.65KB\) EN](#)

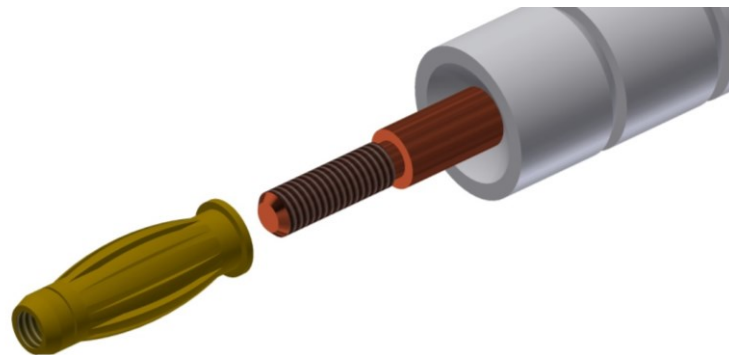


Figure 17: Banana connector to be screwed (M3) onto HV feedthrough extension rod

Banana connector	
Status	Ordered and received

Ceramic beads



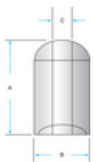
[ENLARGE](#)

Features

- > Also known as fish-spine beads because of flexibility
- > Insulate bare electrical wires in air or vacuum systems
- > Available fitted to wire sizes up to 0.156" diameter
- > Consist of short cylindrical tubes with one concave and one convex end
- > Provide continuous shielding of a central conductor when stacked in a mating order
- > Their versatility is most evident in nonlinear flexible applications such as shielded coaxial vacuum cabling, projects requiring intricate layout patterns, or projects requiring motion displacement

NOTE: Wire-to-ceramic coaxial clearance does affect overall flexibility; therefore, as wire size increases, flexibility decreases.

Dimensional Drawings



Drawing: D12F33

[ENLARGE](#)

Ordering Table

[Convert To U.S. Imperial Units](#)

(Click column headers to sort data)

Beads/ Linear ft.	DimA (mm)	DimB (mm)	DimC (mm)	PartNo	Price	Add Item	VacuCAD SM
34	10.2	10.2	3.96	FTACERB156	£34.00		N/A

