ANSALDO

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# VACUUM CHAMBERS

**Derivato da** derived from

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## 1. AIM

The present Manufacturing Specification aims at detailed description of both the manufacturing criteria of the «Vacuum Chambers» (with exclusion of the «Wigglers Vacuum Chambers»), the working materials and procedures, the required number of Suppliers/Manufacturers, the time schedule agreed upon, the number of pieces to be delivered within schedule and the overall costs of the finished product.

## 2. REFERENCES

The present specification invokes the following documents:

1. List of deliverables, whose version dated 06/12/2000 has been provided by INFN., item 1.4.4.1. (Attachment 13)
2. ARI Procedure n.P0111767000L dated 13/12/1999.
3. Drawings:
   1. **General Drawings**
      D02954UX3000L Damping Ring General Draw.
      D02653UX3000L Damping Ring Lay-out 1
      D02654UX3000L Damping Ring Lay-out 2
      D02655UX3000L Damping Ring Lay-out 3
      D02656UX3000L Damping Ring Lay-out 4
      D02657UX3000L Damping Ring Lay-out 5
   2. **Vacuum Chamber Assembly**
      D02658UX3000L Type CV43 MOD.1/1
      D02660UX3000L Type CV43 MOD.1/3
      D02679UX3000L Type CW80 MOD.4
      D02008UX3000L Type CW80 MOD.5
      D02682UX3000L TypeCV100 MOD.6/1
      D02789UX3000L Type CV100
      D02790UX3000L Type CVD
      D02791UX3000L Type CV43
      D02792UX3000L Type CW80
      D02799UX3000L Type CV43
   3. **Bellows**
      D02659UX3000L Type MOD.1/2
      D02680UX3000L Type MOD.4/3
      D02681UX3000L Type MOD.6
   4. **Vacuum Pump Connections**
      D02661UX3000L Type DN63/DN160-MOD.2
      D02662UX3000L Type DN63/DN160-MOD.3
      D02683UX3000L Vacuum Pump Connection - $\phi$43 T1 -

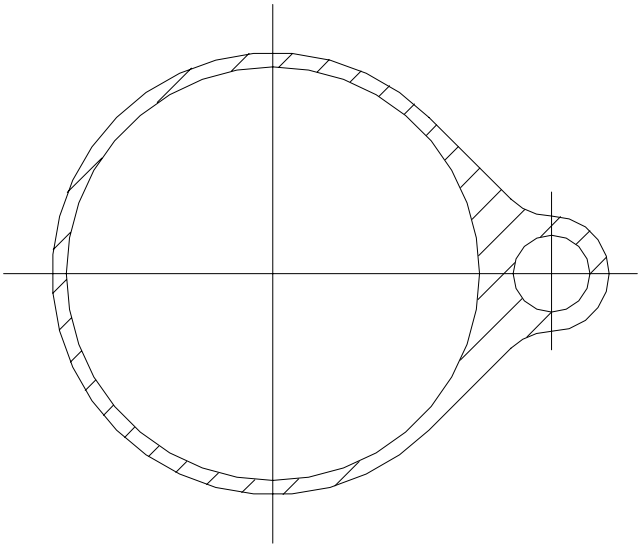
D02684UX3000L Vacuum Pump Connection - $\phi$43 T2 -
D02685UX3000L Vacuum Pump Connection - $\phi$43 T3 –
D02690UX3000L Type DN100/DN200-CW80 T4
D02691UX3000L Vacuum Pump Connection – CVW/CW80 T5 -
D02692UX3000L Type DN100/DN200- CW80 T6 -
D02693UX3000L Vacuum Pump Connection – CV100 T7 -
D02694UX3000L Type DN63/DN100-$\phi$43 T8
D02695UX3000L Type DN100/DN200-CW80 T9
D02696UX3000L Type DN63/DN200-$\phi$43/RF$\phi$200 T10
D02782UX3000L Traversal Kicker Stripline - $\phi$43 T15 -
D02785UX3000L Vacuum Pump Connection – RF$\phi$200 T18-

## 3. COMPONENTS

### 3.1 Vacuum Chamber

Different models of Vacuum Chamber exist:

- **CV43** This configuration is sketched below



It is the only one which is cooled. It is utilized in the regions: ± ARC MATCH, ±ARC PNOD, ARC PCELL, ARC DRIFT, ±ARC MNOD, ARC MCELL (dipole regions are excluded).

- **CVD** The second configuration is sketched below

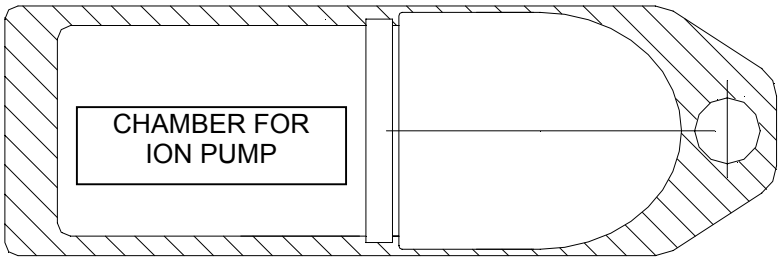



FIG.2

Its design allows location of a «chain» ion pump in the above quoted rectangular cross-section room. It is utilized in the dipole regions: ±ARC PNOD, ARC PCELL, ±ARC MNOD, ARC MCELL

- **C100** The third configuration is sketched below

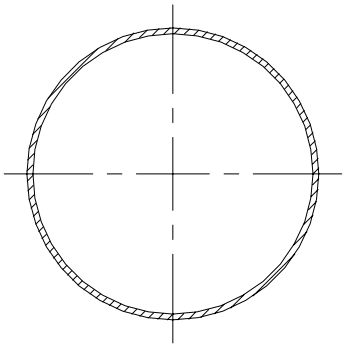


FIG.3

It is the cross-section of the chambers to be utilized in the «Damping Ring» straight regions, i.e.: ± L2A MATCH, LONG CELL.

- **CW80** The fourth configuration is sketched below

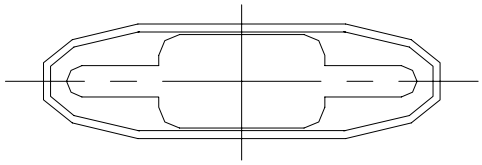


FIG.4

It is the cross-section of the chambers to be utilized in the «Wiggler» regions, i.e.: ± W2A MATCH, WIG CELL.

### 3.2 Bellows

Three models of Bellows exist:
**MOD.1/2** with DN63 flanges is similar to **MOD.4/3** with DN100 flanges. Both are utilized near the Quadrupoles of the beamlines equipped with CV43-Vacuum Chamber:

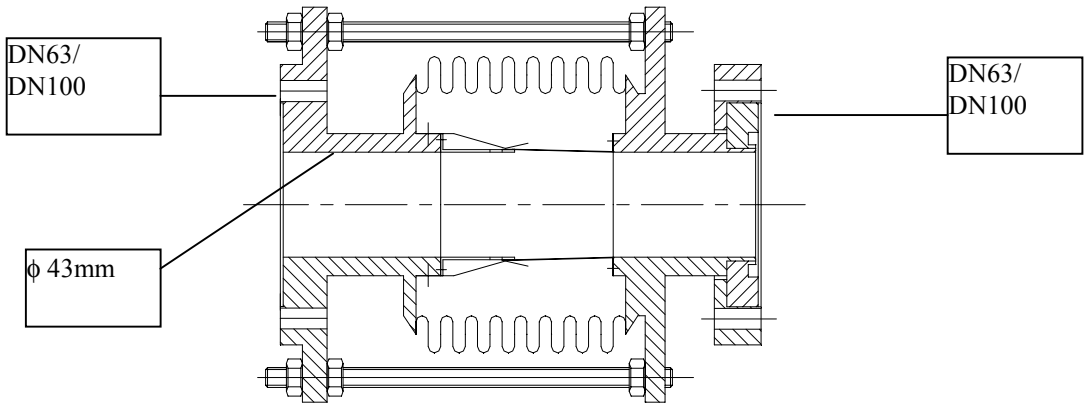



**FIG.5**

In contrast, **MOD.6** with DN100 flanges is utilized in the regions ± L2A MATCH and LONG CELL, near the Quadrupoles of the beamlines equipped with CV100-Vacuum Chamber:

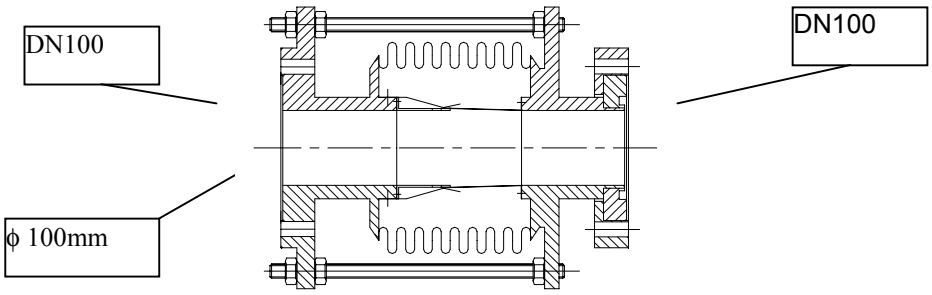



**FIG.6**

### 3.3 Vacuum Pump Connections

Their design allows linking of different kinds of flanges. MOD.2 is entirely manifactured starting from aluminium plates. Other models are manifactured through assembling two different flanges with a «Vacuum Chamber» crop (As a matter of example, model D02890UX3000L DN100/DN200-CW80 T4 is drawn below):

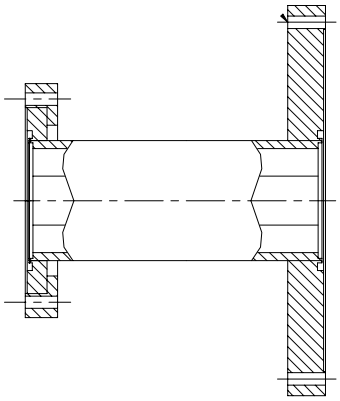


**FIG.7**

# 3. MANIFACTURING

## 4.1 Vacuum Chambers

### CVD

Assemblies made of three kinds of extrusion material allow careful handling of inner surfaces (see FIG.2).
Furthermore, we envisage utilization of a limited quantity of CVD-relevant pieces (A1,A2 and A3, see Attachment 3) for preliminary testing campaign aimed at geometric optimization of the assembly.

