

OUTLINE:

Introduction ESRF

Injection and Chambers at ESRF

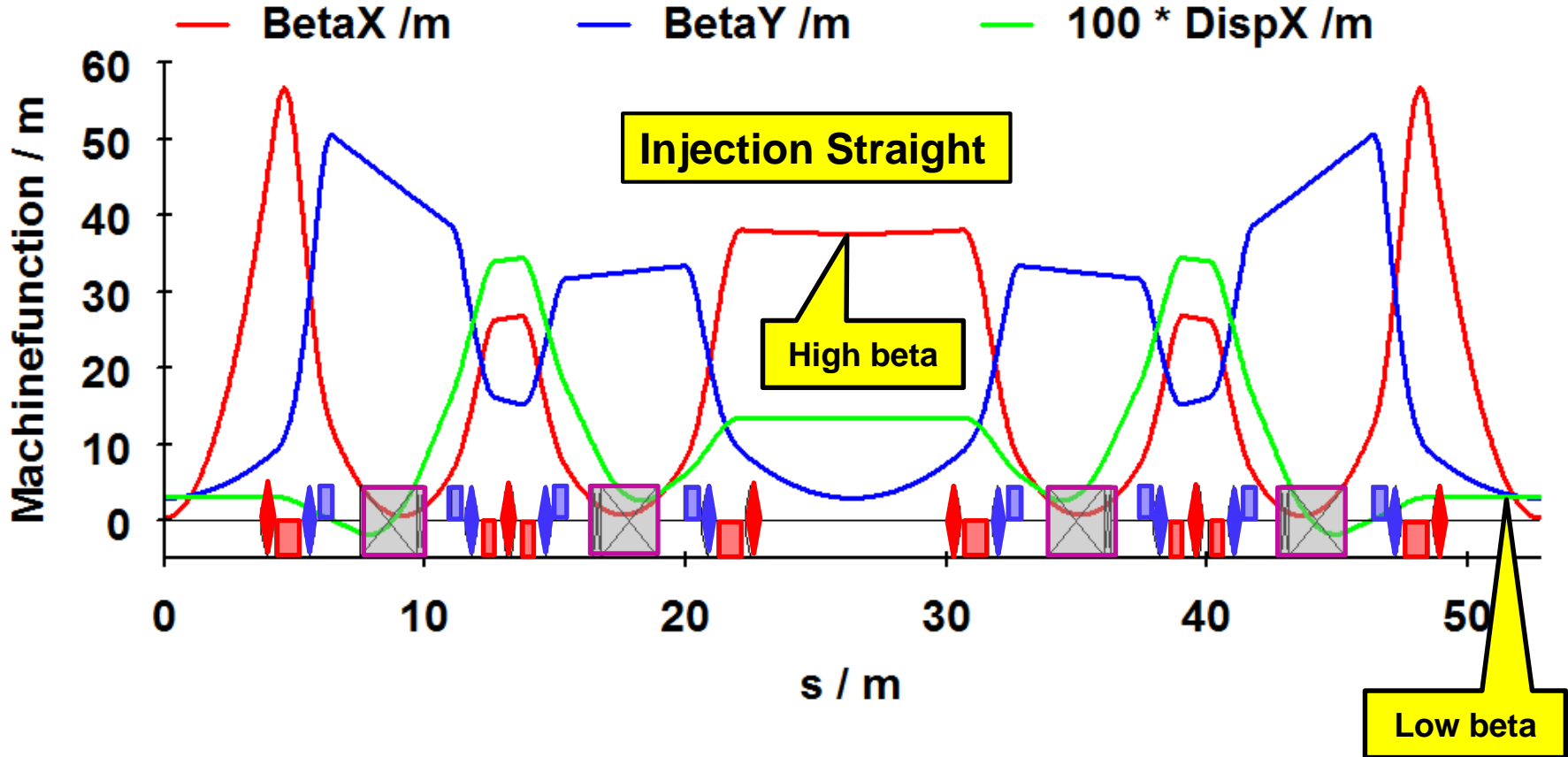
Injection at ESRF-EBS

Ceramic Chambers at ESRF-EBS

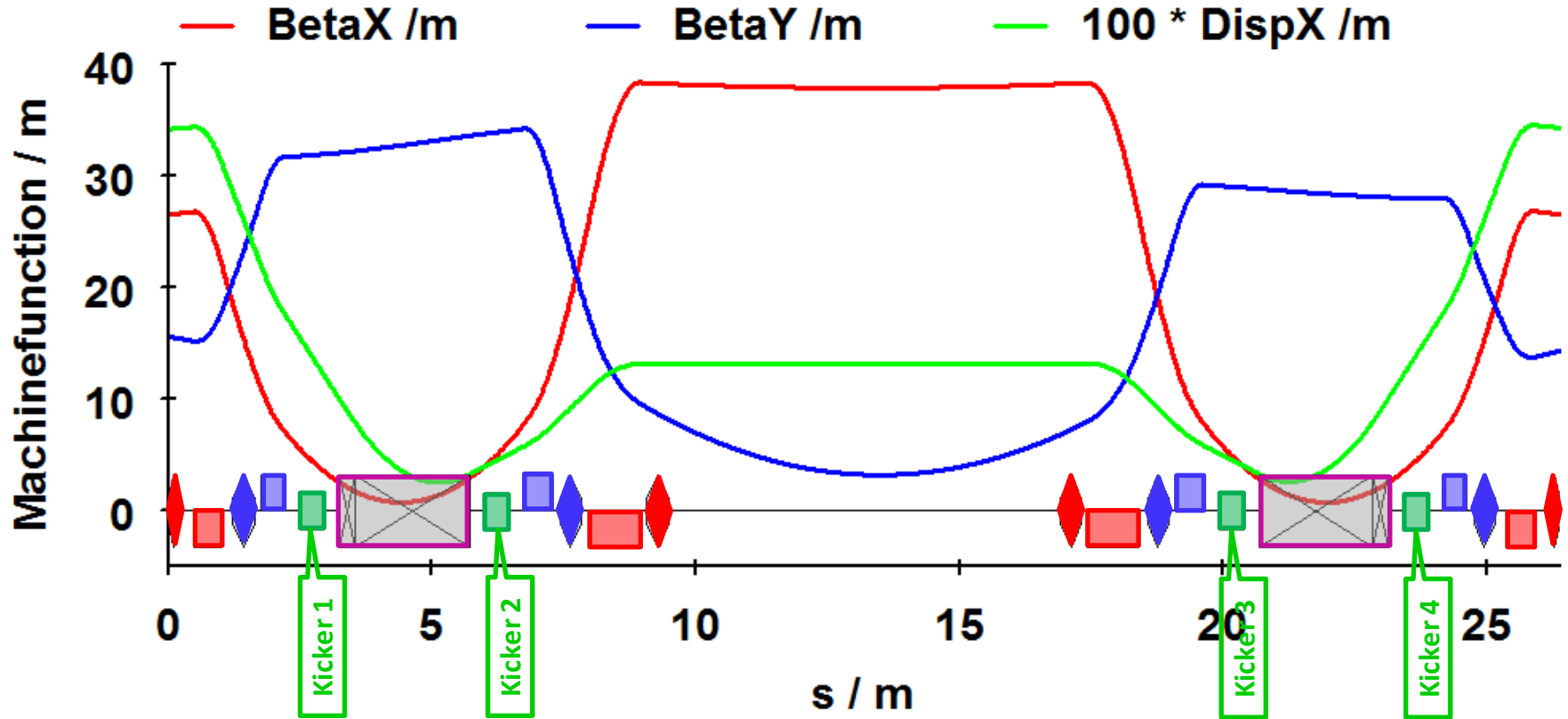
Time schedule

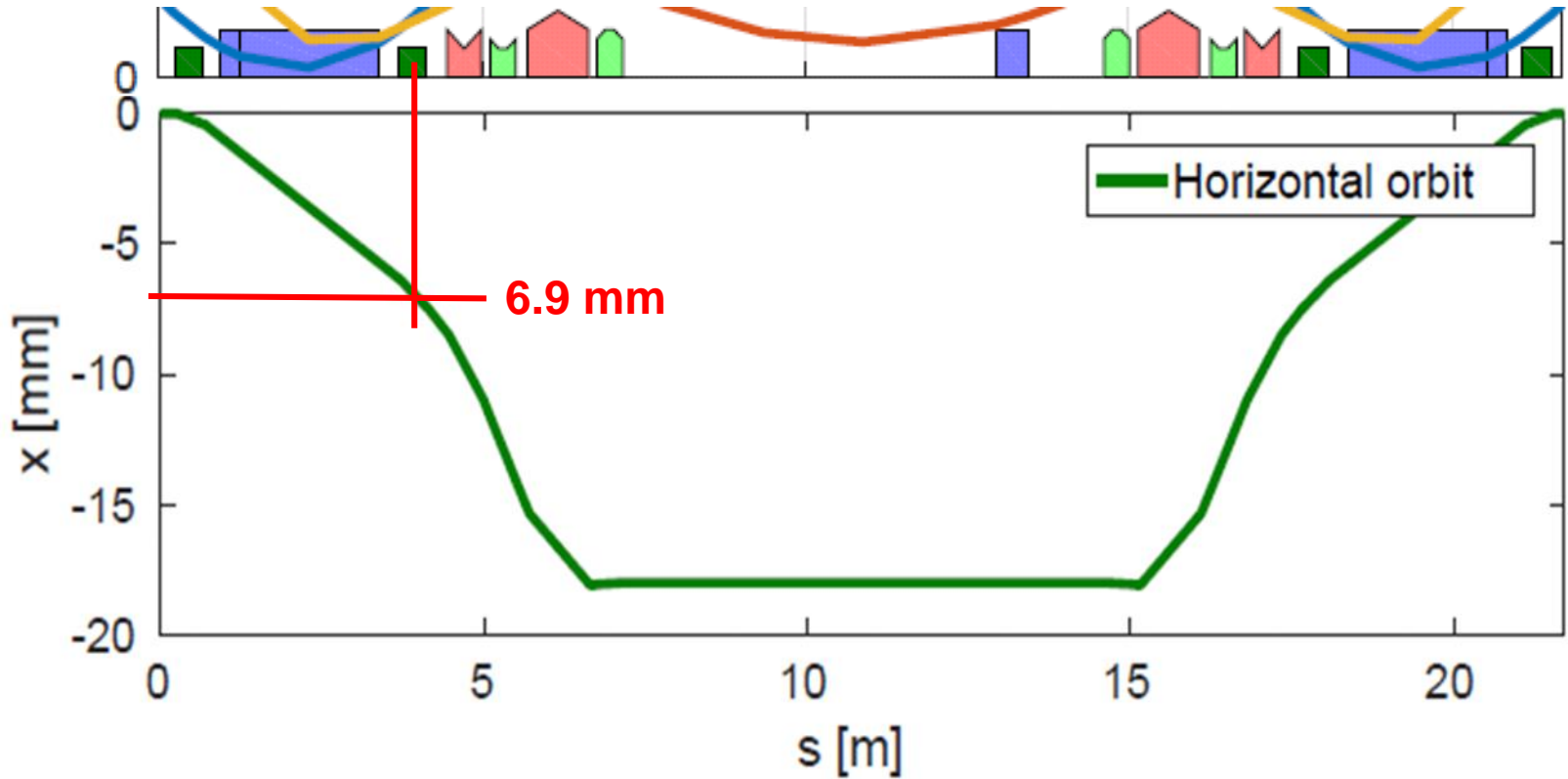
Conclusions

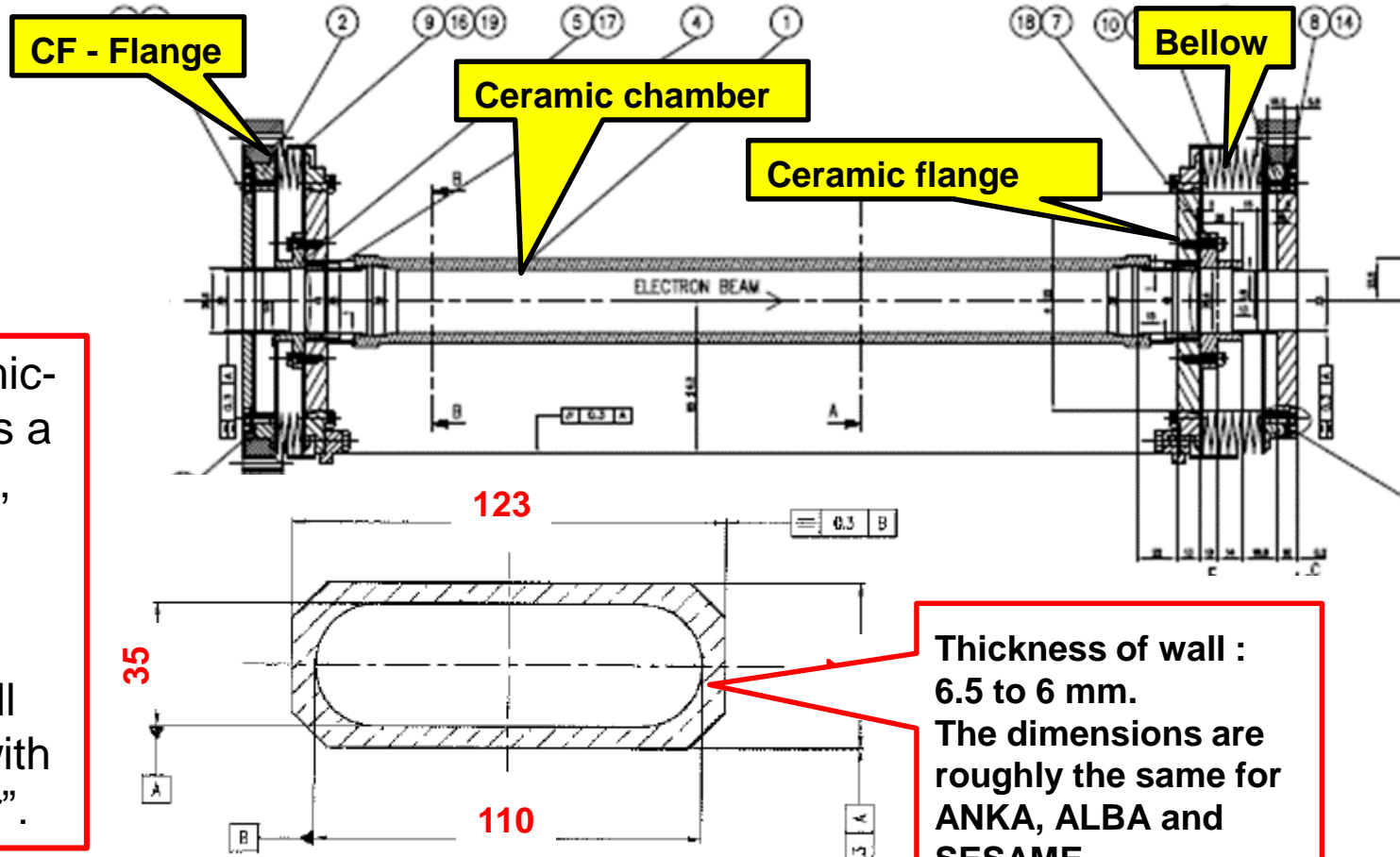
ESRF-Old: $E=6$ GeV, $\varepsilon = 4400$ pmrad, $C = 844$ m, $N = 32$ periods