Ceramic beads

Status	To be ordered
---------------	---------------

Vacuum tube

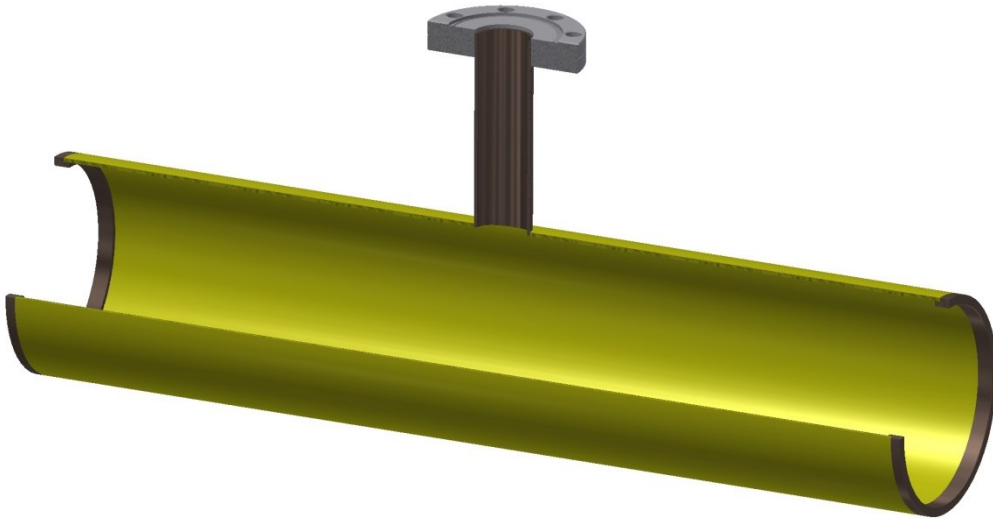


Figure 18: Sectioned view of vacuum tube assembly

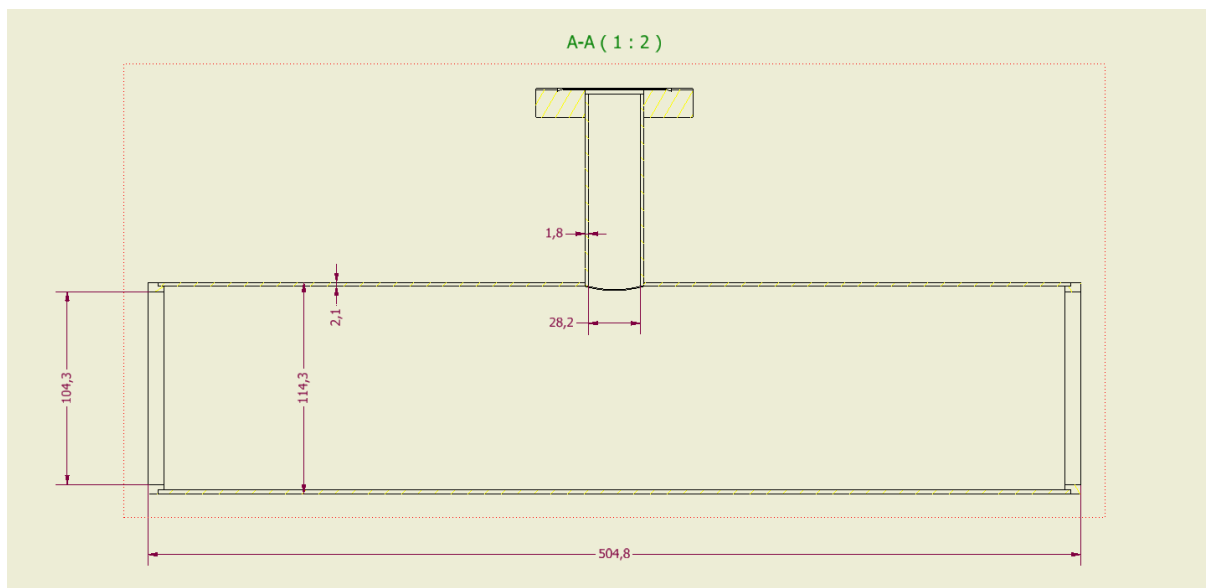


Figure 19: Vacuum tube key dimensions

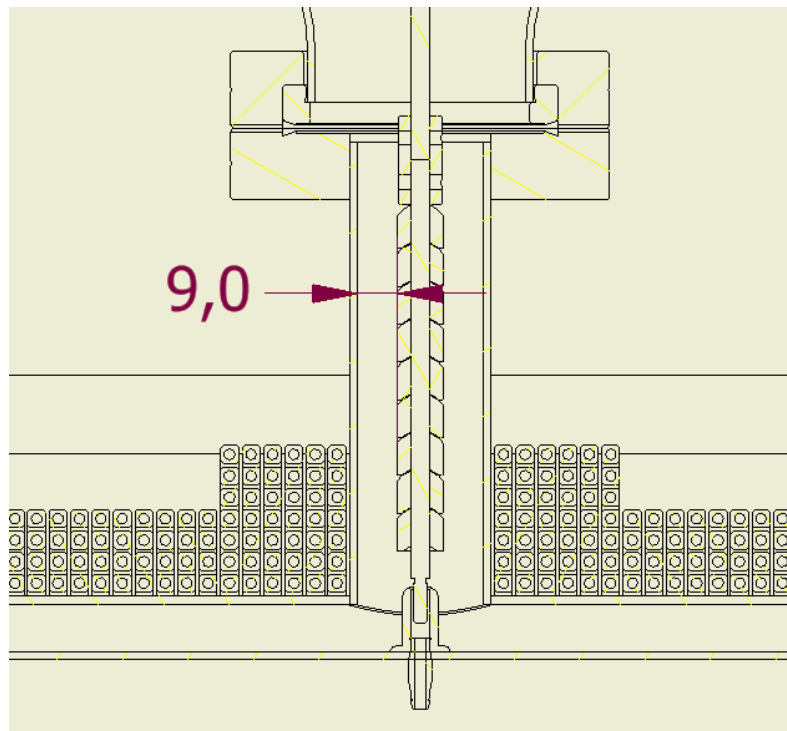


Figure 20: Maintaining 9mm gap in vacuum between HV and OV

Vacuum tube	
Material	Stainless steel
Quantity	1
Manufacture	OM – NTE?
O.D.	114,3mm
Length	504,8mm
Status	To be manufactured

End tubes



Figure 21: Copper end tube

End tubes	
Material	Copper
Quantity	2
Manufacture	HEP workshop
O.D.	69,9mm
Wall	1,63mm
Length	34mm
Voltage	0V
Minimum gap to HV	16,8mm
Potential material supplier	Smiths metals
Supplied size	2 ¾" O.D. 16 SWG Wall
Status	To be manufactured*