### CV43 and CVD

We envisage further cooling with demineralized water (see FIG.1 and FIG.2).

- Both a rotating and a fixed flange will be welded on the edge of all Vacuum Chambers (even the complex ones, i.e. Mod.1/1, Mod.1/3, Mod.5 and Mod.6/1).
- The fixed flange will carry a small reference plate with a calibrated drill; the plate will exhibit both the mark and the orientation of the axis.
- Assembled Vacuum Chamber will fulfil the following length tolerance requirement:

±0,05% for L>1000 mm ; ±0,5mm for L= 1000÷500 mm; ±0,2mm for L<500 mm

- Special Aluminium joining flanges allow joining of different parts of the Vacuum Chamber with negligible damage of their joining planes during assembly/disassembly phases, provided that special metallic gaskets are utilised («diamond» AL - see Attachment 1).
- Suitable inner copper screening -to be placed between Vacuum Chamber flanges- will minimize possible flange-joining induced «beam disturbances».

## 4.2 Bellows

Mechanical/electrical properties of bellows are listed below (see Attachment 12):

- Stroke (Expansion/Contraction)
  ±8,5 mm (Mod.6) ±15 mm (Mod.1/2 - Mod.1/2)
- Bellows Lifetime : $10^5$ times
- Step at Contact Point : 1 mm
- Peak Wall Current: 50A per 20psec (f=50Mhz.)
- Setting of Shield – Contact Force: 60 ≈ 70 g/finger

Envisaged Titanium Nitride (TiN) 5μm coating of the Inner Tube prevents unacceptable wear in the contact region between the Inner Tube itself and moving parts.

# 4. MACHINING

## 5.1 MATERIALS

### Vacuum Chambers and Vacuum Pump Connections

We envisage Aluminium Anticorodal **6060-T4 (9006/1 alloy)** and Aluminium Anticorodal **6082-T6** as the manufacturing material of Vacuum Chambers and of joining flanges respectively. We envisage **Cadmium-Phosphorous-Bronze-(Helicel BR)**-made threads on the joining drills of some flanges, as well as **AISI304**-made joining screws**.**

### Bellows

We envisage:

- Beam Tube : Anticorodal 6060
- Inner Tube : Anticorodal 6060 (con TiN)
- Spring Finger : Rame – Berillio
- Shield Finger : Rame – Berillio
- Fixed Flange : Anticorodal 6082
- Rotatable Flange : Anticorodal 6082
- Bellows : AISI 304L
- Welding Transition Flange : AISI 304L/Anticorodal 6082

as the manifacturing material of Bellows (see Attachment 12).

## 5.2 STATE OF DELIVERY

The state of deliveries is as follows:

### Vacuum Chambers and Vacuum Pump Connections

- Flange (typically, Attachment1) : from a 25/30mm-thick slab
- Screws : see catalogue
- Gaskets (Attachment 2) : according to dwg (diamond geometry)
- Pipes (Attachment 3) : Extruded with the following features:

TOLERANCES

| | |
|---|---|
| -mod A3 | +0/-0,4 mm at 34 mm (internal) |
| -mod A3 | +0/-0,1 mm at 34 mm (internal) |
| -mod A1 | +0/-0,5 mm at 34 mm (internal) |
| -mod B1/B2 | ±0,35 mm ovality |
| -mod C1 | ±0,60 mm ovality |
| -mod E | ±0,20 mm at 18 mm |

Elsewhere, no tolerance will exceed ±0,30 mm
Roughness will exceed Ra=0,8μm on no inner surface
Envisaged rolling improves 1-mm thick tongue surface in Mod.3

WEIGHTS and LENGTHS

| | | | |
|---|---|---|---|
| -mod A1 | n°227 pieces | length mm.5500 | (≈2000Kg) |
| -mod A2 | n°227 pieces | length mm.5500 | (≈ 470Kg) |
| -mod A3 | n°227 pieces | length mm.5500 | (≈3150Kg) |
| -mod B1/B2 | n°150 pieces | length mm.6500 | (≈ 860Kg) |
| -mod C1 | n°2100 pieces | length mm.7000 | (≈24300Kg) |
| -mod E | n° 45 pieces | length mm.7000 | (≈ 650Kg) |

- Particular connections : Plates and particular pipes

### Bellows

- Flanges : from a 25mm-thick slab
- Pipes : Round Φ80/120mm
- Electrical continuity : Sheet
- Bellows : corrugated sheet
- Connection : 5mm-thick special bimetallic sheet

## 5.3. MANUFACTURING PROCEDURES

### Vacuum Chambers and Vacuum Pump Connections

1. Flanges

- Various Suppliers will manifacture the flanges according to the required tolerances and values of roughness listed in Attachment 1 (typically, CFs100).
- Measures/tolerances concerning flange drilling required by welding for different Vacuum Chamber models («L» cog thickness for boundary fusion is also shown):

| | | | |
|---|---|---|---|
| Flanges CFs100 | (Att. 7) | tolerance | +0.3/+0.5 |
| Flanges CFs200 | (Att. 7) | tolerance | +0.5/+0.7 |
| Flanges CFs150 | (Att. 8) | tolerance | +0.4/+0.6 |
| Flanges CFs200 | (Att. 9) | D=200.8mm | L=5mm |
| Flanges CFs150 | (Att. 9) | D=160.6mm | L=5mm |
| Flanges CFs100 | (Att. 9) | D=100.4mm | L=2mm |
| Flanges CFs 35 | (Att. 9) | D= 38.2mm | L=1.5mm |
| Flanges CFs 63 | (Att. 9) | D= 70.5mm | L=2mm |
| Flanges CFs100 | (Att. 9) | D= 70.5mm | L=2mm |
| Flanges CFs 63 | (Att. 9) | D= 48.3mm | L=2mm |
| Flanges CFs100 | (Att. 9) | D= 48.3mm | L=2mm |
| Flanges CFs 63 | (Att. 9) | D= 46.3mm | L=2mm |
| Flanges CFs100 | (Att. 9) | D= 46.3mm | L=1.5mm |

2. Extruded pipes (standard/special)

- Manifacturers agreed to the procedure described in Attachment 10.
- Preliminary tests (roller leveling, hot bending, cold bending, etc.) allow selection of the proper CVD bending procedure for further serial production.
- Welding technology (Electron Beam, TIG, Plasma) will be chosen during tests

## 5.4. TESTS

We envisage:

- statistical tests on the roughness of particular components;
- dimensional tests on all components;
- vacuum leakage tests according to the parameters listed in Attachment 10 pag.4/4 item n.3;
- penetrating liquid tests on all weldings.

at Manifacturer's location for acceptance before shipping, according to ISO 9000

## 5.5. OTHERS

«Baking» treatment is required after each manifacturing, machining and washing phase in order to assure proper cleaning of components and adequate stability in time.

All ferrous surfaces will undergo «strong» burnishing in order to prevent oxydization.

## 5. LOCATION. QUANTITIES

### Vacuum Chamber Assembly

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02653UX3000L Damping Ring **Lay-out 1**

it turns out that the quantities are:

n° **8** D02658UX3000L Type CV43 MOD.1/1
n° **6** D02660UX3000L Type CV43 MOD.1/3
n° **10** D02679UX3000L Type CW80 MOD.4
n° **35** D02008UX3000L Type CW80 MOD.5
n° **4** D02790UX3000L Type CVD
n° **11** D02791UX3000L Type CV43
n° **12** D02792UX3000L Type CW80
n° **4** D02799UX3000L Type CV43

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02654UX3000L Damping Ring **Lay-out 2**

It turns out that the quantities are:

n° **82** D02658UX3000L Type CV43 MOD.1/1
n° **3** D02660UX3000L Type CV43 MOD.1/3
n° **41** D02790UX3000L Type CVD
n° **53** D02791UX3000L Type CV43
n° **61** D02799UX3000L Type CV43

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02655UX3000L Damping Ring **Lay-out 3**

It turns out that the quantities are:

n° **79** D02658UX3000L Type CV43 MOD.1/1
n° **3** D02660UX3000L Type CV43 MOD.1/3
n° **39** D02790UX3000L Type CVD
n° **72** D02791UX3000L Type CV43
n° **55** D02799UX3000L Type CV43

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02656UX3000L Damping Ring **Lay-out 4**

It turns out that the quantities are:

n° **57** D02658UX3000L Type CV43 MOD.1/1
n° **6** D02660UX3000L Type CV43 MOD.1/3
n° **24** D02790UX3000L Type CVD
n° **49** D02799UX3000L Type CV43

n° **34** D02799UX3000L Type CV43

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02657UX3000L Damping Ring **Lay-out 5**

It turns out that the quantities are:

n°**135** D02682UX3000L TypeCV100 MOD.6/1

n°**950** D02789UX3000L Type CV100

**Bellows**

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02653UX3000L Damping Ring **Lay-out 1**

It turns out that the quantities are:

n° **22** D02659UX3000L Type MOD.1/2

n° **55** D02680UX3000L Type MOD.4/3

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02654UX3000L Damping Ring **Lay-out 2**