Injection straight with the location of the 4 kickers



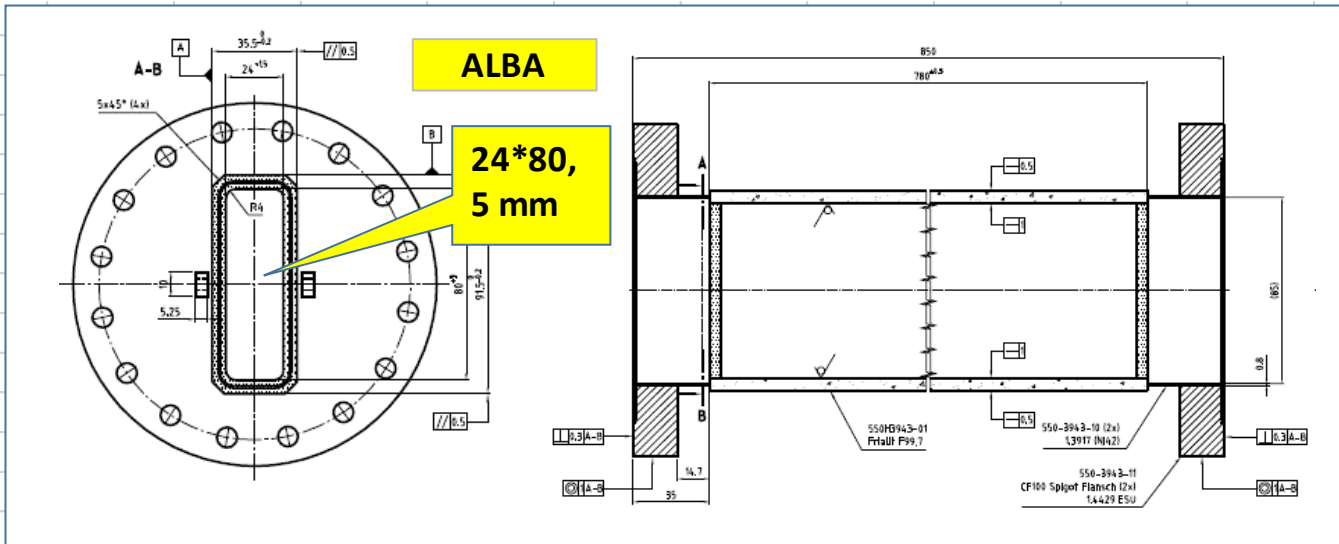
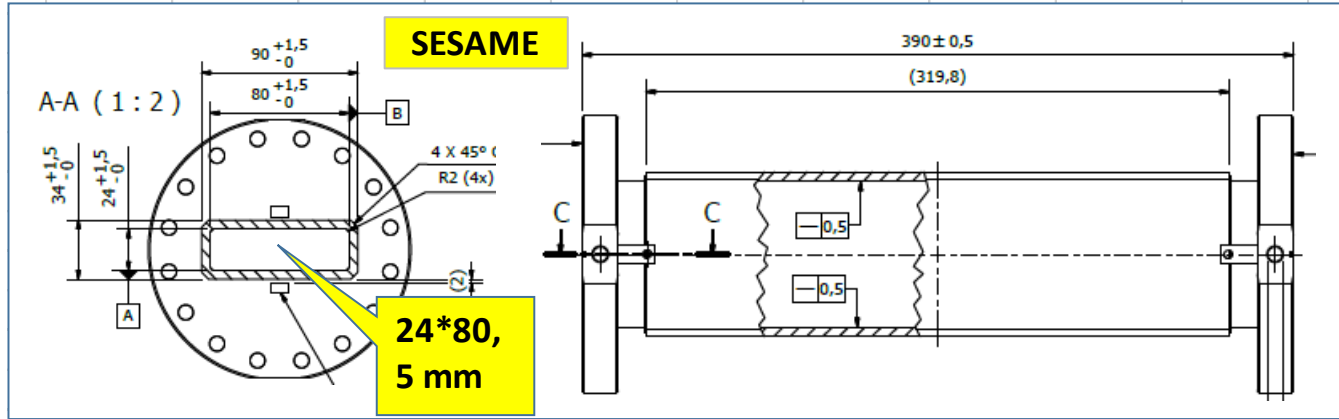


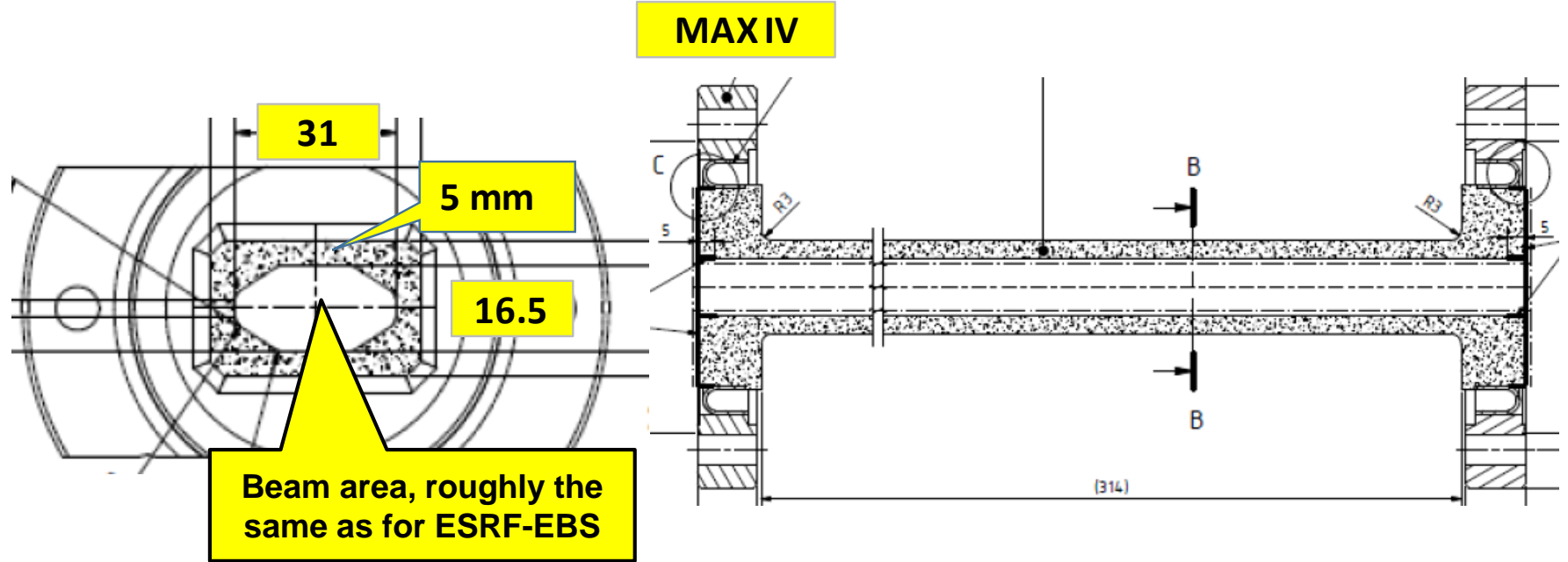


The Ceramic-Chamber is a unit device, like a tube.

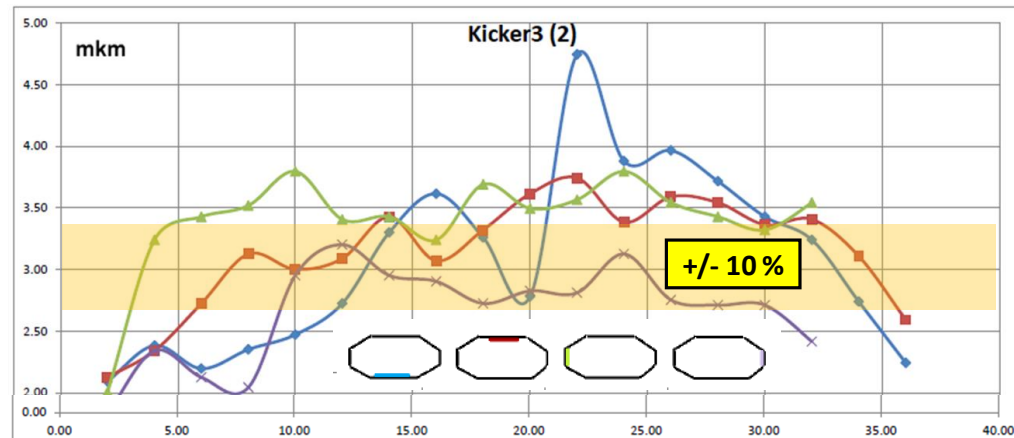
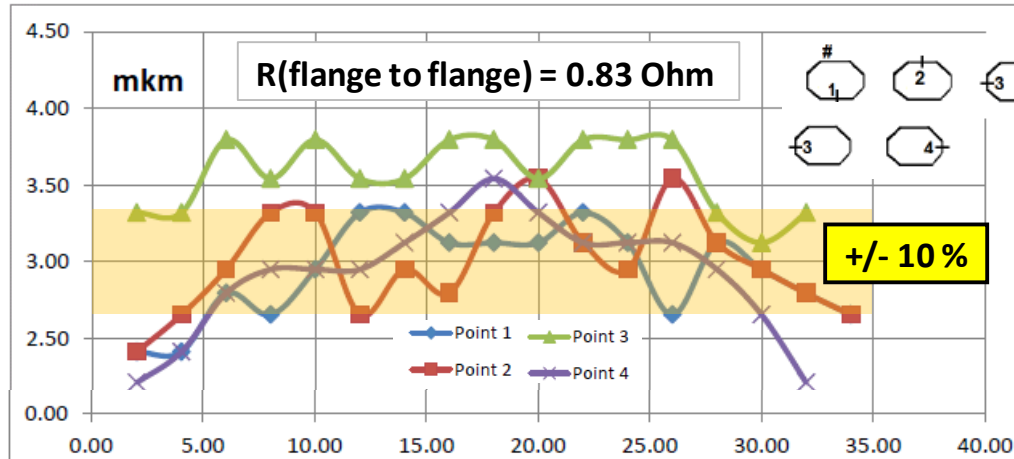
The beam channel will be made with a “core bar”.