*Radius inner tube ends to reduce likelihood of sparking

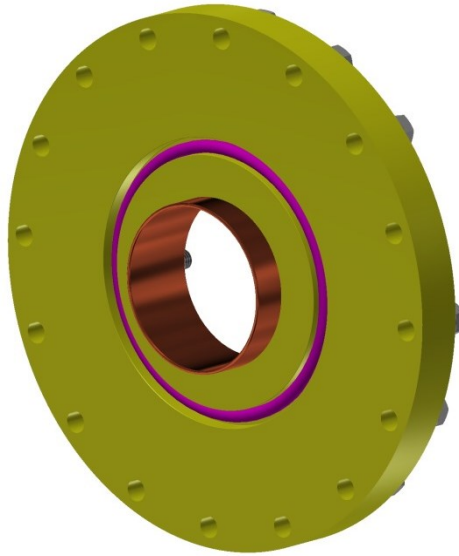


Figure 22: Press fit end tube into mild steel end flange

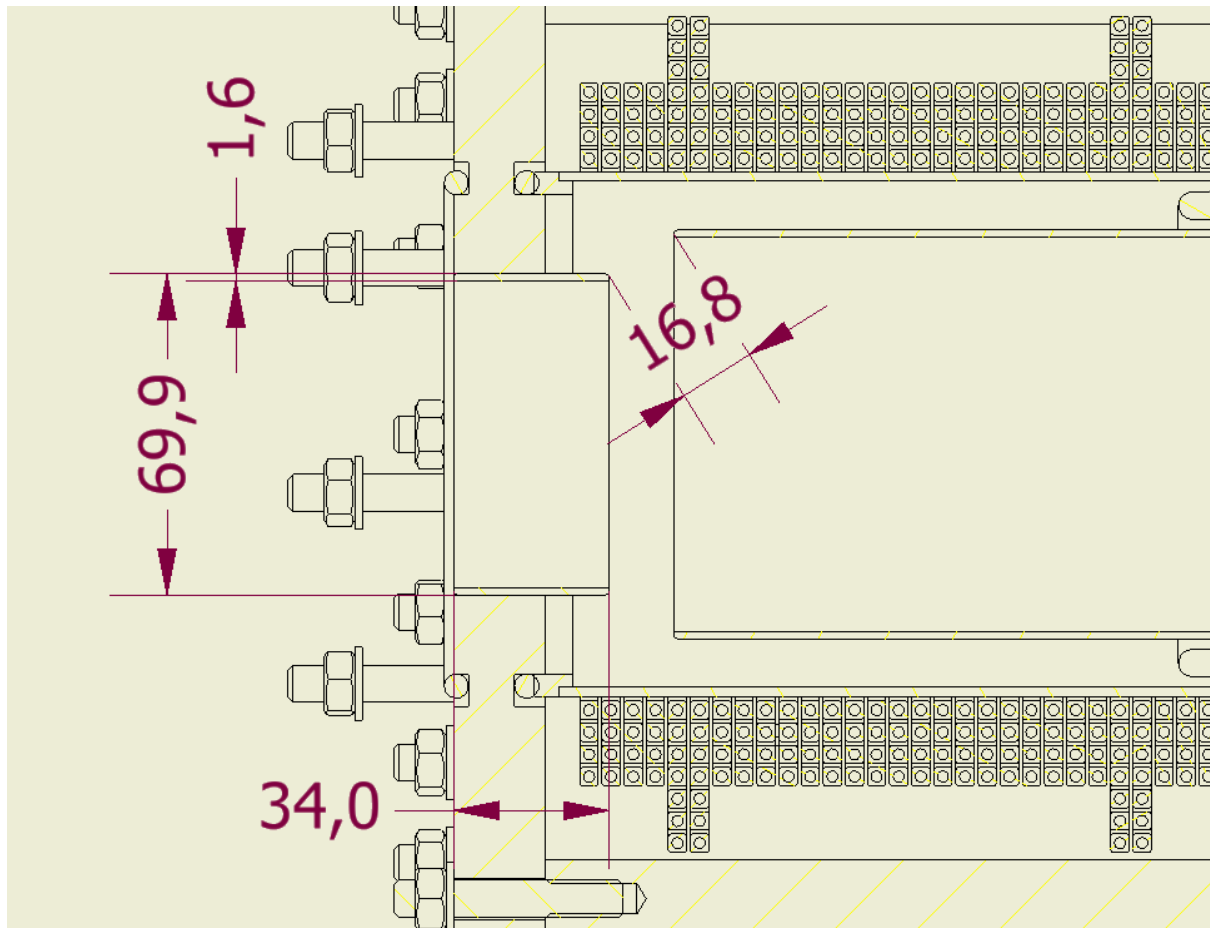


Figure 23: End tube key dimensions

End flanges

End flanges	
Material	Mild steel, EN8*
Quantity	2
Manufacture	HEP workshop
O.D.	219,1mm
Length	20mm
Potential material supplier	?
Status	To be manufactured*

*Material: Mild steel. Important to be able to support a magnetic field. Mild steel with a 0.2% Carbon content has a relative permeability of 2000 (compared to Iron with a relative permeability of 5000).