It turns out that the quantities are:

n° **87** D02659UX3000L Type MOD.1/2

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02655UX3000L Damping Ring **Lay-out 3**

It turns out that the quantities are:

n° **85** D02659UX3000L Type MOD.1/2

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02656UX3000L Damping Ring **Lay-out 4**

It turns out that the quantities are:

n° **82** D02659UX3000L Type MOD.1/2

Referring to:

- D02954UX3000L Damping Ring General Draw.
- D02657UX3000L Damping Ring **Lay-out 5**

It turns out that the quantities are:

n°**938** D02681UX3000L Type MOD.6

### Vacuum Pump Connections

Referring to

- D02954UX3000L Damping Ring General Draw.
- D02653UX3000L Damping Ring **Lay-out 1**

It turns out that the quantities are:

n° **7** D02683UX3000L Vacuum Pump Connection - ϕ43 T1 -
n° **4** D02684UX3000L Vacuum Pump Connection - ϕ43 T2 -
n° **6** D02685UX3000L Vacuum Pump Connection - ϕ43 T3 -
n° **36** D02691UX3000L Vacuum Pump Connection – CVW/CW80 T5 -
n° **1** D02661UX3000L Type DN63/DN160-MOD.2
n° **1** D02662UX3000L Type DN63/DN160-MOD.3
n° **18** D02690UX3000L Type DN100/DN200-CW80 T4
n° **1** D02692UX3000L Type DN100/DN200-CW80 T6
n° **7** D02694UX3000L Type DN63/DN100-ϕ43 T8
n° **1** D02782UX3000L Traversal Kicker Stripline - ϕ43 T15 -

Referring to

- D02954UX3000L Damping Ring General Draw.
- D02654UX3000L Damping Ring **Lay-out 2**

It turns out that the quantities are:

n° **23** D02683UX3000L Vacuum Pump Connection - ϕ43 T1 -
n° **41** D02684UX3000L Vacuum Pump Connection - ϕ43 T2 -
n° **1** D02661UX3000L Type DN63/DN160-MOD.2

Referring to

- D02954UX3000L Damping Ring General Draw.
- D02655UX3000L Damping Ring **Lay-out 3**

It turns out that the quantities are:

n° **20** D02683UX3000L Vacuum Pump Connection - ϕ43 T1 -
n° **39** D02684UX3000L Vacuum Pump Connection - ϕ43 T2 -
n° **1** D02662UX3000L Type DN63/DN160-MOD.3

Referring to

- D02954UX3000L Damping Ring General Draw.
- D02656UX3000L Damping Ring **Lay-out 4**

It turns out that the quantities are:

n° **20** D02683UX3000L Vacuum Pump Connection - ϕ43 T1 -
n° **24** D02684UX3000L Vacuum Pump Connection - ϕ43 T2 -
n° **24** D02785UX3000L Vacuum Pump Connection – RFϕ200 T18-
n° **1** D02661UX3000L Type DN63/DN160-MOD.2
n° **1** D02662UX3000L Type DN63/DN160-MOD.3
n° **12** D02696UX3000L Type DN63/DN200-ϕ43/RFϕ200 T10

Referring to

- D02954UX3000L Damping Ring General Draw.
- D02657UX3000L Damping Ring **Lay-out 5**

It turns out that the quantities are:

n°**938** D02693UX3000L Vacuum Pump Connection – CV100 T7 -
n° **2** D02694UX3000L Type DN63/DN100-ϕ43 T8

## 6. TOTAL QUANTITIES(+ spare)

### Vacuum Chamber Assembly

n° **226x2x1.05= 475** D02658UX3000L Type CV43 MOD.1/1

n° **18x2x1.05= 38** D02660UX3000L Type CV43 MOD.1/3

n° **10x2x1.10= 22** D02679UX3000L Type CW80 MOD.4

n° **35x2x1.05= 74** D02008UX3000L Type CW80 MOD.5

n° **135x2x1.05= 284** D02682UX3000L TypeCV100 MOD.6/1

n° **950x2x1.05=1995** D02789UX3000L Type CV100

n° **108x2x1.05= 227** D02790UX3000L Type CVD

n° **185x2x1.10= 407** D02791UX3000L Type CV43

n° **12x2x1.40= 34** D02792UX3000L Type CW80

n° **154x2x1.1= 339** D02799UX3000L Type CV43

### Bellows

n° **276x2x1.05= 580** D02659UX3000L Type MOD.1/2

n° **55x2x1.05= 116** D02680UX3000L Type MOD.4/3

n° **938x2x1.05=1970** D02681UX3000L Type MOD.6

### Vacuum Pump Connections

n° **3x2x1.10= 8** D02661UX3000L Type DN63/DN160-MOD.2

n° **3x2x1.10= 8** D02662UX3000L Type DN63/DN160-MOD.3

n° **70x2x1.05= 147** D02683UX3000L Vacuum Pump Connection - $\phi$43 T1 -

n° **108x2x1.05= 227** D02684UX3000L Vacuum Pump Connection - $\phi$43 T2 -

n° **6x2x1.10= 14** D02685UX3000L Vacuum Pump Connection - $\phi$43 T3 –

n° **18x2x1.10= 40** D02690UX3000L Type DN100/DN200-CW80 T4

n° **36x2x1.10= 80** D02691UX3000L Vacuum Pump Connection – CVW/CW80 T5 -

n° **1x2x1.10= 3** D02692UX3000L Type DN100/DN200- CW80 T6 -

n° **938x2x1.05= 1970** D02693UX3000L Vacuum Pump Connection – CV100 T7 -

n° **9x2x1.10= 20** D02694UX3000L Type DN63/DN100-$\phi$43 T8

n° **17x2x1.10= 38** D02695UX3000L Type DN100/DN200-CW80 T9

n° **12x1.10= 14** D02696UX3000L Type DN63/DN200-$\phi$43/RF$\phi$200 T10

n° **1x2x1.10= 3** D02782UX3000L Traversal Kicker Stripline - $\phi$43 T15 -

n° **24x1x1.10= 28** D02785UX3000L Vacuum Pump Connection – RF$\phi$200 T18-

## 8. DELIVERY TIME and COST

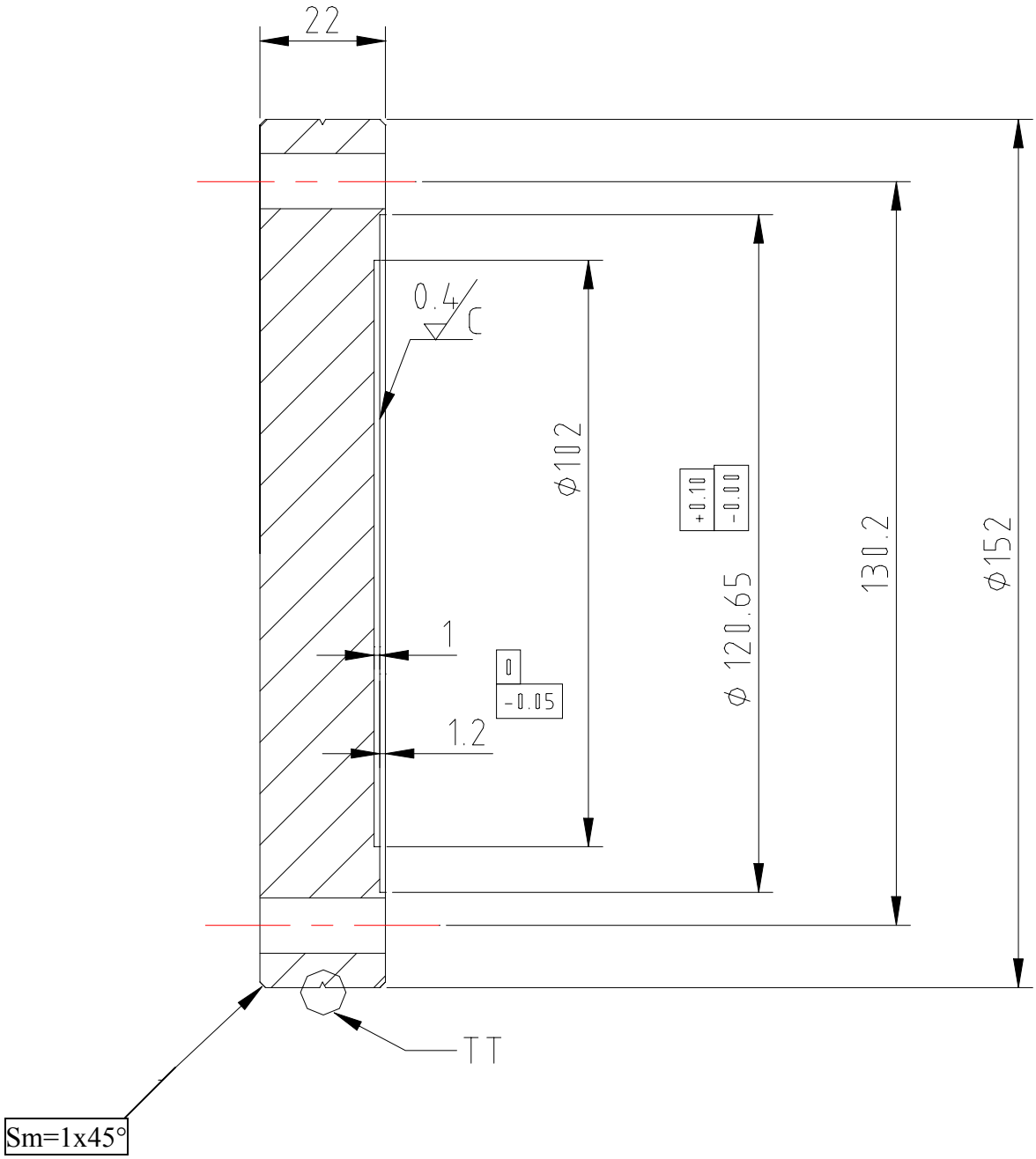
«Time Schedule for the Constructions (Ref. Spec. S02957UX3000L)» encompasses 27 months. Manifacturing of several components is required. Accordingly, we are bound to envisage utilization of seven different Manifacturers, as listed below:

# VACUUM CHAMBER

| CONSTR. NUMBER | PLANNING (months) | | | | | | | | | | | | | | | | | | | | | | | | | | | Quantity | TOTAL COST | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MONTHS | 1 | 2 | 3# | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | TOT. | (Mlire) | (Euro) |
| | COMPONENTS | - | - | - | - | - | - | - | (PIECES X MONTH) - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1 | D03031UX3000L | + | | | 227 | 227 | 227 | | | | | | | | | | | | | | | | | | | | | | 681 | | |
| | D03032UX3000L | + | | 450 | 450 | 450 | 450 | 450 | | | | | | | | | | | | | | | | | | | | | 2.250 | | |
| | D03034UX3000L | + | | | 45 | | | | | | | | | | | | | | | | | | | | | | | | 45 | | |
| | Extrusions | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.976 | 412 | 212.780 |
| 2 | D02939UX3000L | + | | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 975 | | | | | | | | | | | 15.395 | 1.479 | 763.840 |
| 3 | D02939UX3000L | + | | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 1030 | 996 | | | | | | | | | | | 15.416 | 2.783 | 1.437.300 |
| | Flange | | | | | | | | | | | | | | | | | | | | | | | | | | | | 30.811 | 4.262 | 2.201.140 |
| 6 | D02813UX3000L | + | | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8350 | 8346 | | | | | | | | | | | | | | 100.196 | 698 | 360.487 |
| | Gaskets | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100.196 | 698 | 360.487 |
| 2 | D03035÷38UX3000L | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | D03035÷38UX3000L | + | | # | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 82 | | | | | | | | | | | | | 1.182 | 12 | 6.197 |
| | Flange Lavoration for Welding | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.182 | 12 | 6.197 |
| 2 | D02790UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02679UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02008UX3000L | | + | | # | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 112 | | | | | 1.948 | 1.208 | 623.880 |
| | D02792UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02658UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02660UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | D02791UX3000L | | + | | | | | | # | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 112 | 1.948 | 2530 | 1.306.635 |
| | D02789UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02682UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Vacuum Chambers | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3.895 | 3738 | 1.930.515 |
| 5 | D02659UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | D02680UX3000L | | | + | | # | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 146 | | | | | | | | 2.666 | 3.977 | 2.053.949 |
| | D02681UX3000L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Bellows | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.666 | 3.977 | 2.053.949 |
| | D02683÷96UX3000L | | | | | # | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | | | | | | | | 630 | 1.958 | 1.011.223 |
| 6 | D02782 / 85UX3000L | | | + | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | D02693UX3000L | | | + | | # | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 61 | | | | | | | | 985 | 4.494 | 2.320.957 |
| 4 | D02693UX3000L | | | + | | # | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 61 | | | | | | | | 985 | 3.694 | 1.907.792 |
| | Vac. Pump connection/ Flange Joint | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.600 | 10.146 | 5.239.972 |
| 7 | Supply | | + | # | $7x10^5$ | | | | | | | $7x10^5$ | | | | | | | $7x10^5$ | | | | | | | | $6.9x10^5$ | 2.790.000 | 247 | 129.114 |
| | Bolts, nuts and washers | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.790.000 | 247 | 129.114 |
| | Order | (+) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | First Supply | (#) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **GRAND TOTAL** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **23.470** | **12.121.242** |