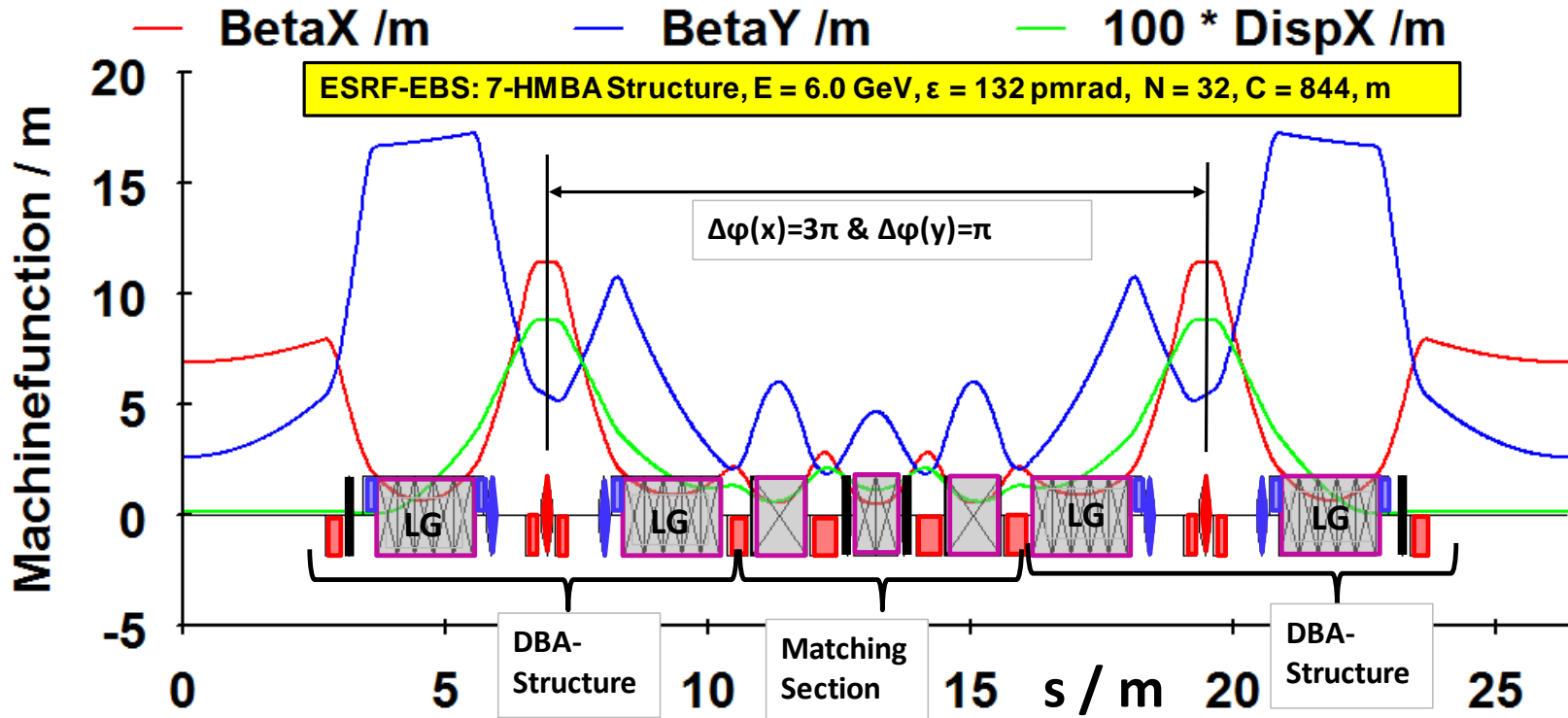
Thickness of wall : 6.5 to 6 mm.
The dimensions are roughly the same for ANKA, ALBA and SESAME



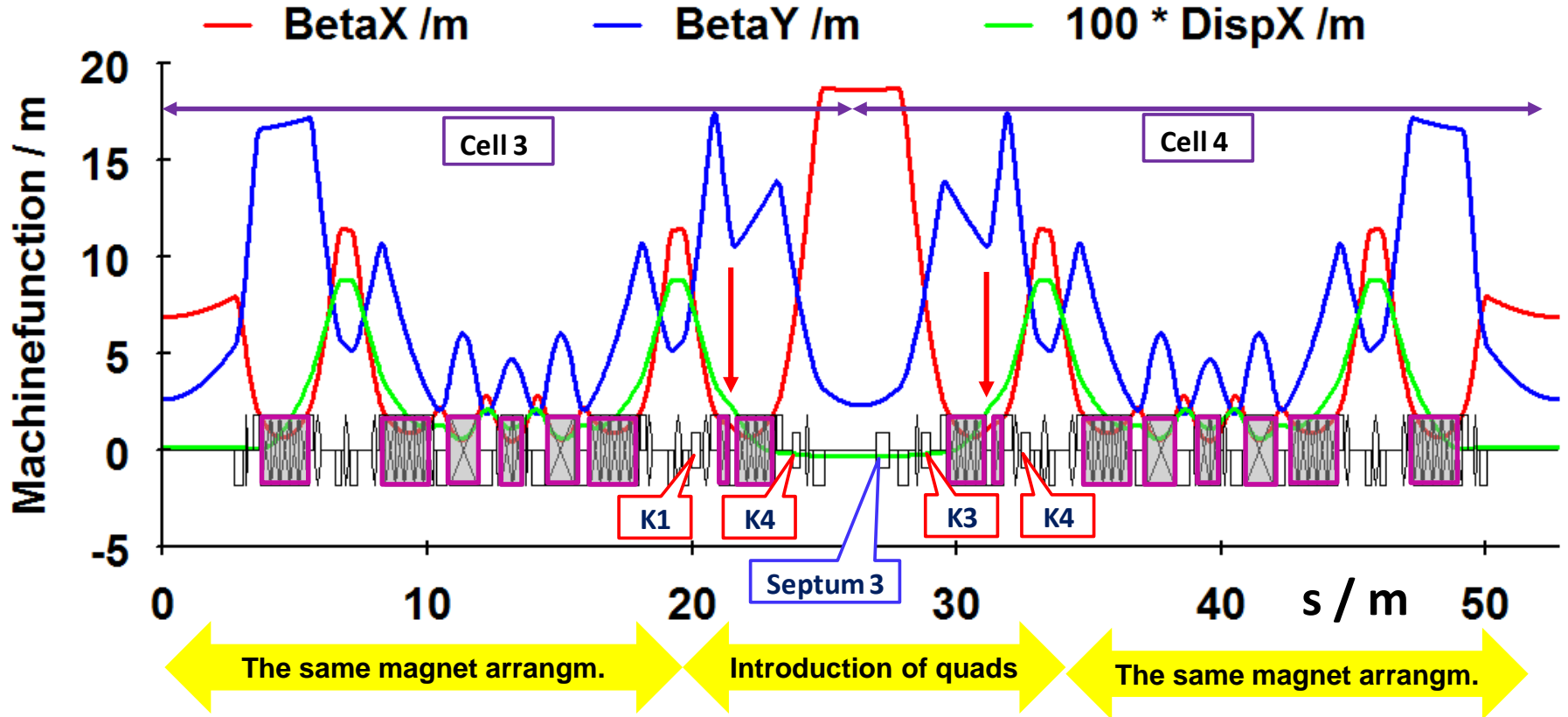


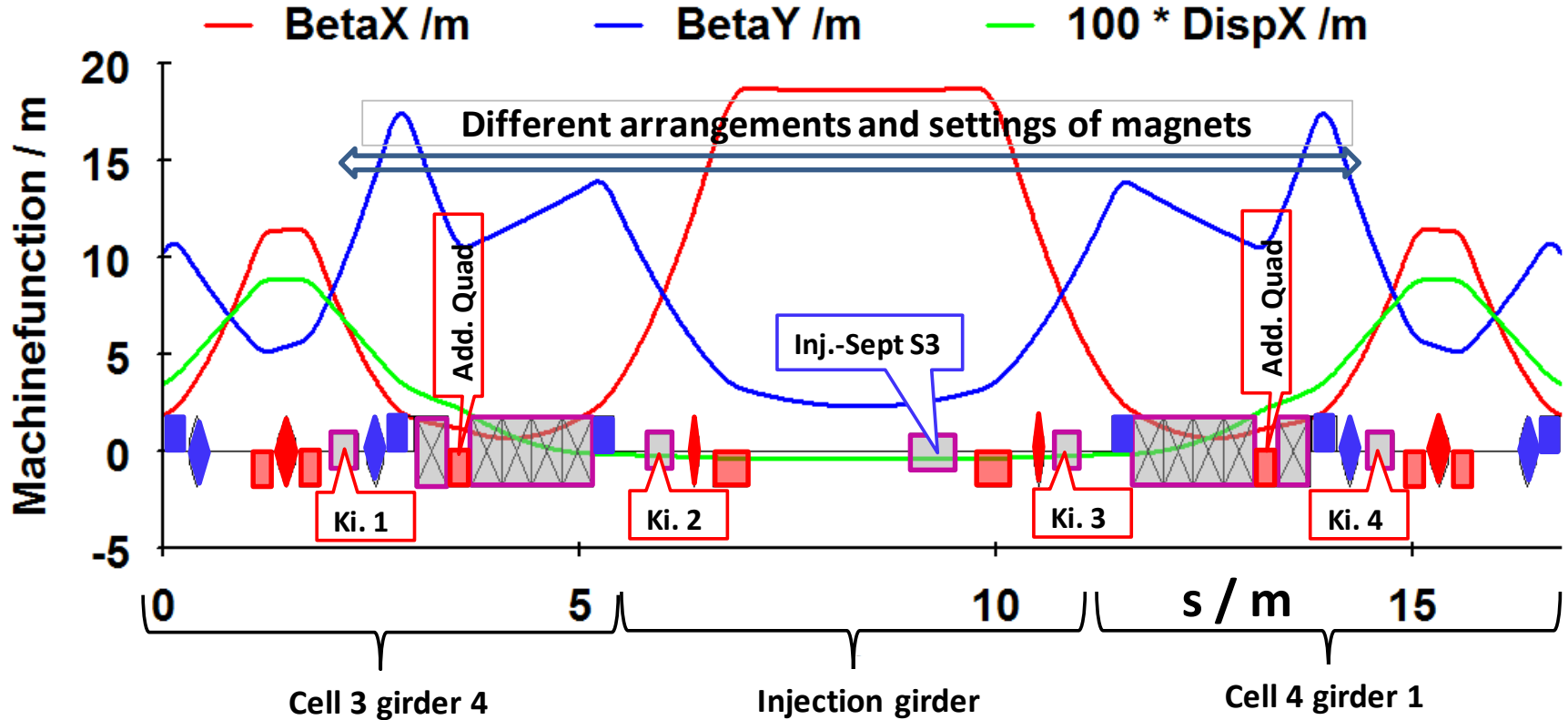
With all these chambers there were no manufacturing problems, because of using the “core bar” for the production of the beam channel.