Material: **EN8**, carbon content 0.35-0.45%

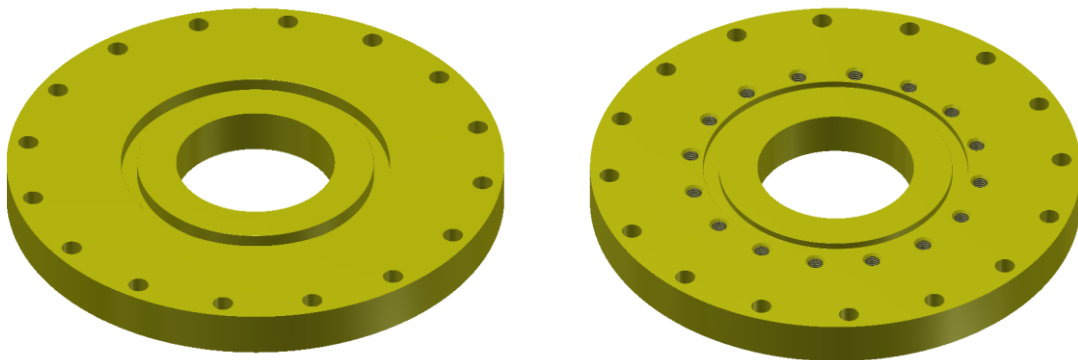


Figure 24: Inner and outer faces of end flange

O Ring seals

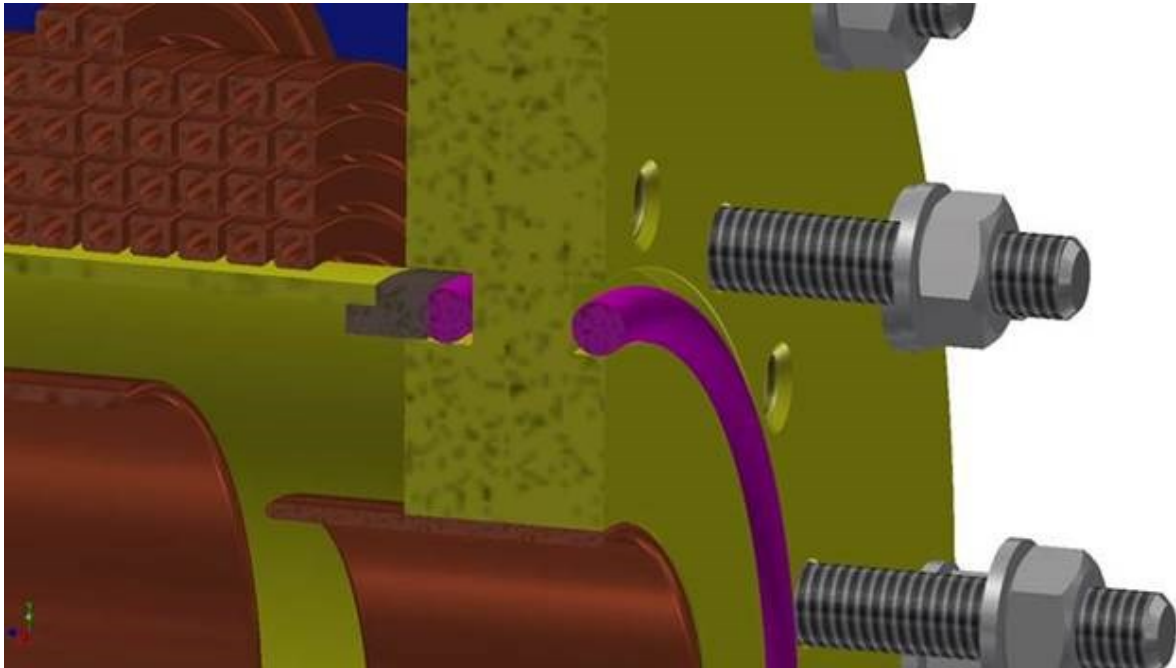


Figure 25: Section view showing O ring seals

O ring seals	
Supplier	Polymax
Material	Viton
O ring cross section	5,33mm
Groove width	7,1mm
Groove depth	4,3mm
Part no.	BS346V75
Status	To be purchased