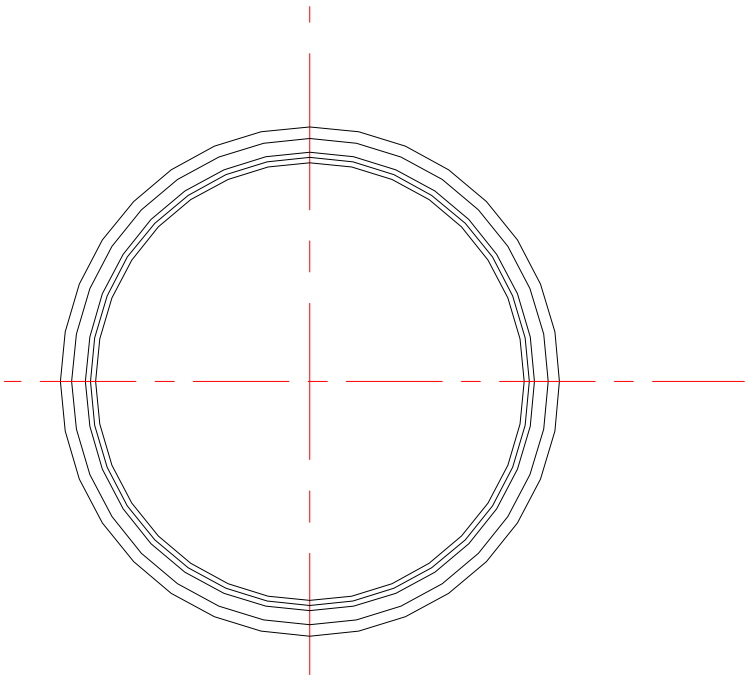
## 9.1. ATTACHMENT 1

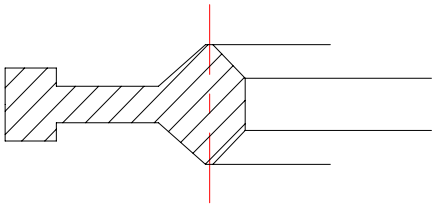
**Flange Draw (Typical CFs100)**



## 9.2. ATTACHMENT 2

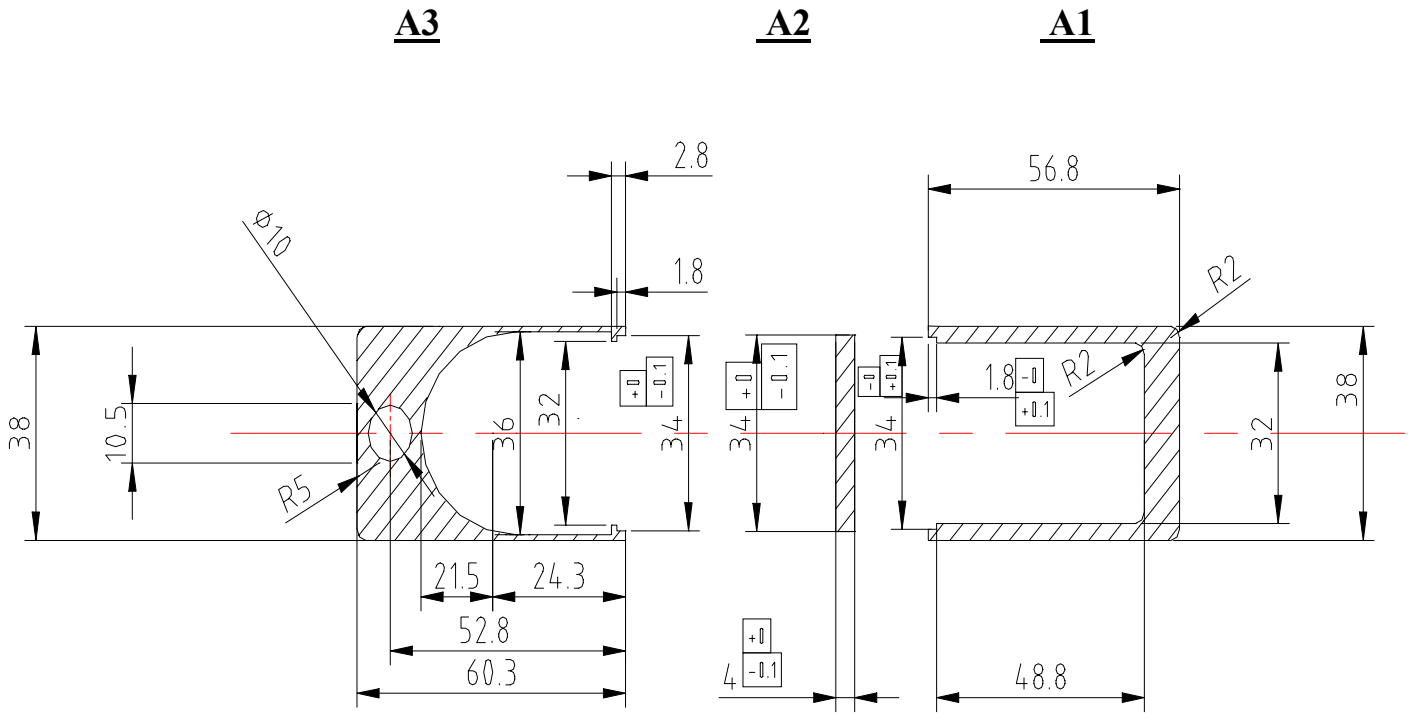
### Diamond Gasket Geometry





## 9.3. ATTACHMENT 3

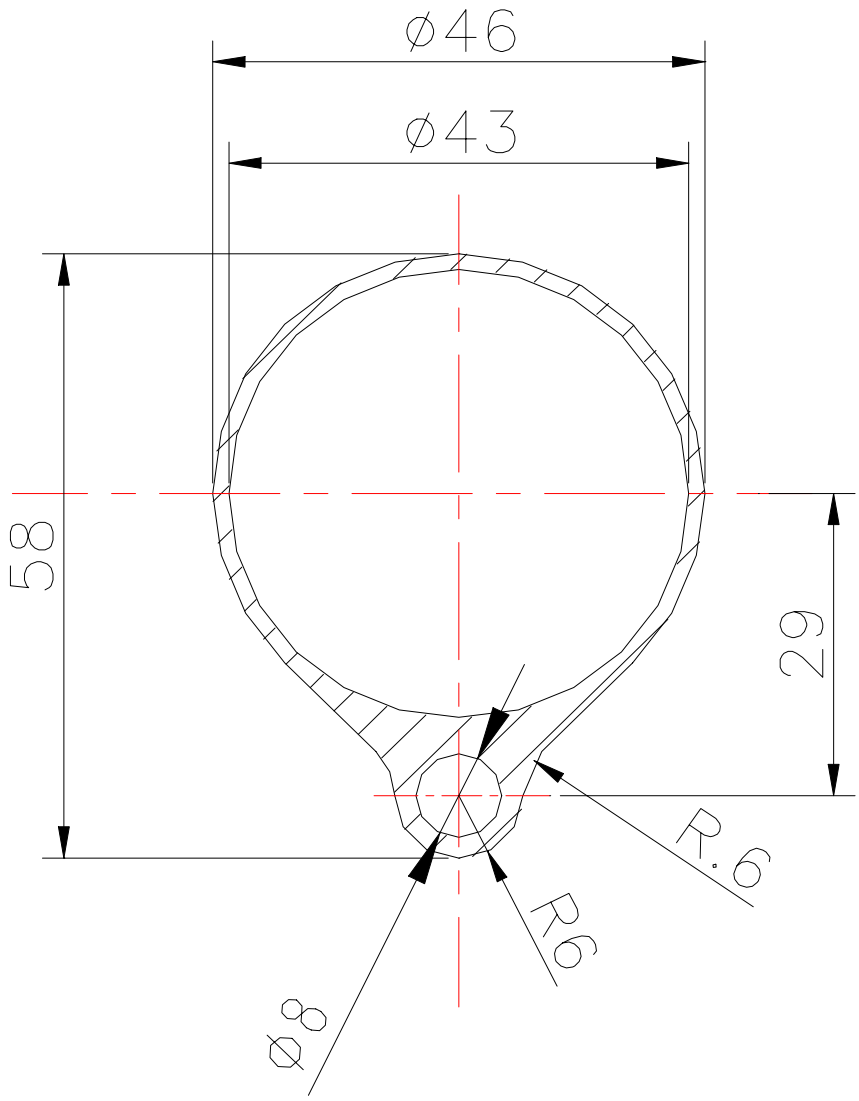
**Extruded Section Type: A1, A2, and A3 (draw D03031UX3000L sheet 2/2)**