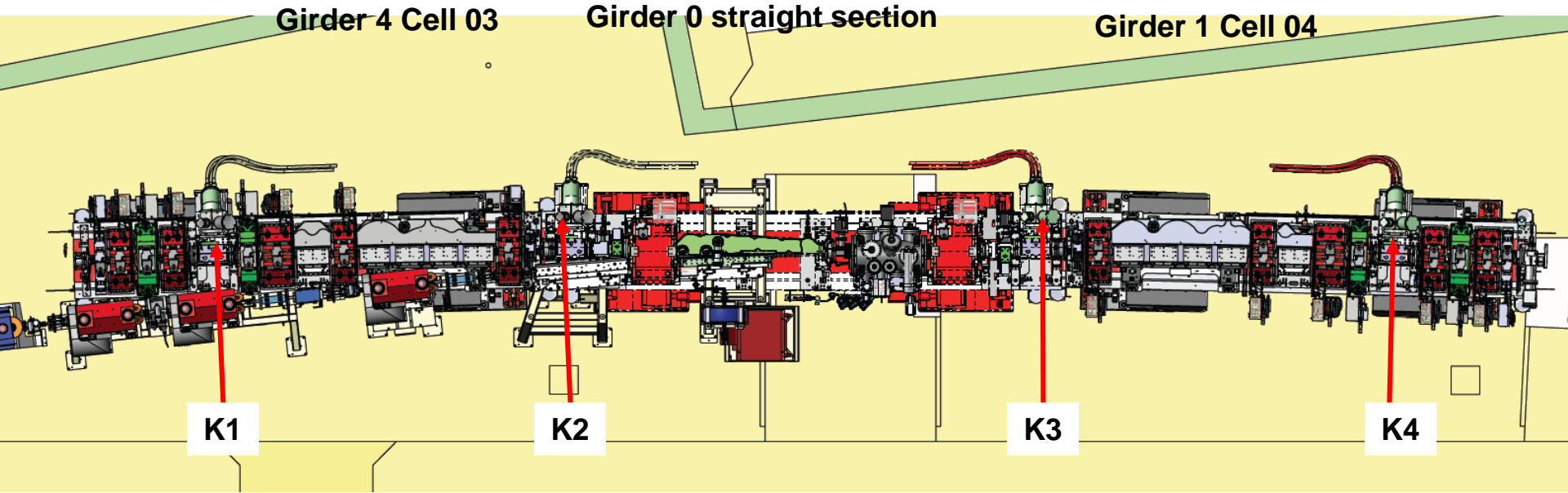


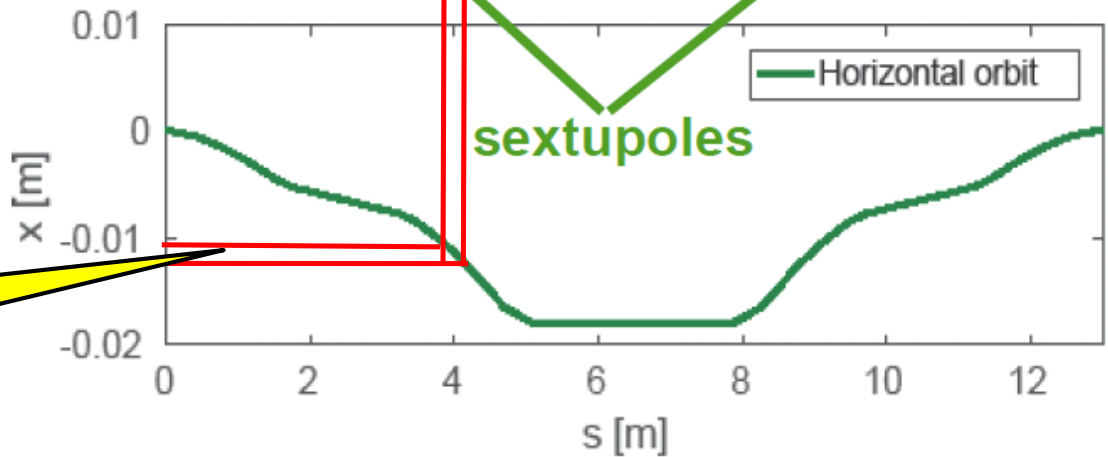
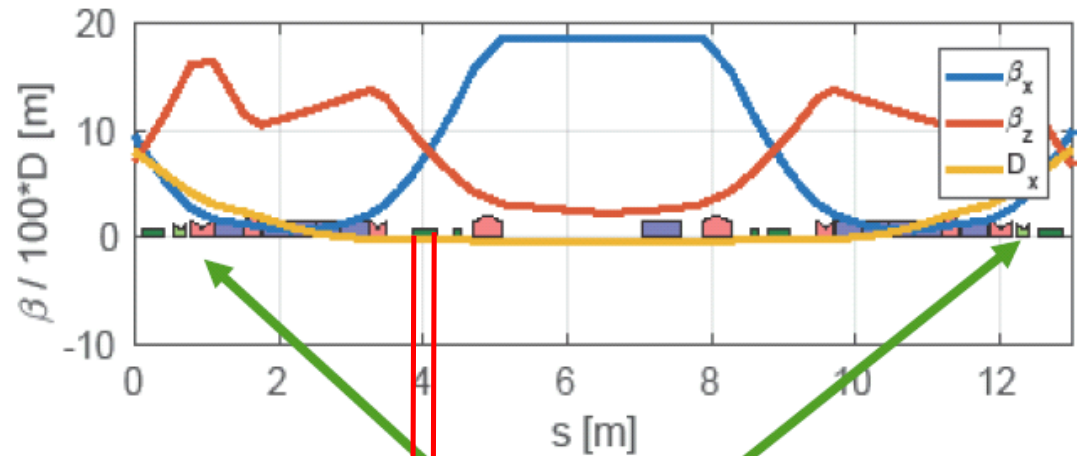


The ESRF made the decision to use also for the injection of ESRF-EBS the 4 kicker solution. For this the horizontal beta functions are too small and another arrangement of the magnets in the injection cells have to be used in order to increase the horizontal beta functions.

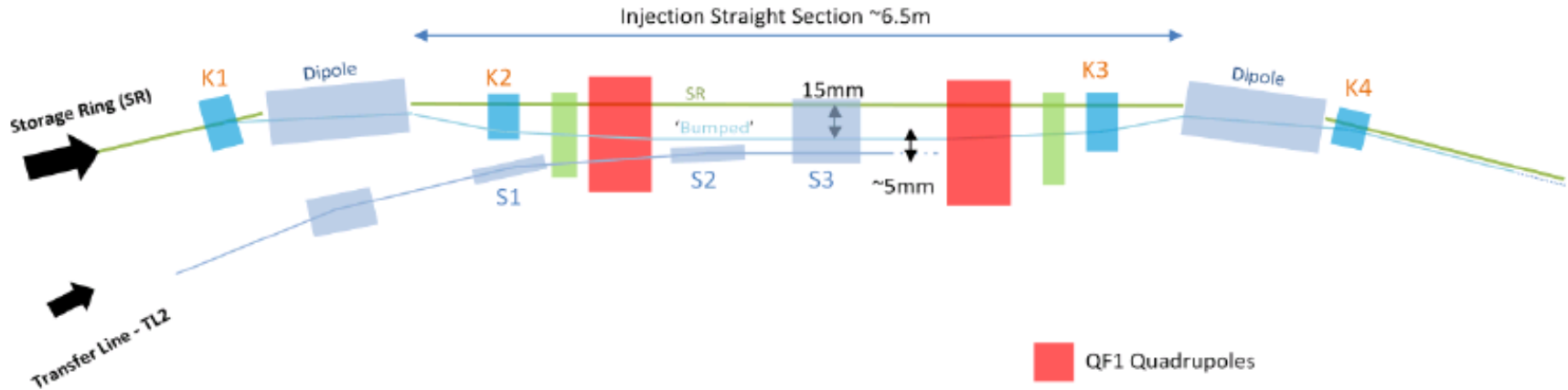


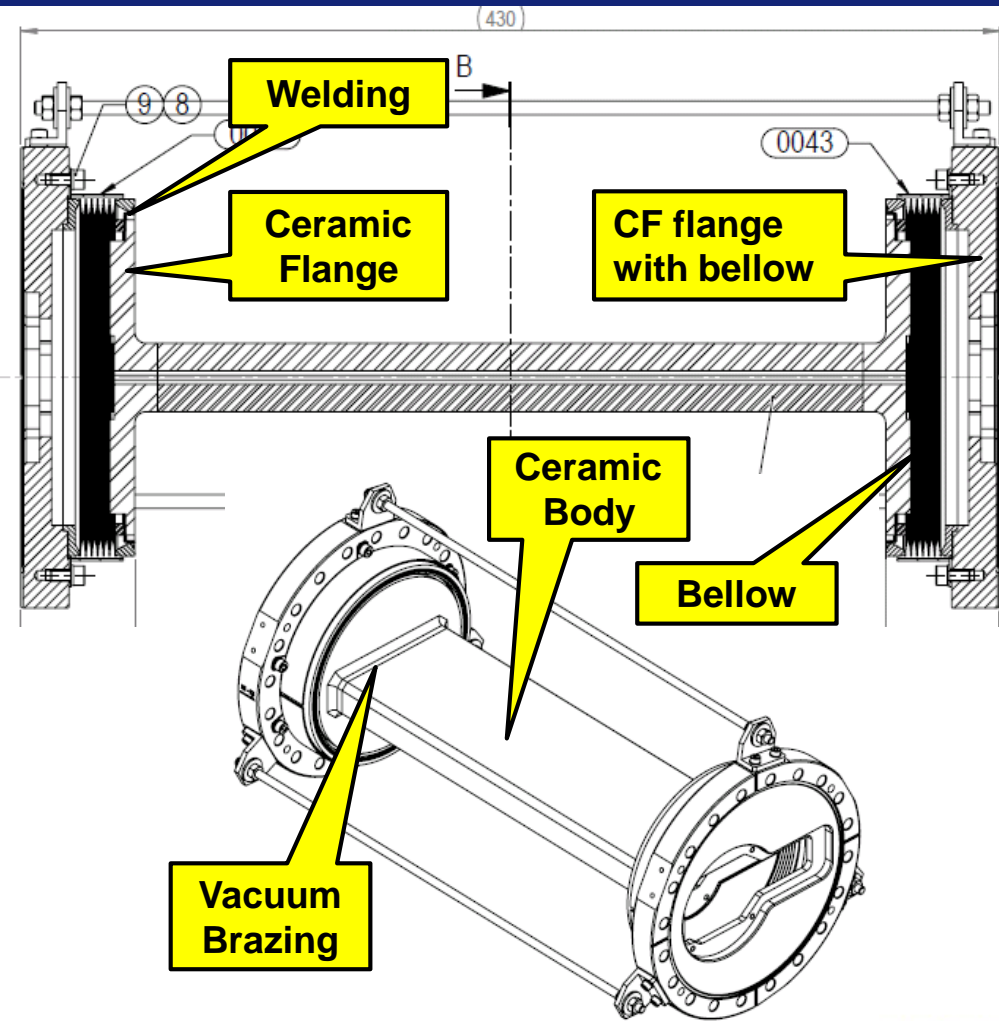
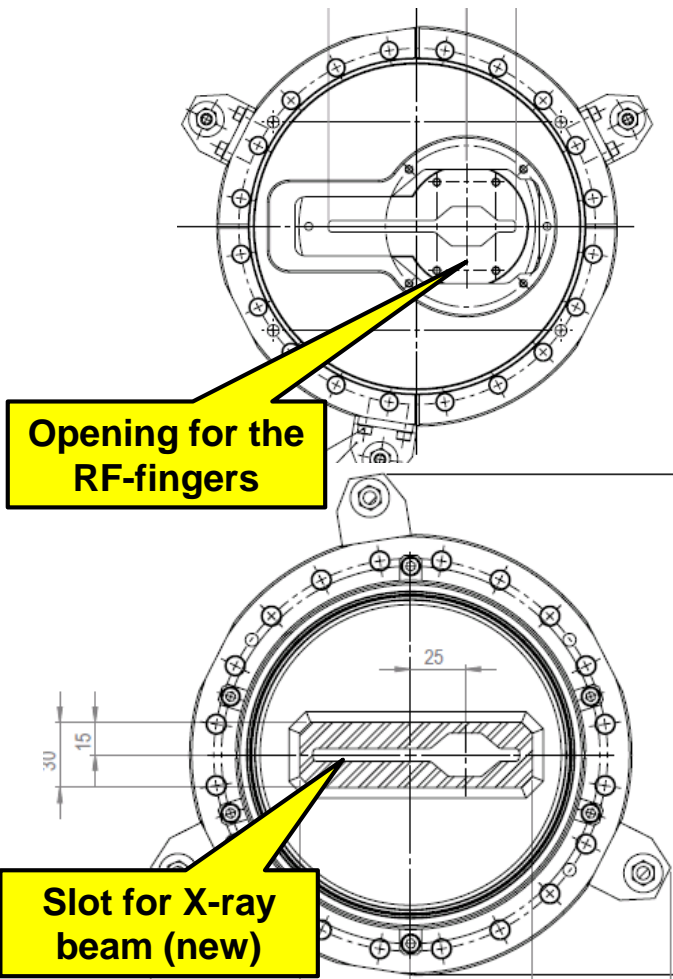