Support brackets

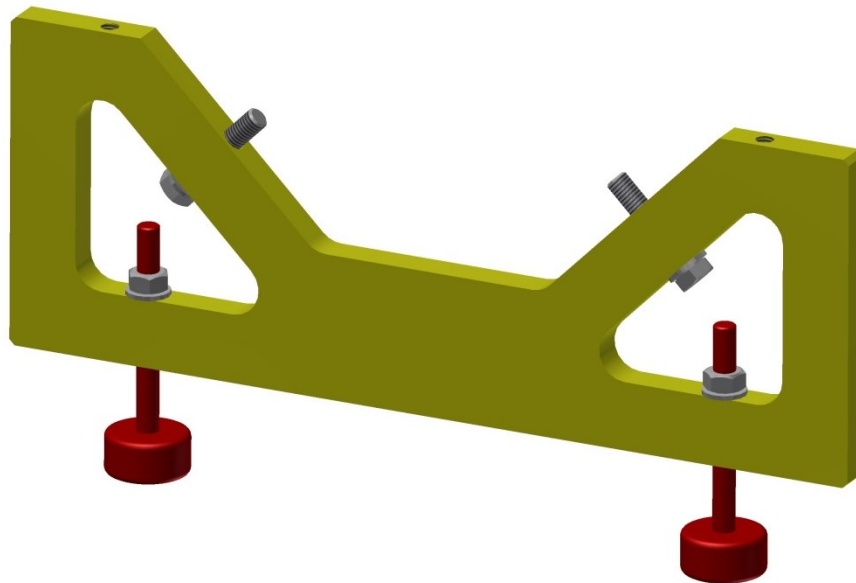


Figure 26: Support bracket with adjustable feet

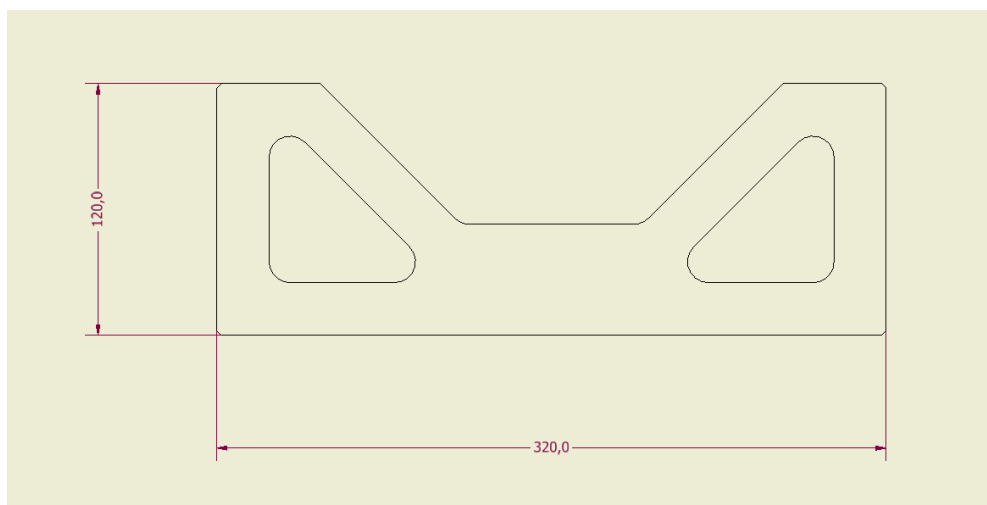


Figure 27: Support bracket key dimensions. Material 12mm 5080 aluminium alloy tooling plate

Support bracket	
Material	5080 aluminium alloy plate
Quantity	2
Manufacture	HEP workshop
Length	20mm
Height	120mm
Potential material supplier	Aalco
Status	To be manufactured

Support stand



Figure 28: Support stand, 2 required

Support stand	
Material	Minitec
Quantity	2
Manufacture	HEP workshop
Height	T.B.C.
Status	To be designed, material purchased and then manufactured.