## 9.4. ATTACHMENT 4

### Extruded Section Type: B1/B2 e C1

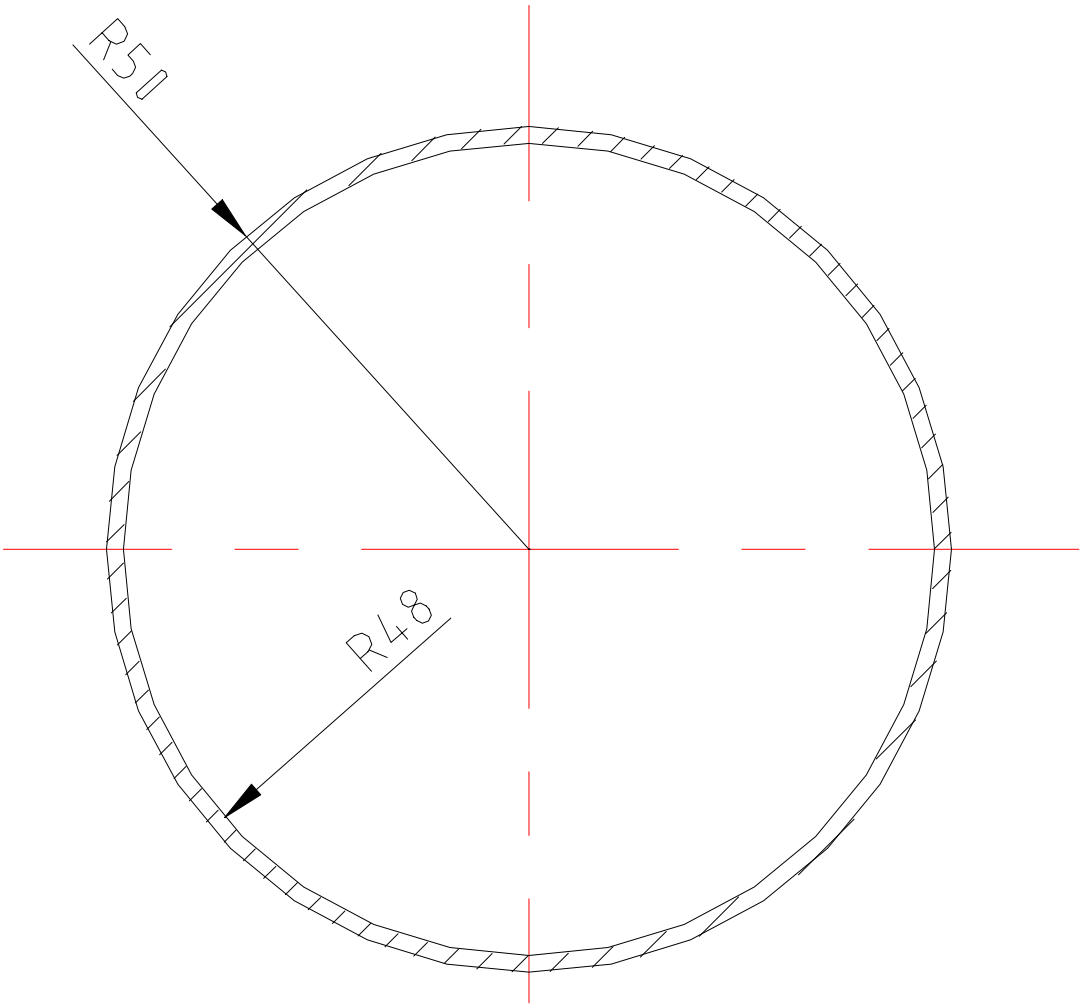
### B1 / B2



## 9.5. ATTACHMENT 5

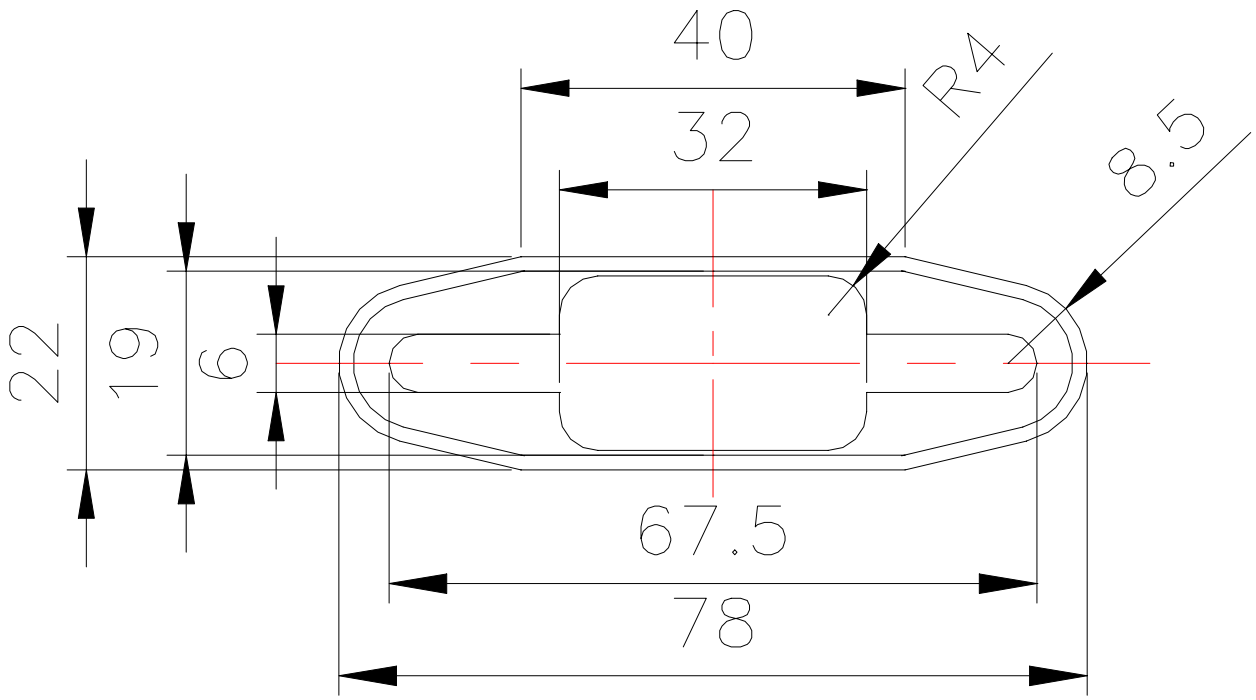
### Extruded Section Type: C1

**C1**



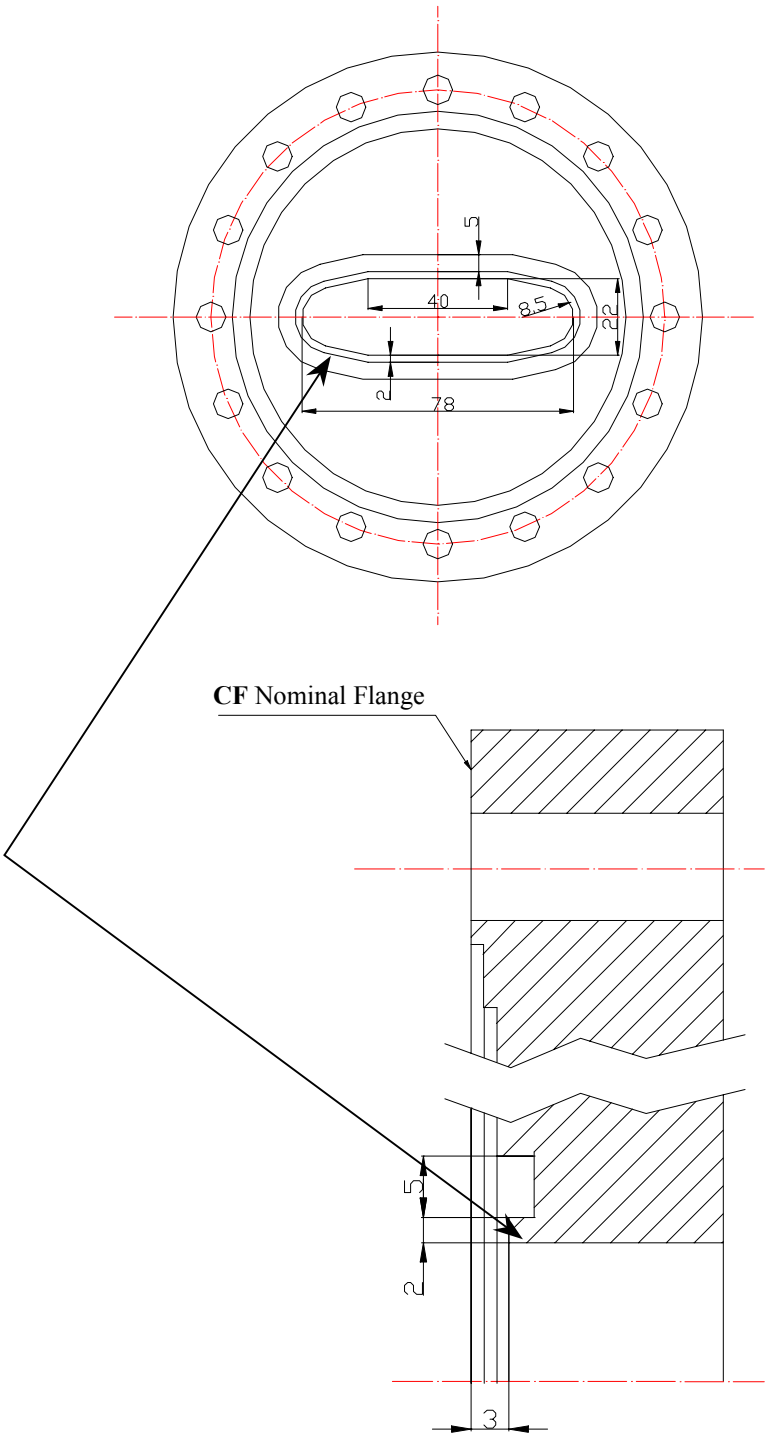
## 9.6. ATTACHMENT 6

**Extruded Section Type: E**



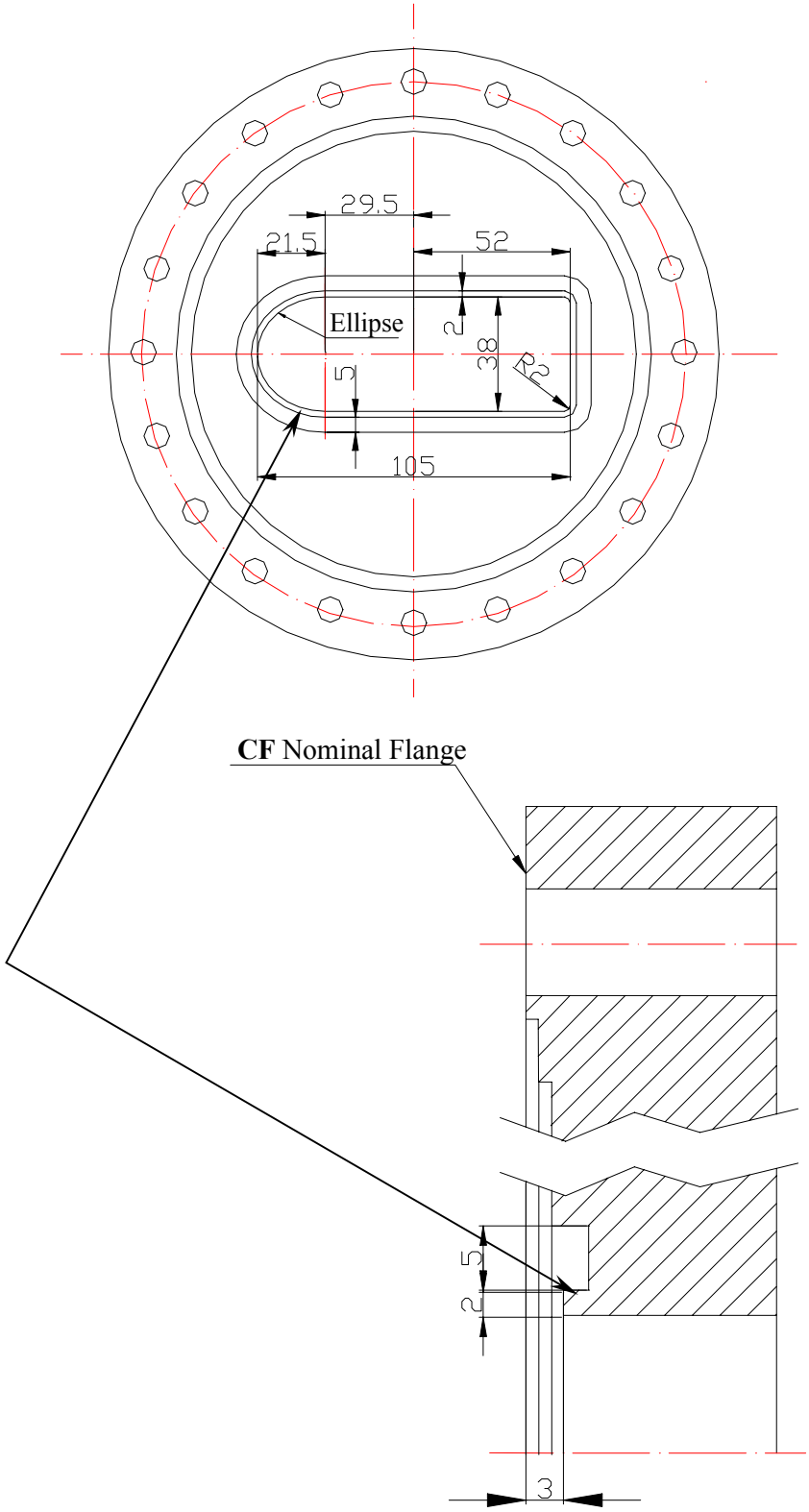
## 9.7. ATTACHMENT 7

### Boring on the Flange for Welding "W 80" Vacuum Chamber



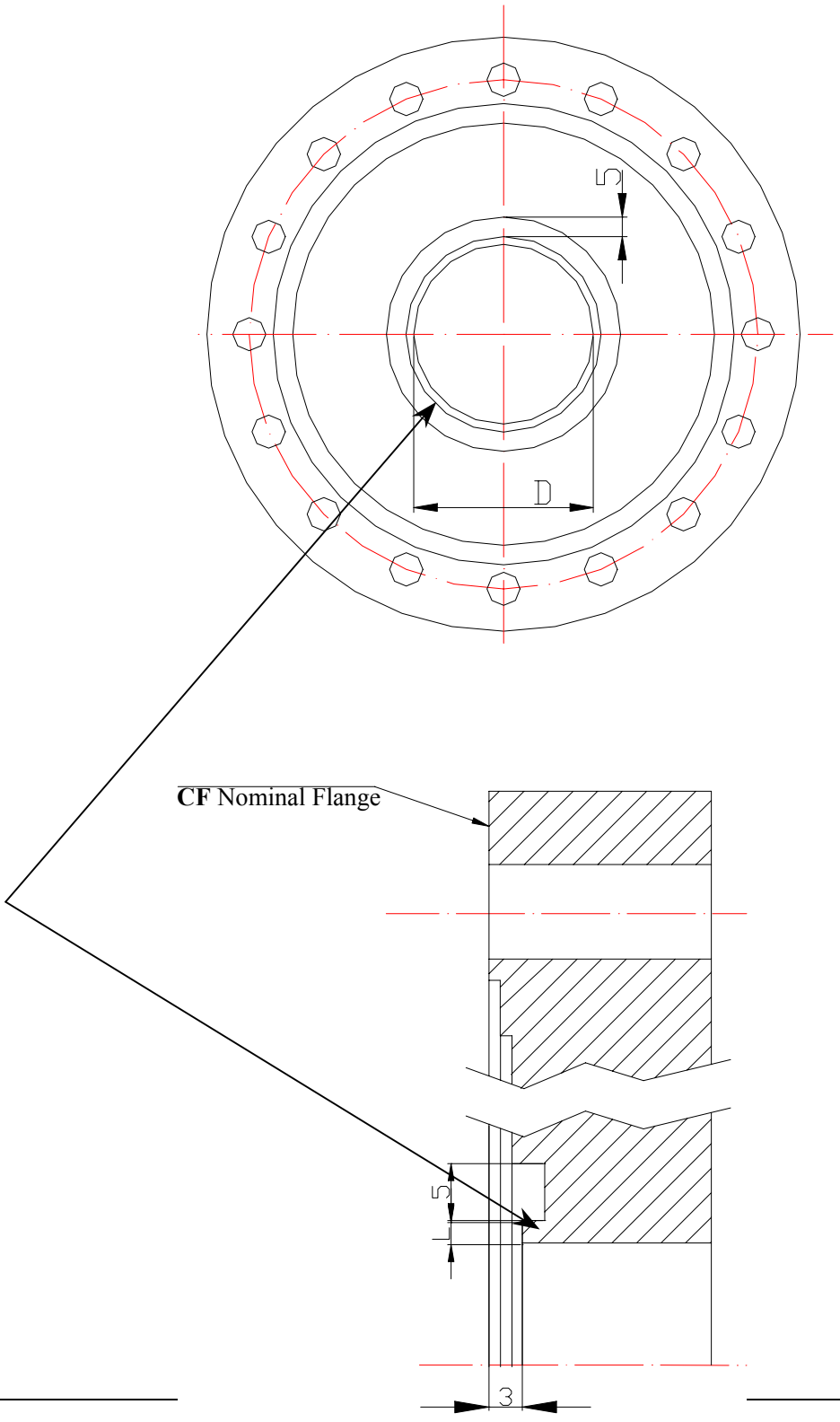
## 9.8. ATTACHMENT 8

**Boring on the Flange for Welding "Dipole" Vacuum Chamber**



## 9.9 ATTACHMENT 9

**Boring on the Flange for Welding "Round" Vacuum Chamber**



## 9.10 ATTACHMENT 10

### METHODOLOGY TO CONSTRUCTION FOR THE VACUUM CHAMBER

The Vacuum Chambers are two very different types:

a) Types: **CVW, CV43, CW80 e CV 100**

The main sequences to construction/assembly can be defined:

1) Supply of the section bar

2) Preparation of the component, in length and on the edges, to weld the flanges

3) Cleaning of the component with washings (see page ¾)

4) Welding of the flanges (using the "Tooling" that it guarantees the orthogonality with axle beam), it's important to stop inside the Vacuum Chamber with clean and not contaminating material, and probably welding cooling tubes.

5) Heat treatment defined "BAKING". (n° 3 times at 120°C, once to day)

6) Held Test before and after the BAKING.

7) Stocking with nitrogen in polyethylene buckets.

b) Model: **CVD**

The main sequences to construction/assembly can be defined:

1) Supply of three types section bar (A1, A2, A3)
2) Cleaning of the component with washings (see page ¾)
3) Location three section bar in Control Tooling type "A "
4) Execution of the two Weld Beads using TIG (or another type), possibly in automatic.
5) Hot/Cold (other) Rolled, like to draw
6) Location in Cut Tooling type "B", that it allows the cut in length to measure. The preparation of the edges to weld and flanges orthogonality with axle beam.
7) Welding of the flanges (using the "Tooling" that it guarantees the orthogonality with axle beam). It's important to stop inside the Vacuum Chamber with clean and not contaminating material, and probably welding cooling tubes.
8) Heat treatment defined "BAKING". (n° 3 times at 120°C, once to day)
9) Held Test before and after the BAKING.
10) Stocking with nitrogen in polyethylene buckets.

## Cleaning Treatment

To obtain the pressure values of $1*10^{-8}$ mbar in the "Arc Zone" and $1*10^{-9}$ mbar in the "Long Straight Sections", all Vacuum Chamber components must be subjects to an accurate and rigorous
"Cleaning Procedure", followed from a heat treatment, before being mounted.
The Cleaning components, it must be carried out to the end of the phases of working and possibly before phases of welding. Once, the Vacuum Chamber is welded, it can't have any washings again.