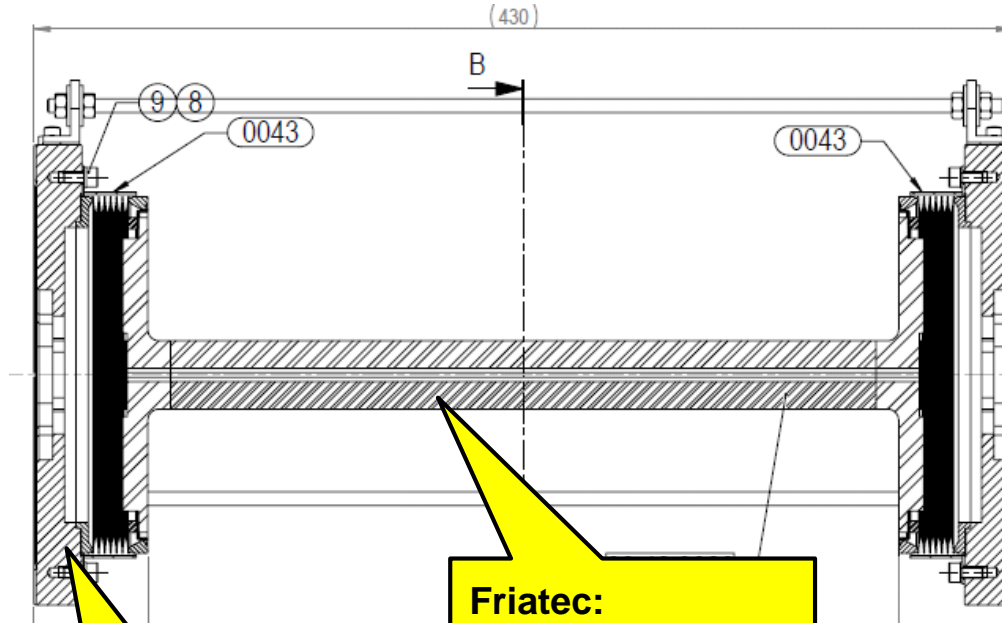




At K2-K3 there is a bump of 10 to 13 mm

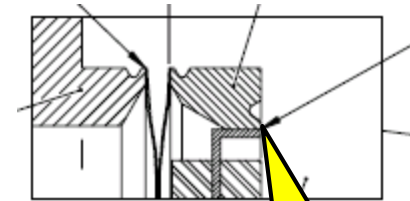




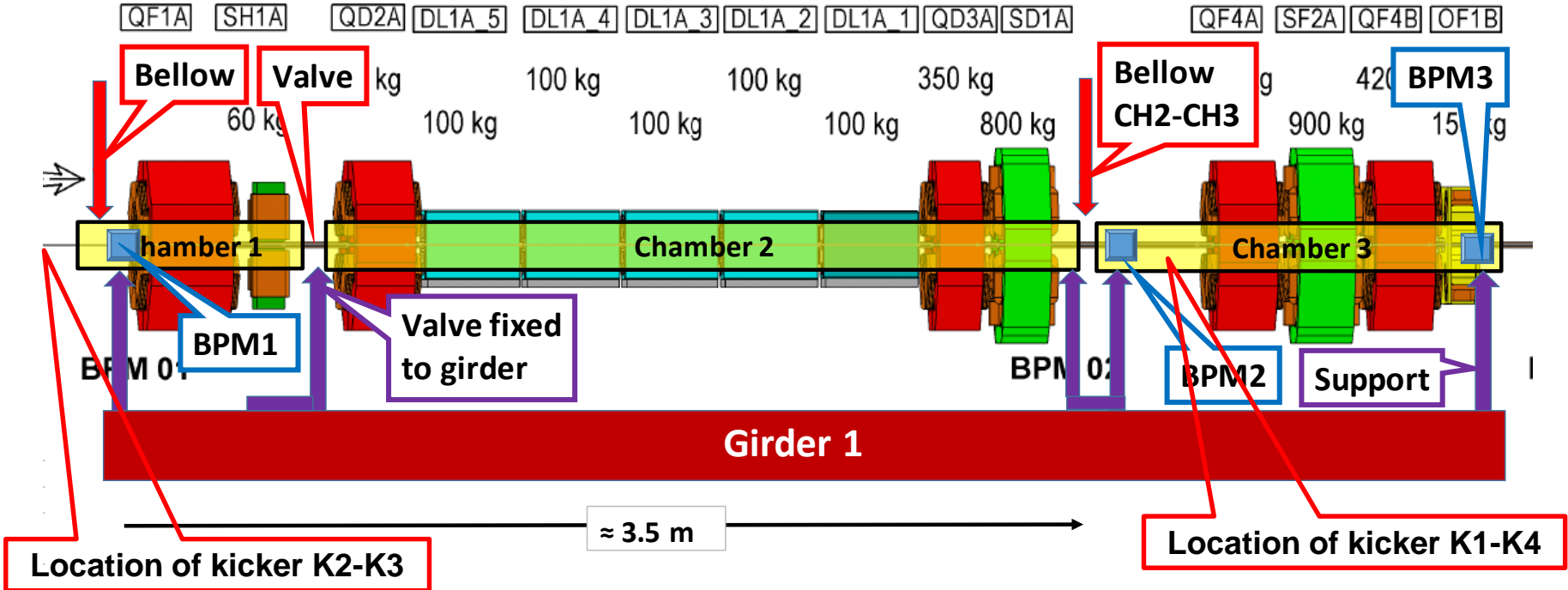


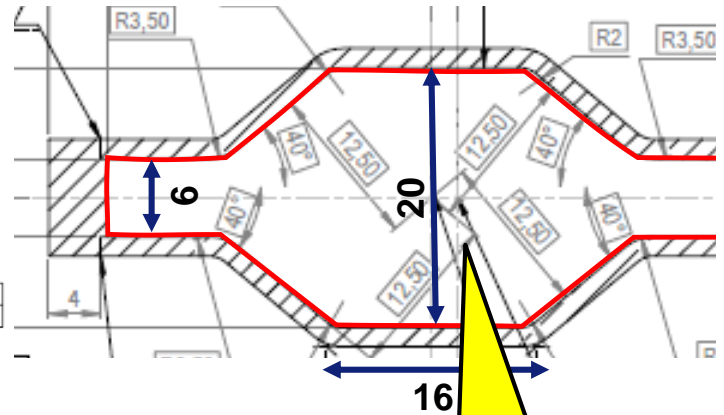
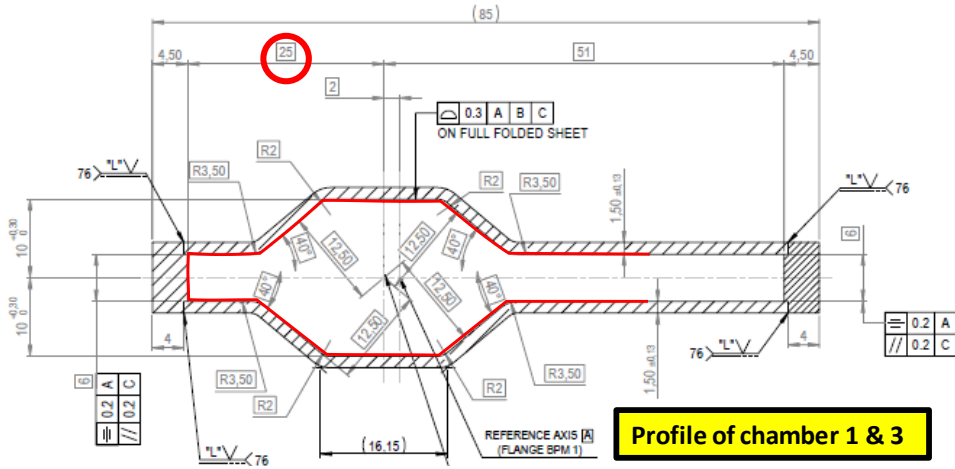
COMVAT:
CF flange with
bellows

Friatec:
Ceramic chamber

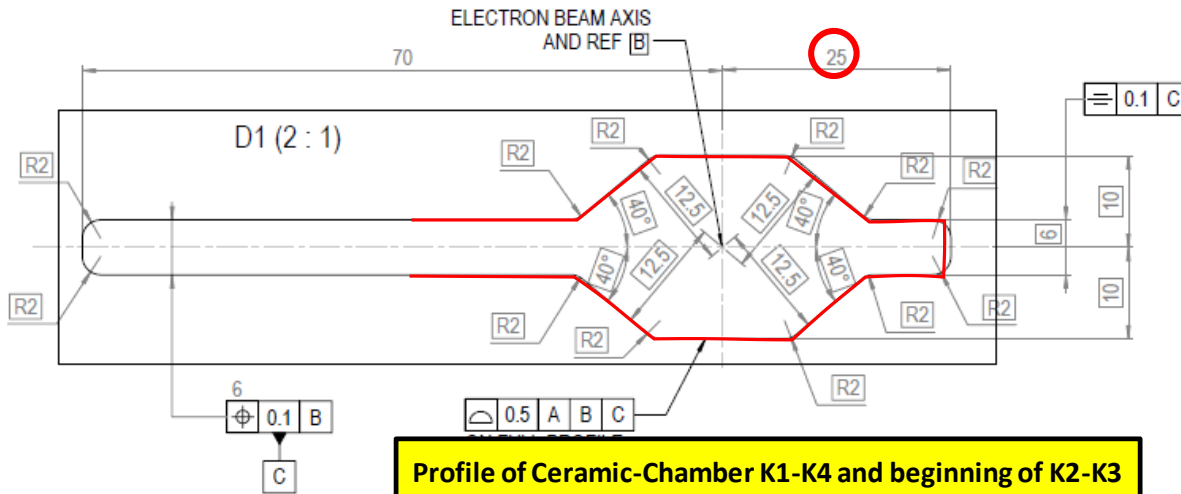


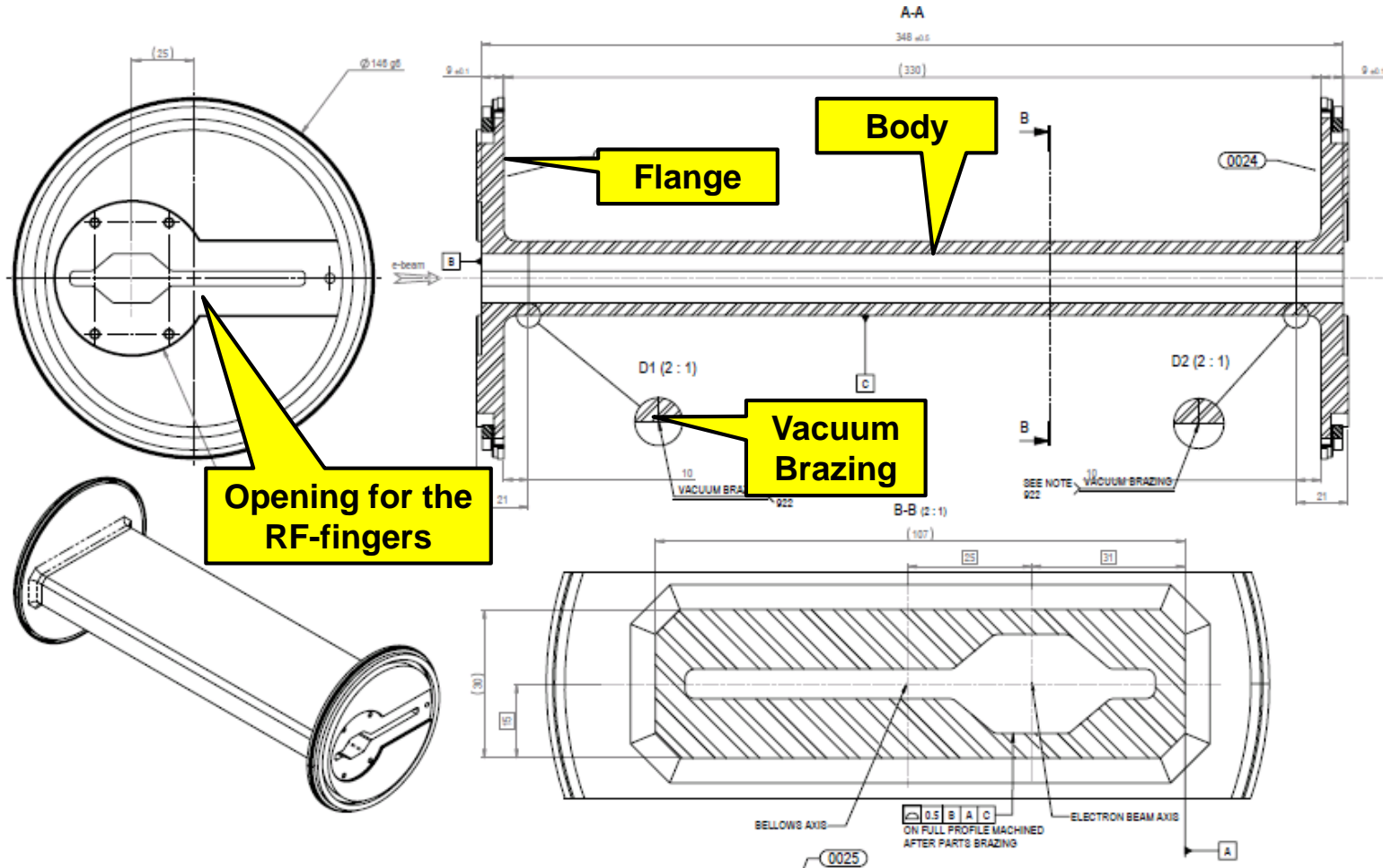
Reuters-Technology:
Welding of flange
and chamber