Pumping Tee

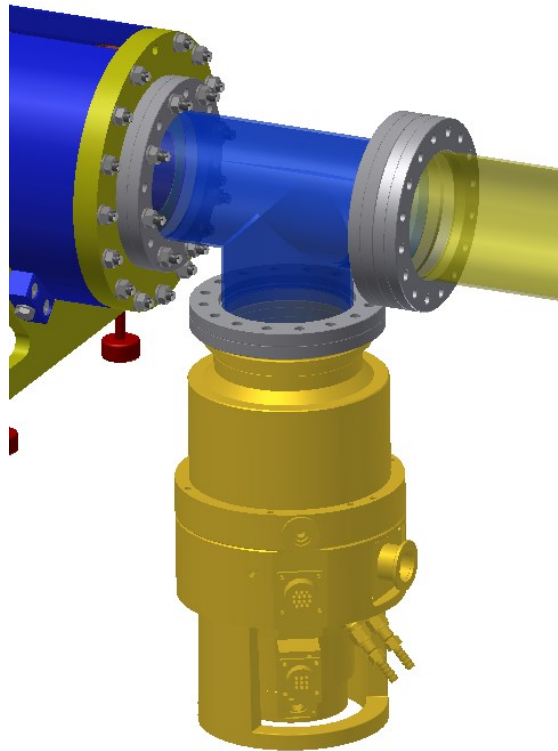


Figure 29: DN100CF Tee with Turbovac 340M shown

DN100CF	134.9	101.6	6.8	--	T-0600	£272.00
DN100CF	109.7	101.6	6.8	--	T-0600S	£330.40

Pumping Tee	
Item	DN100CF Tee
Quantity	2
Supplier	Kurt Lesker
Cost	£272 + VAT each (Plus seals, nuts, bolts, washers)
Status	To be purchased

Drift tube

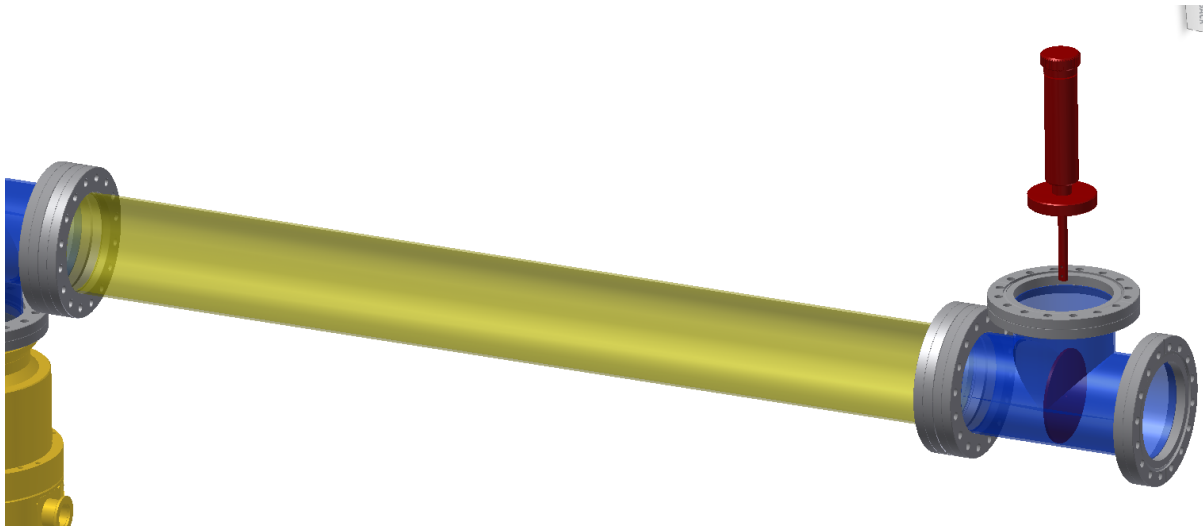


Figure 30: Drift tube and aperture Tee

Drift tube	
Item	DN100CF custom length nipple
Quantity	1
Supplier	NTE?
Cost	£500 estimated
Status	To be ordered

Aperture

Metal plate with a small hole at the centre – to be designed

Aperture movement device

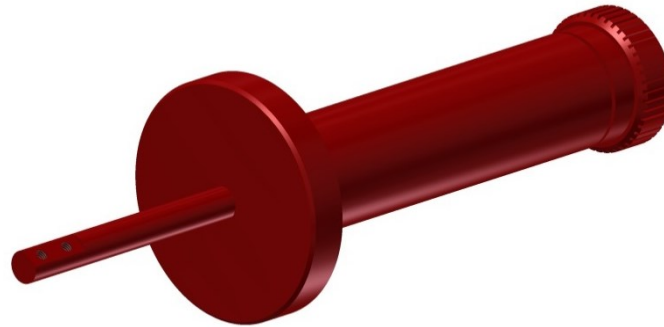


Figure 31: Aperture movement device

Start Your Configuration

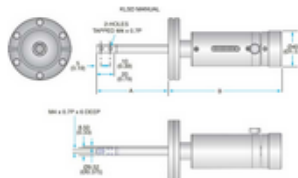
Choose the series, travel, flange size, and actuation. Next, compose the order code as shown, below.