The washings will have to be carried out using an alkaline detergent in watery solution (ALMEKO-18 to 3% in weight) to the temperature of approximately 50°C, they will have to re-washing using water to the same temperature until the every total removal residual about cutting fluid or others contaminating.
Last washing must be carried out only using tepid distillate water.
Immediately after the phase of washing, all components will have accurately to be dried and every residual of working or dust, removed.
After the phase of washing and drying, all components must be subordinates to the BAKING.
The Vacuum Chamber, eventually pre-assembled will have to be closed with blind flanges.
The same have applied a metal gasket and therefore heated vacuum to T≅120°C for 24 hours.
To the end of the heating, they will have to be filled up to the atmospheric pressure with dry nitrogen from liquid nitrogen.
This procedure (heating and successive filling with nitrogen), it must be repeated three times.
When the sequences described are finished, the several Vacuum Chamber sections will have remain sealed and filled up of dry nitrogen and opened, only immediately before the final assembly.

## Weldings

All weldings seal must be type TIG (or other). The weldings must exclusively seal weldings and not structural. The parts to weld must be perfectly clean; the surfaces created after welding must be reduced lessened and "discharged" to avoid the formation of bags and cavity. All weldings must be executed in cleaned up place, with relative humidity ≤ to 40%, if the weldings come externally executed to the Vacuum Chamber must be previewed an adapted inert gas flow inside of the Vacuum Chamber, because it's important to prevent

oxides make-up not. Once they welded, the Vacuum Chamber can't more being subordinates to ulterior cleaning treatments.

## Seal Test

Every component of the Vacuum Chamber must be subjected at rigorous seal test using the " helium Lear Finder " or the mass spectrometer with adapted pumping system.
In both the cases must be used vacuum systems type "oil free". The seal tests of must be make-up before and after a heating to T=120°C.
They are considered exceeded if the leak value is ≤ to $1*10^{-10}$ mbar*l*$s^{-1}$ (of helium).

## Mounting Procedure

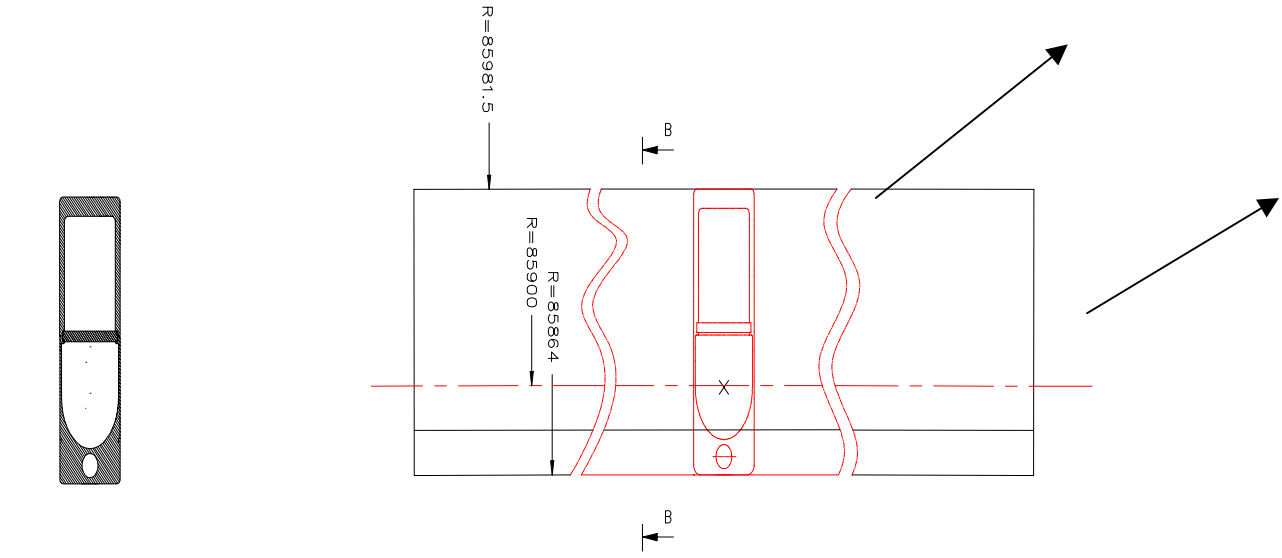
Particular attention will have to be lend during all of TDR Vacuum Chamber mountings. Absolute importance that all the operations are carried out in the best possible cleaning conditions.
Particular attention to avoid every type of contamination inside Vacuum Chamber surfaces. During all mounting phases, when the Vacuum Chamber is open, an adequate dry nitrogen flow must be assured in order to avoid every possible contamination with air the internal Vacuum Chamber surfaces.

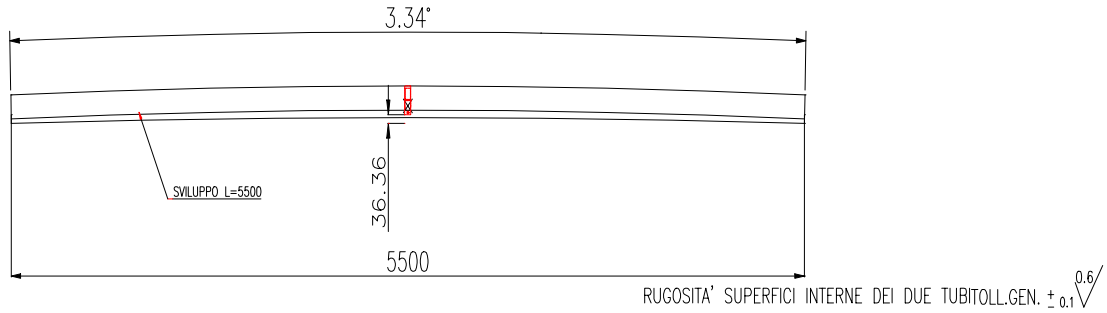
## End Seal Test

After last Vacuum Chamber mounting, with all its components, it must be carried out the End Seal Test.
It will come considered exceeded if the leak values is ≤ to $1*10^{-10}$ mbar*l*$s^{-1}$ (of helium)