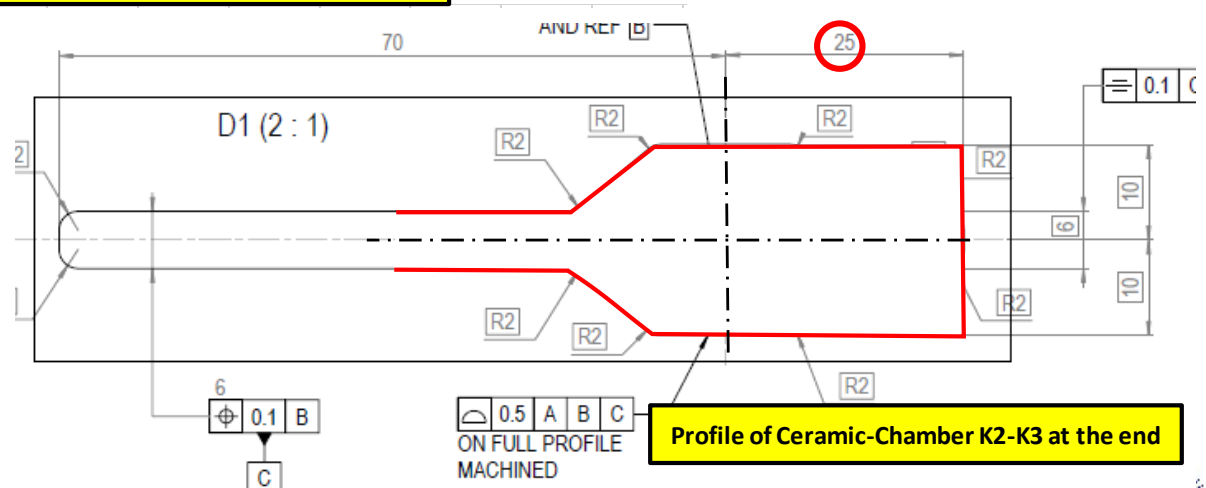
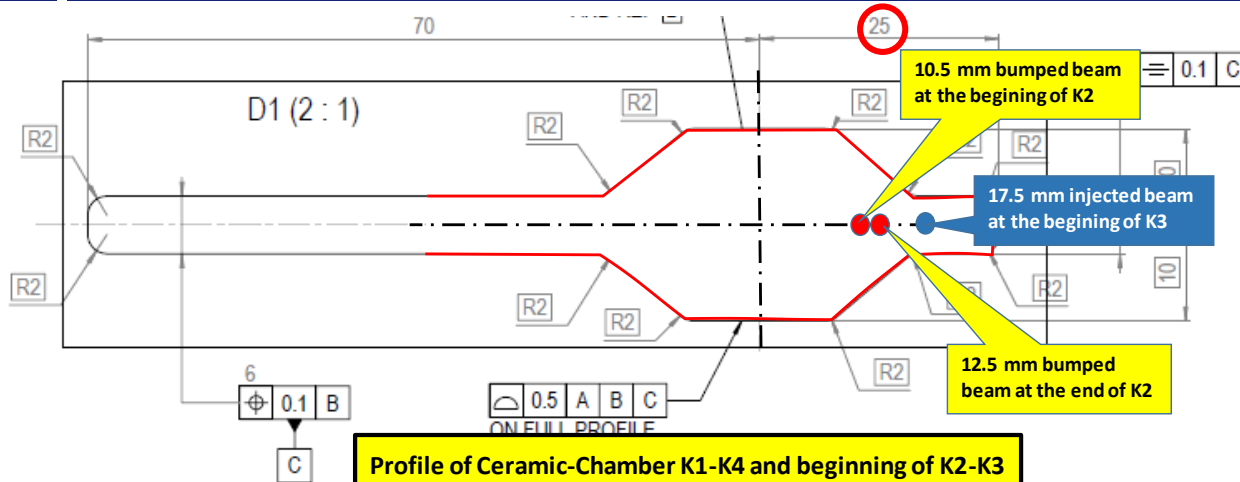


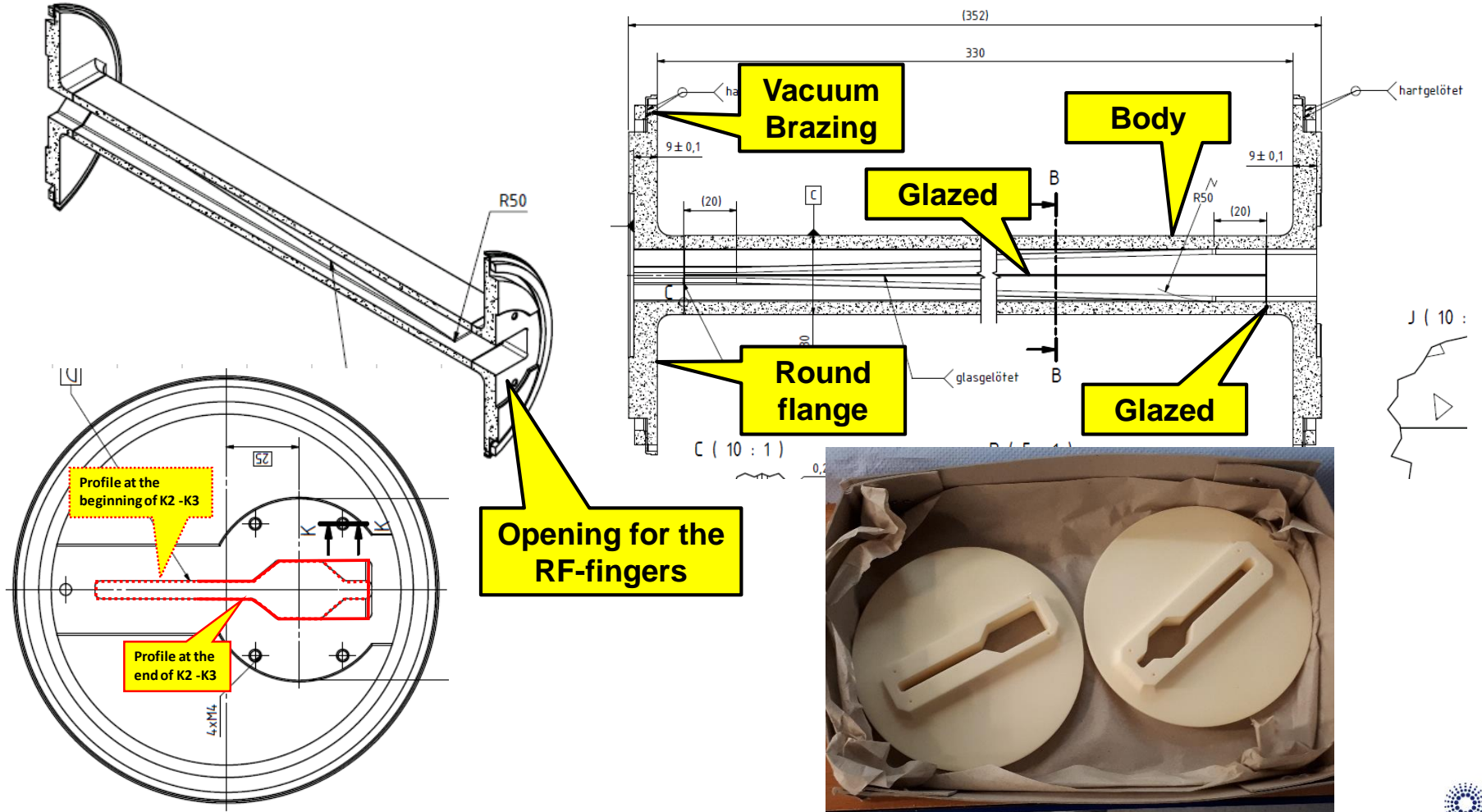
Beam area is roughly the same as for MAX IV





LOCATION OF THE BEAM IN K2-K3





- We changed the radius at the chamber inner contours from $R=1.5$ to $R=2\text{mm}$ because of grinding tool issues.
- We intend to produce the central ceramics out of two machined half-shells glued together at high temperature by glazing. This will allow a very good precision of the inner chamber contour (obtained by diamond hard-machining). Glass brazing is UHV compatible and already approved/used at several accelerator customers.
- We will have into the chambers a meniscus from the glass solder.
- We will have small chamfers at the joining area of the two shells.
- Ceramic flanges will be also glass brazed onto the central ceramics with a slight change of the design: length +10mm / Radius $R=5\text{mm}$ to reduce the thermal stresses during the glass brazing at high temperature.
- Threads M4 will be machined directly into the ceramic body without metal insert.
- Cleaning procedure and Helium leakage test as the FRIATEC's standard operating procedures. See also document attached "*FRIATEC Cleaning Plan for ESRF Ceramic Vacuum Chambers*".

Name	Reference drawing N°	Quantity to quote
Kicker K2 & K3 Chamber	88.42.0051	4
Kicker K1 & K4 Chamber	88.42.0021	4
Shaker Chamber	88.50.0066	3
Vertical Kicker Chamber	88.50.0461	2