1. Series:	KLSD
2. Travel (mm) "A":	51 (B)
3. Flange Size:	2.75" (B)
4. Actuation Options:	Manual

Create

Reset

Dimensional Drawings



Drawing: KLSD MANUAL

ENLARGE



Dimensions As Configured

Flange Size	Actuation	Travel	Retracted A	Extended B
2.75" CF		51 mm (2.00")	80 mm (3.15")	161 mm (6.34")

Part Number: KLSDBB

VacuCad: N/A

Price as Configured: £ 537.00

+ Add to Cart

What does the lens connect to?

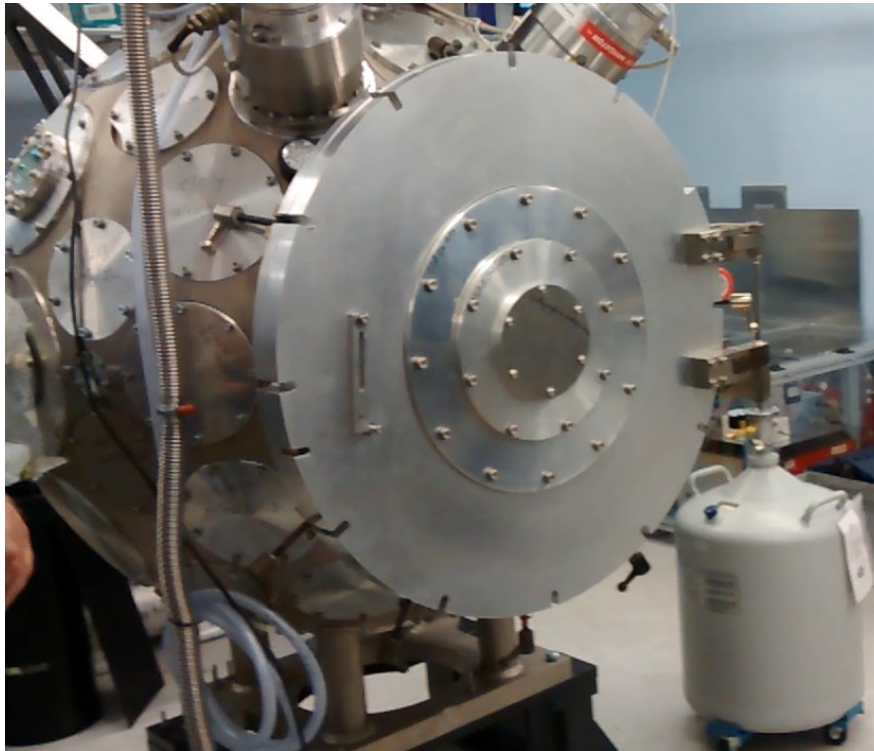


Figure 32: Photograph of 'Death Star' in Roland Smith's lab. The Gabor Lens is to be mounted to one of the concentric ports shown.

Height to centre to be measured

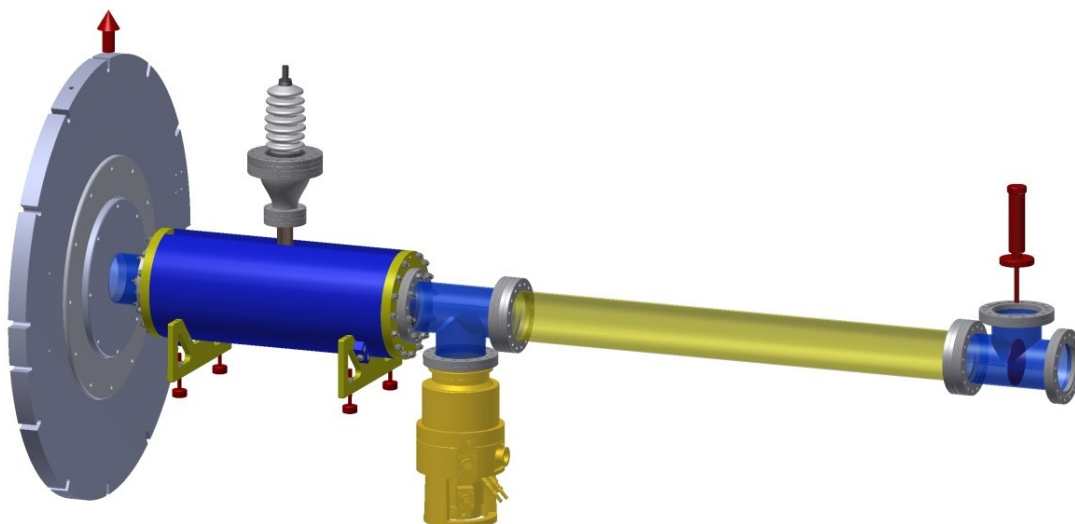


Figure 33: Gabor lens mounted to death star flange. Downstream drift and aperture concept shown.