## 9.11 ATTACHMENT 11

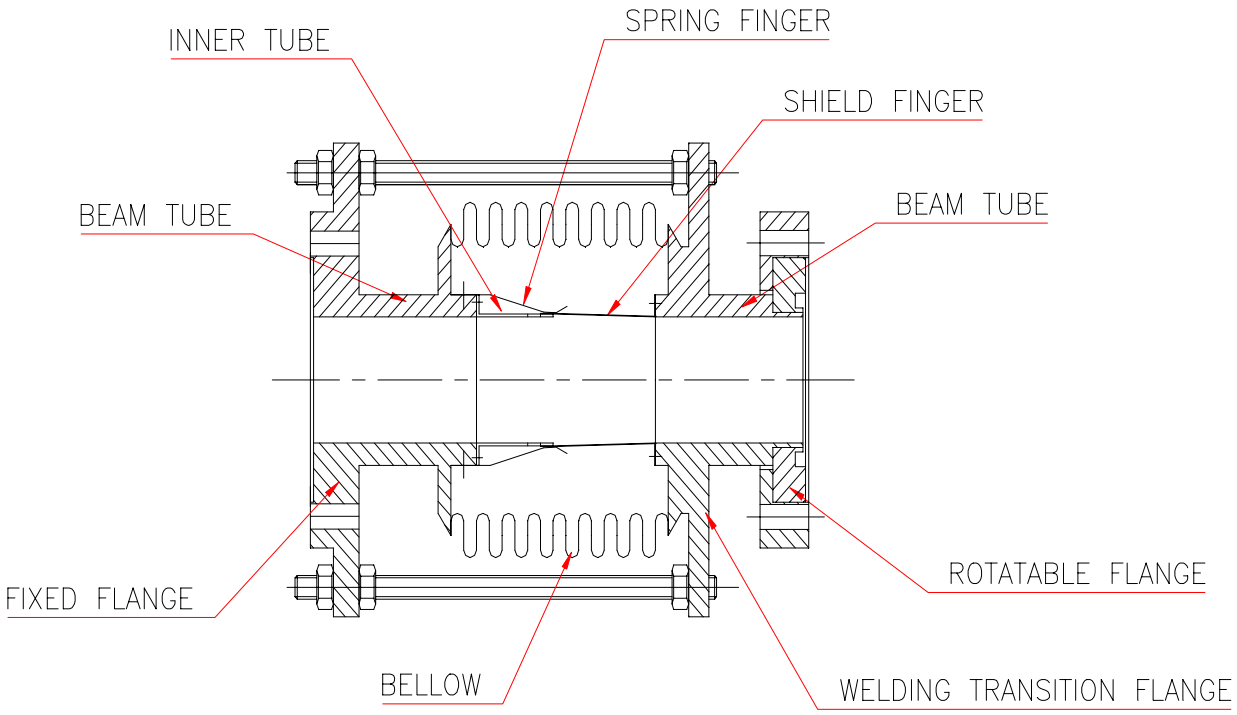
### Vacuum Chamber Type: CVD (Draw D03031UX3000L sheet 1/2)



## 9.12. ATTACHMENT 12

**Draw of a Bellow with all mechanical details**



## 9.13. ATTACHMENT 13

### Editing List (Activity) to carry out (I.N.F.N) to the 06/12/2000

| Progressive Number | | | | | Main Item | Requested Job | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | | Des. | Mag/Therm Mechan/Ver. |
| 1 | | | | | TESLA 5 GeV Damping Rings | | |
| 1 | 1 | | | | Damping Ring Lattice | Not | |
| 1 | 2 | | | | General Lay-out | Yes | |
| 1 | 2 | 1 | | | D.R. Arc Tunnel Lay-out | Yes | Not |
| 1 | 2 | 2 | | | D.R. 8 km Conn. Tunnel Lay-out | Yes | Not |
| 1 | 3 | | | | Injection/Extraction Sections | Yes | Yes |
| 1 | 4 | | | | Damping Rings | | |
| 1 | 4 | 1 | | | Magnetic Components | | |
| 1 | 4 | 1 | 1 | | Bending Dipoles | Yes | Yes |
| 1 | 4 | 1 | 2 | | Quadrupoles | Yes | Yes |
| 1 | 4 | 1 | 3 | | Sextupoles | Yes | Yes |
| 1 | 4 | 1 | 4 | | Magnetic Measurements | Not | Not |
| 1 | 4 | 1 | 5 | | Magnet Assembly | Yes | Yes |
| 1 | 4 | 1 | 6 | | H/V Correctors | Yes | Yes |
| 1 | 4 | 1 | 7 | | Dipole Stands and Supports | Yes | Yes |
| 1 | 4 | 1 | 8 | | Multipole Girders/Supports | Yes | Yes |
| 1 | 4 | 1 | 9 | | Special Magnets (Electromagnetic Wigglers) | Yes | Yes |
| 1 | 4 | 2 | | | Power Supply System | Not | Yes |
| 1 | 4 | 2 | 1 | | Mains Connections | Not | Not |
| 1 | 4 | 2 | 2 | | Med/Low Voltage Breaker | Not | Not |
| 1 | 4 | 2 | 3 | | Med/Low Voltage Cables and Trays | Not | Yes |
| 1 | 4 | 2 | 4 | | Electromagnetic Wiggler Power Supplies | Not | Yes |
| 1 | 4 | 3 | | | RF System | | |
| 1 | 4 | 3 | 1 | | RF Cryo-modules | Not | Not |
| 1 | 4 | 3 | 2 | | RF Power Surces | Not | Not |
| 1 | 4 | 3 | 3 | | Waveguide network system | Not | Not |
| 1 | 4 | 3 | 4 | | Cryogenic System | Not | Not |
| 1 | 4 | 3 | 5 | | Cooling System | Not | Not |
| 1 | 4 | 3 | 6 | | Others (electronics, controls, interlocks, etc.) | Not | Not |
| 1 | 4 | 4 | | | Vacuum System | | |
| 1 | 4 | 4 | 1 | | D. R. Vacuum Chamber | Yes | Yes |
| 1 | 4 | 4 | 2 | | Conn. Tunnel Vacuum Chamber | Not | Not |
| 1 | 4 | 4 | 3 | | Vacuum Chamber Supports | Yes | Yes |
| 1 | 4 | 4 | 4 | | Pumps and Power Supplies | Not | Yes |
| 1 | 4 | 4 | 5 | | Vacuum Diagnostics | Not | Yes |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 4 | 6 | | Manual and Automatic Valves | Not | Yes |
| 1 | 4 | 4 | 7 | | Control Units | Not | Yes |
| 1 | 4 | 4 | 8 | | Special Magnets Vacuum Chamber (Wigglers) | Yes | Yes |
| 1 | 4 | 5 | | | Beam Diagnostics | | |
| 1 | 4 | 5 | 1 | | Fluorescent Screens | Not | Yes |
| 1 | 4 | 5 | 2 | | Toroidal Current Transformers | Not | Yes |
| 1 | 4 | 5 | 3 | | Wall Current Monitors | Not | Yes |
| 1 | 4 | 5 | 4 | | DC Current Transformers | Not | Yes |
| 1 | 4 | 5 | 5 | | BPM Button/Strip Line Monitors | Not | Yes |
| 1 | 4 | 5 | 6 | | Beam Diagnostics Electronics | Not | Not |
| 1 | 4 | 5 | 7 | | Emittance Measurement System | Not | Not |
| 1 | 5 | | | | Computer Control System | | |
| 1 | 5 | 1 | | | Computer Control System Hardware | Not | Not |
| 1 | 5 | 2 | | | Computer Control System Software | Not | Not |
| 1 | 6 | | | | Electrical Services | | |
| 1 | 6 | 1 | | | Standard Line Voltage Sources | Not | Not |
| 1 | 6 | 2 | | | Main Power Distribution Boards | Not | Not |
| 1 | 6 | 3 | | | Medium/Low Voltage Transformers | Not | Not |
| 1 | 6 | 4 | | | Medium Voltage Breakers | Not | Not |
| 1 | 6 | 5 | | | Cables and Trays | Not | Not |
| 1 | 6 | 6 | | | Lightning System | Not | Not |
| 1 | 6 | 7 | | | Emergency Lightning System | Not | Not |
| 1 | 7 | | | | Process Water Facilities | | |
| 1 | 7 | 1 | | | Cooling Towers and Anc. Equip. | Not | Not |
| 1 | 7 | 2 | | | Pumps, Motors and Anc. Eqiuip. | Not | Not |
| 1 | 7 | 3 | | | Heat Exchangers | Not | Not |
| 1 | 7 | 4 | | | Piping | Not | Not |
| 1 | 7 | 5 | | | Filters | Not | Not |
| 1 | 7 | 6 | | | De-ionization Units | Not | Not |
| 1 | 7 | 7 | | | Tanks | Not | Not |
| 1 | 8 | | | | Cooling and Ventilation System (only for Arcs) | Not | Not |
| 1 | 9 | | | | Compressed Air Facilities (only for Arcs) | Not | Not |
| 1 | 10 | | | | Handling Equipments and Cranes (only for Arcs) | Not | Not |
| 1 | 11 | | | | Tunnel Transport System (only for Arcs) | Not | Not |
| 1 | 12 | | | | Alignment Facilities (only for Arcs) | Not | Not |
| 1 | 13 | | | | Installation Time Schedule and Manpower | Not | Not |
| 1 | 14 | | | | Fire Detection System (only for Arcs) | Not | Not |
| 1 | 15 | | | | Smoke extraction system (only for Arcs) | Not | Not |
| 1 | 16 | | | | Tunnel TV Monitoring (only for Arcs) | Not | Not |
| 1 | 17 | | | | Tests and Acceptance Tests | Not | Not |
| 1 | 18 | | | | Commissioning (with no beam) | Not | Not |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 19 | | | | Engineering and Q.A. | Not | Not |