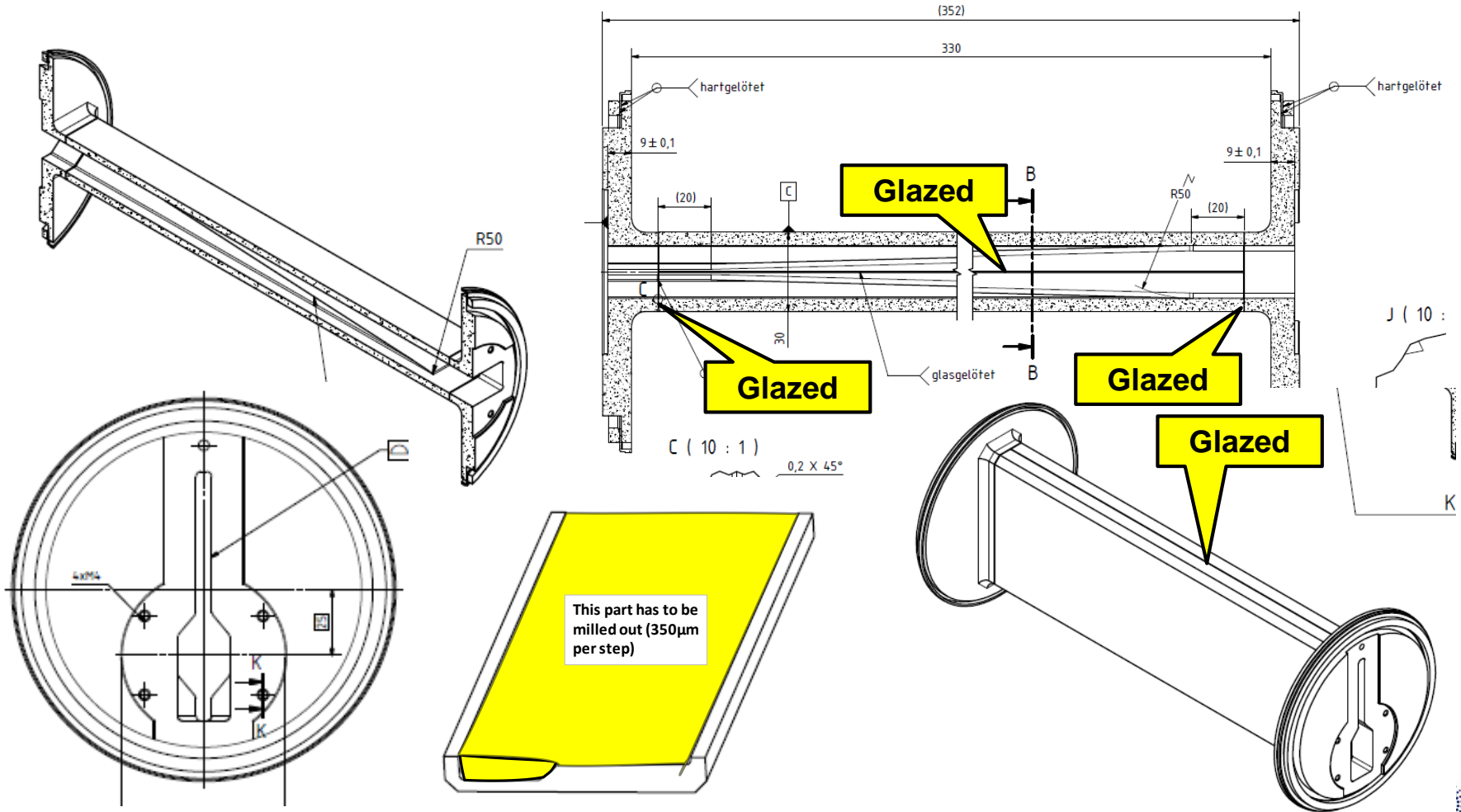
Table 1 - List of chambers quantities

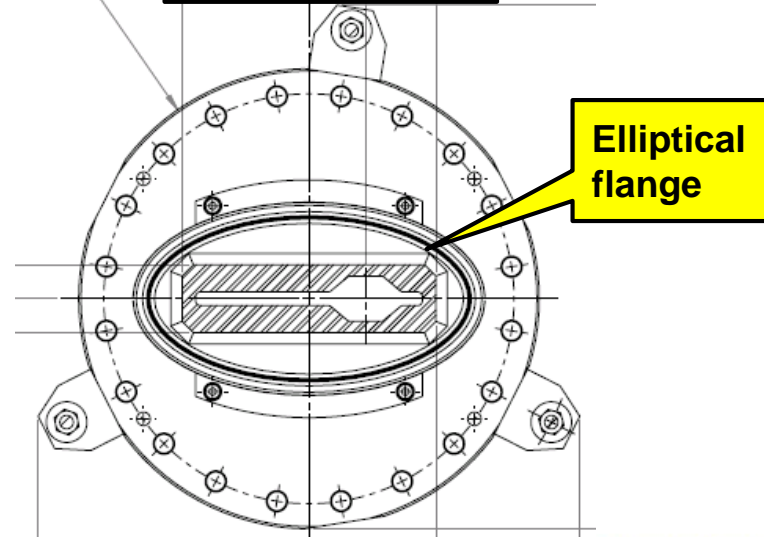
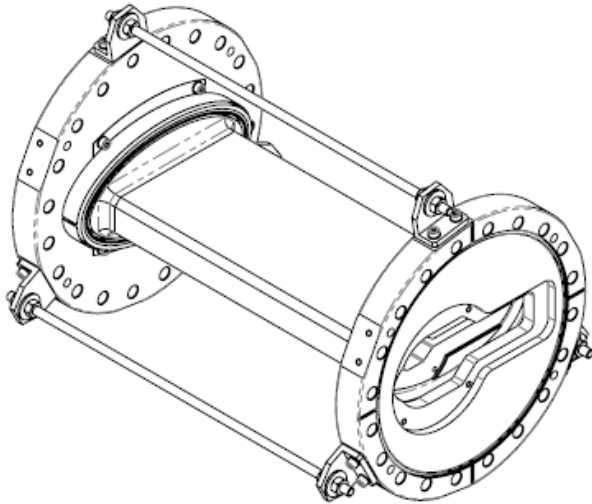
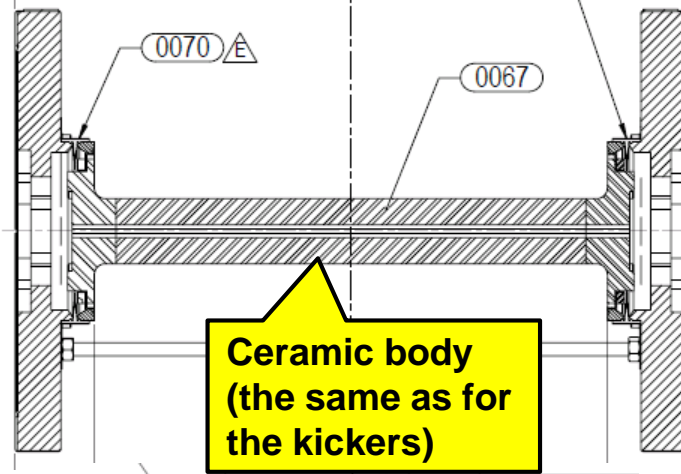
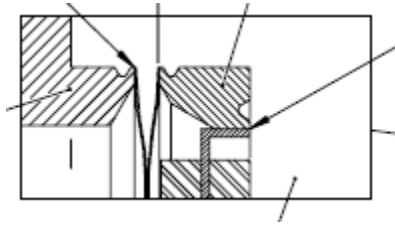
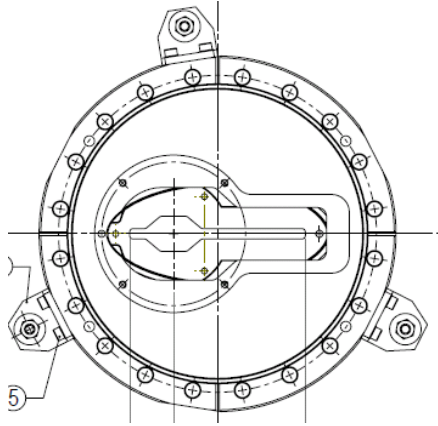
2.1.2 The ESRF definition drawings are listed in APPENDIX 1 of this document.

2.1.3 Table 2 indicates the details of the lot with the relevant batches to be considered for deliveries.

Lot	Vacuum Chambers: Types & Quantities				
	Kicker K2 & K3 Chamber	Kicker K1 & K4 Chamber	Shaker Chamber	Vertical Kicker Chamber	<i>Total</i>
Pre-serie	1	-	1	-	2
Serie	3	4	2	2	11
<i>Total</i>	4	4	3	2	13

Table 2 - Lot Quantities





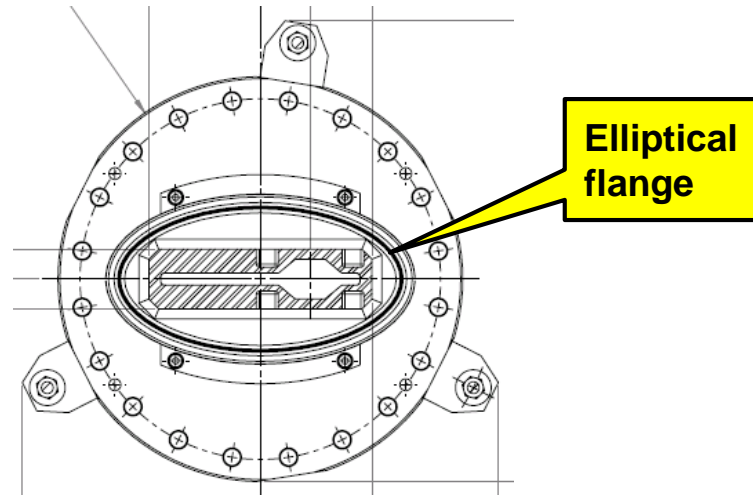
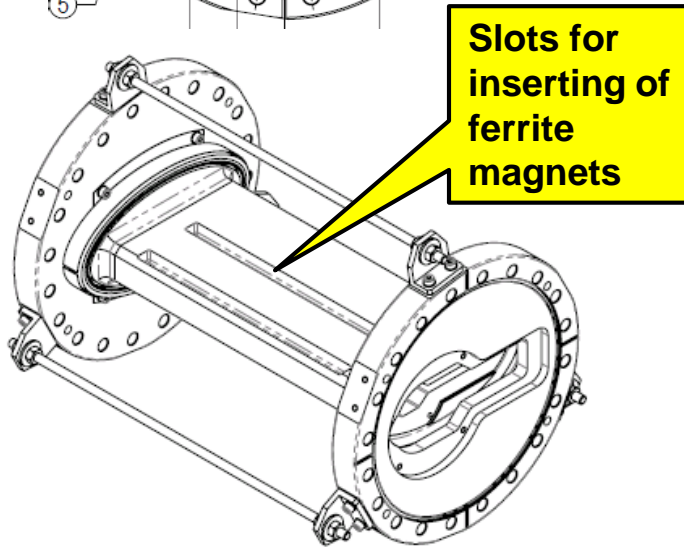
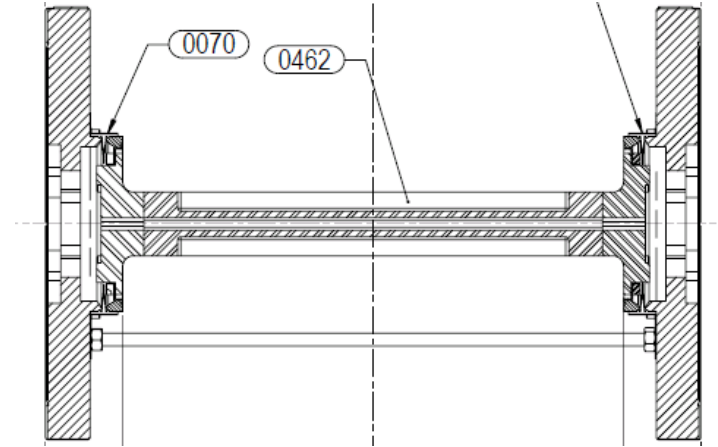
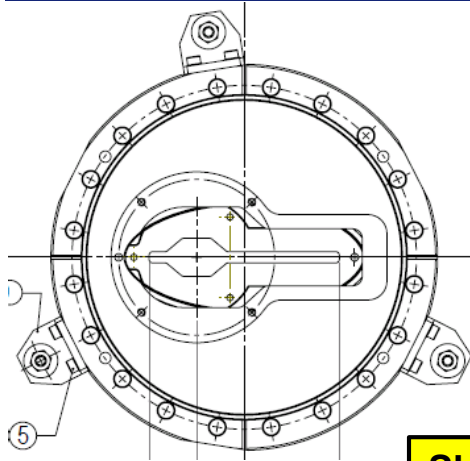
First the shaker was designed. FEM calculation shown that elliptical shape follow , more or less, the internal profile of the chamber, has some advantages because of lower vacuum forces. For the design of the kicker there was a discussion between the two solutions of elliptical or circular bellows.

As we have seen and as predicted the machining of the elliptical components is not that easy to achieve the tolerances. Also the welding is not as easy as the distance between the weld and the laser for welding changes as you rotate the piece. Also brazing a circular piece is easier as the expansions are easier to control.

The advantages for lower vacuum forces did not seem to justify these additional manufacturing difficulties.

There was also the problem that for the kickers K2-K3 we would have had to use a bigger sized elliptical bellow as the x-rays are slightly wider at this point. Therefore the vacuum forces would be bigger and there are less choices for the size of elliptical bellows.

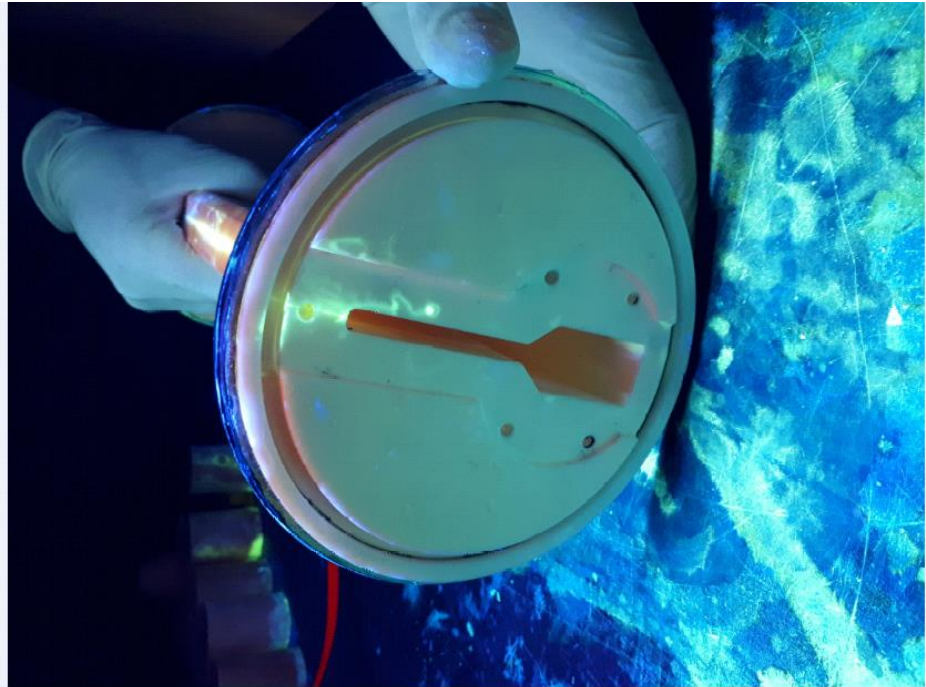
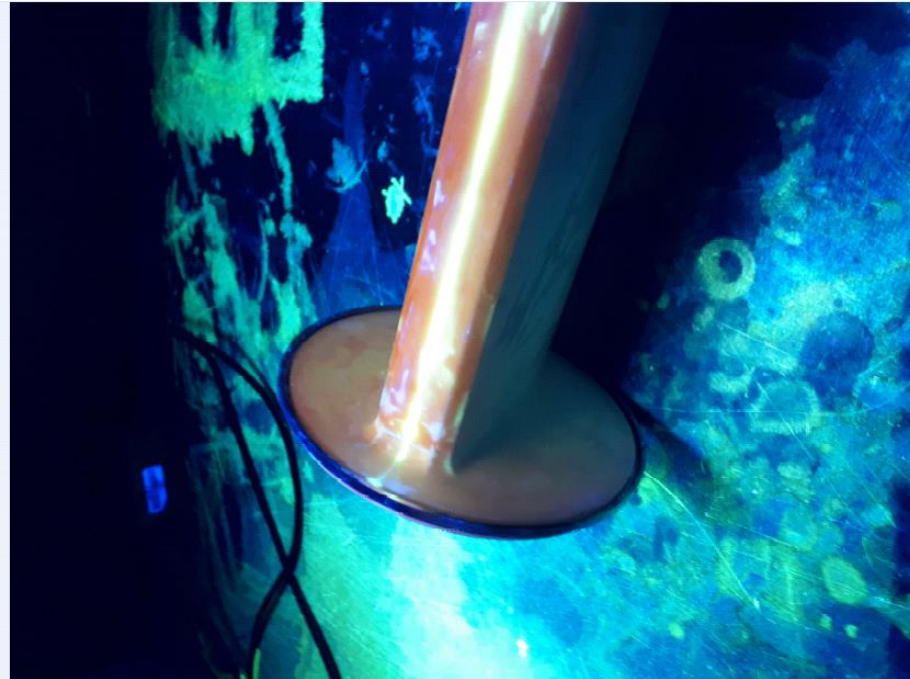
Even after the problems we have had, it is a sort of personal sensitivity to the technical advantages/disadvantages of using an elliptical or round flange.