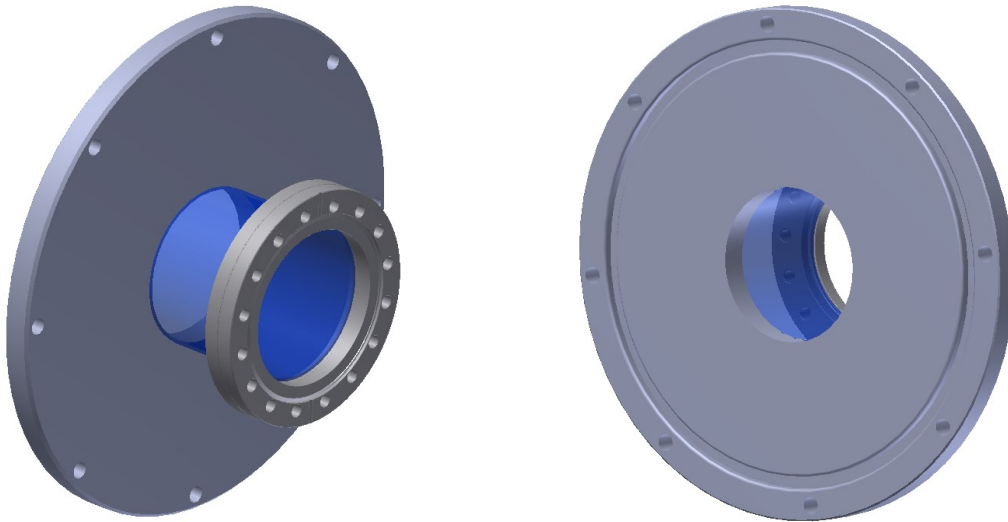


Figure 34: Death star flange

Death star flange	
Material	Stainless steel
Quantity	1
Manufacture	OM – NTE? (Query vac braze in-house)
O.D.	320mm
Length	109mm
Nipple	DN100CF
Part	Kurt Lesker FN-0600
Estimated cost	£500
Status	To be manufactured

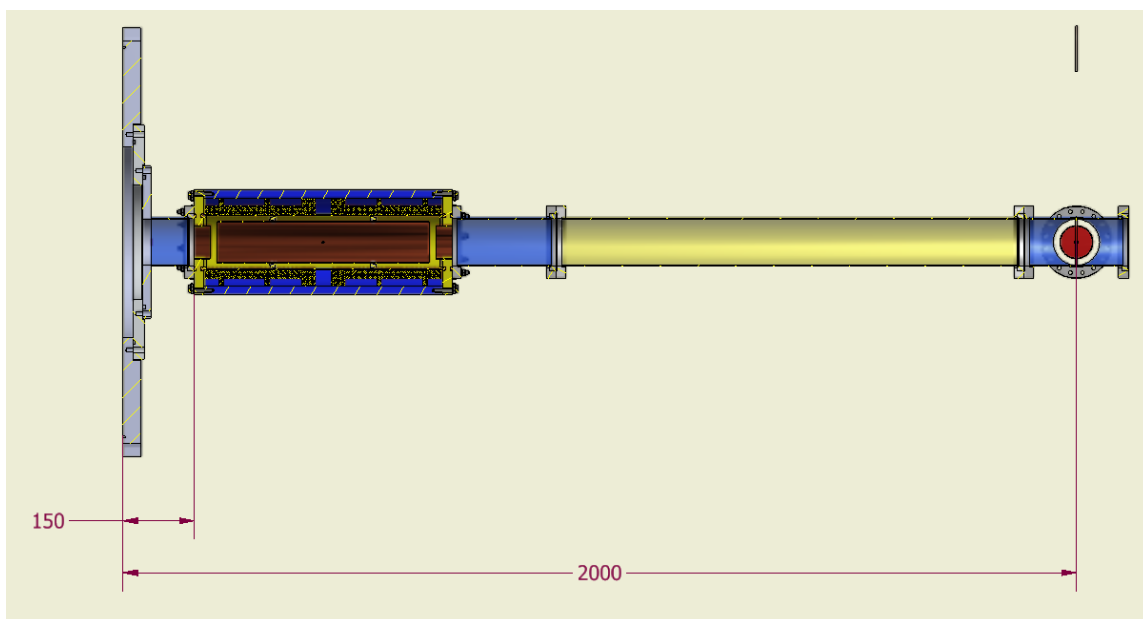


Figure 35: Key distances, 150mm to GL entrance, 2000mm to aperture

Lens Assembly

Assembly sequence to be defined

Lifting

Lifting using support brackets may be viable. Calculations to be made to check suitability.

Installation

Installation sequence to be defined

Cooling system