Ceramic - Body	Ceramic - Flange
1.) Green part finished	1.) Green part finished
2.) Sintering	2.) Sintering
3.) Penetration	3.) Penetration
4.) Rough grinding	4.) Rough grinding
5.) Fine grading (Machined)	5.) Fine grading (Machined)
6.) Measurement of Half-Shelf	6.) Measurement of Flange
7.) Glazing	7.) Glazing
8.) Measurement of complete body	8.) Measurement of Flange
9.) Helium leak test	
10.) Metallization	9.) Metallization
11.) Brazing of body and flange	
12.) Measurement of complete part	
13.) Helium leak test of complete part	
13.) Welding at Reuter Technology	
14.) Leak test at Reuter	
15.) Final measurement (FAT) at Reuter	

Action	Time	Bidder	
Contract placed	to	to	03/01/2018
Phase 1: Engineering phase			
Delivery of the design and production schedule	to + 6 weeks	to + 6 weeks	07/02/2018
Deliverery of the quality plan	to + 6 weeks	to + 6 weeks	07/02/2018
Delivery of the manufacturing drawings	to + 8 weeks	to + 8 weeks	21/02/2018
Approval of the engineering phase by the ESRF	to + 10 weeks	to + 10 weeks	07/03/2018
Phase 2: Pre-series production phase			
Measurement of the central ceramic assembly	to + 16 weeks	to + 22 weeks	30/05/2018
Production of pre-series completed	to + 22 weeks	to + 26 weeks	27/06/2018
Measurement (FAT) of the pre-series completed	to + 23 weeks	to + 27 weeks	04/07/2018
Delivery of pre-series	to + 24 weeks	to + 28 weeks	11/07/2018
ESRF measuerement (SAT) of the pre-series completed	to + 28 weeks	to + 29 weeks	18/07/2018
Acceptance of the pre-series	to + 28 weeks	to + 29 weeks	18/07/2018
Phase 3: Series production phase			
Measurement of the central ceramic assembly	to +30 weeks	to + 42 weeks	17/10/2018
Production of series completed	to + 36 weeks	to + 48 weeks	28/11/2018
Measurement (FAT) of the series completed	to + 37 weeks	to + 49 weeks	05/12/2018
Delivery of the series	to + 38 weeks	to + 50 weeks	12/12/2018
ESRF measurement (SAT) of the series completed	to + 42 weeks	to + 54 weeks	09/01/2019
Acceptance of the series	to + 42 weeks	to + 54 weeks	09/01/2019

The pre-series of the chamber K2-K3 should be delivered in middle of July 2018. At the beginning of November 2018 we got this pictures from the manufacturer showing a crack between the 2 shelf's of the body. No explanation for this crack.

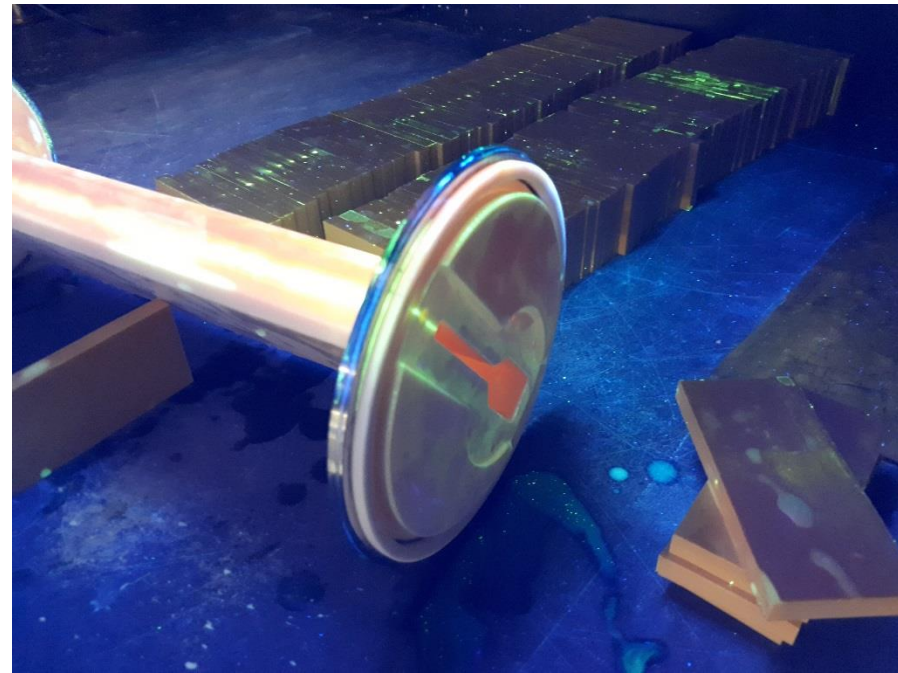


According to the delay of 4 month, the ESRF gave the go ahead for the series production.

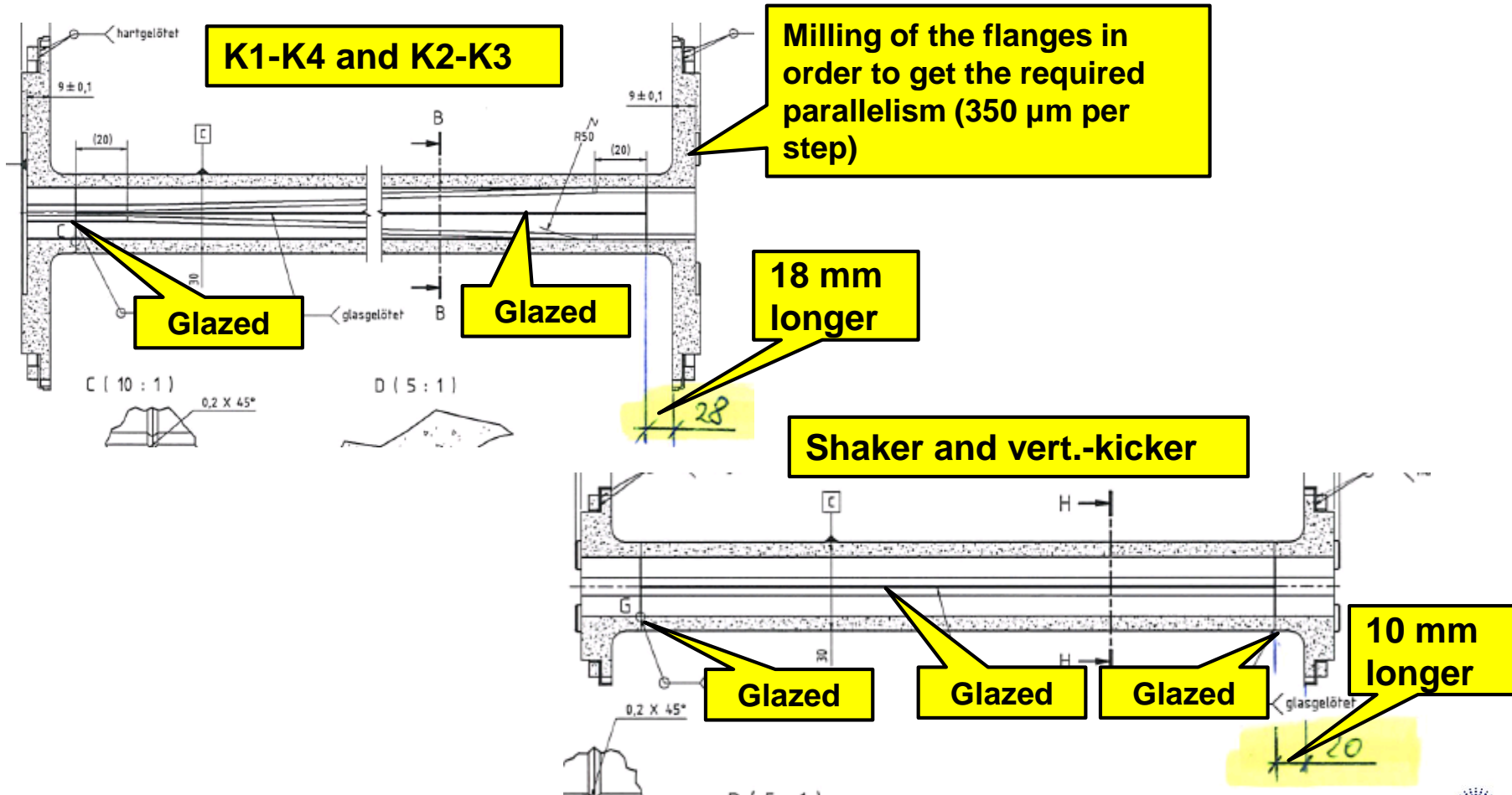


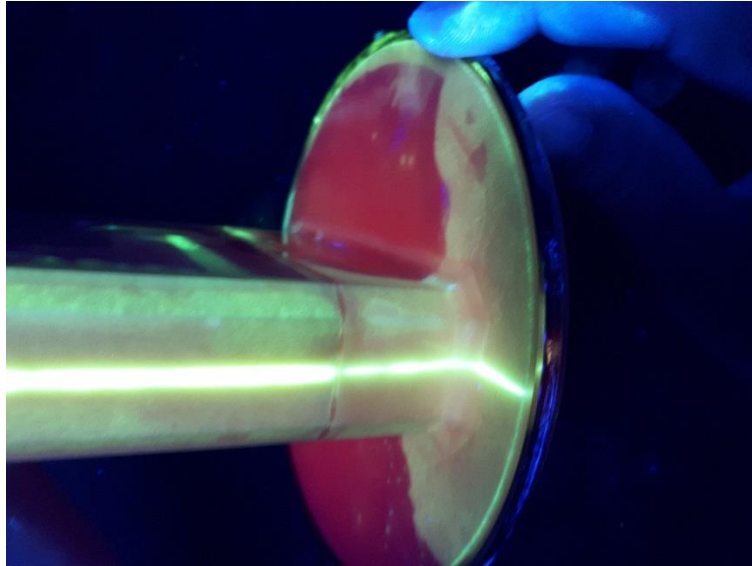
With the Shakers (elliptical shape of the flange) we had no problems with a crack.



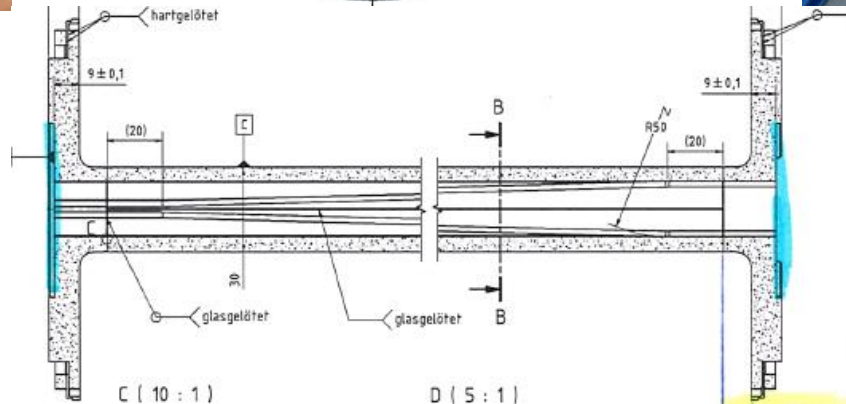
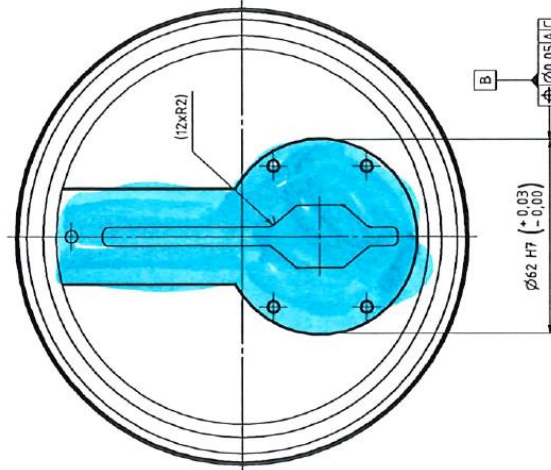


The next ceramic chamber was finished at the end of January 2019 and showing again a crack between both shelf's of the body. To have better stiffness, the manufacturer proposed to make the flange longer: 18 mm for K1-K4 and K2-K3 and 10 mm for Shaker and Vertical-Kicker (see next slide).

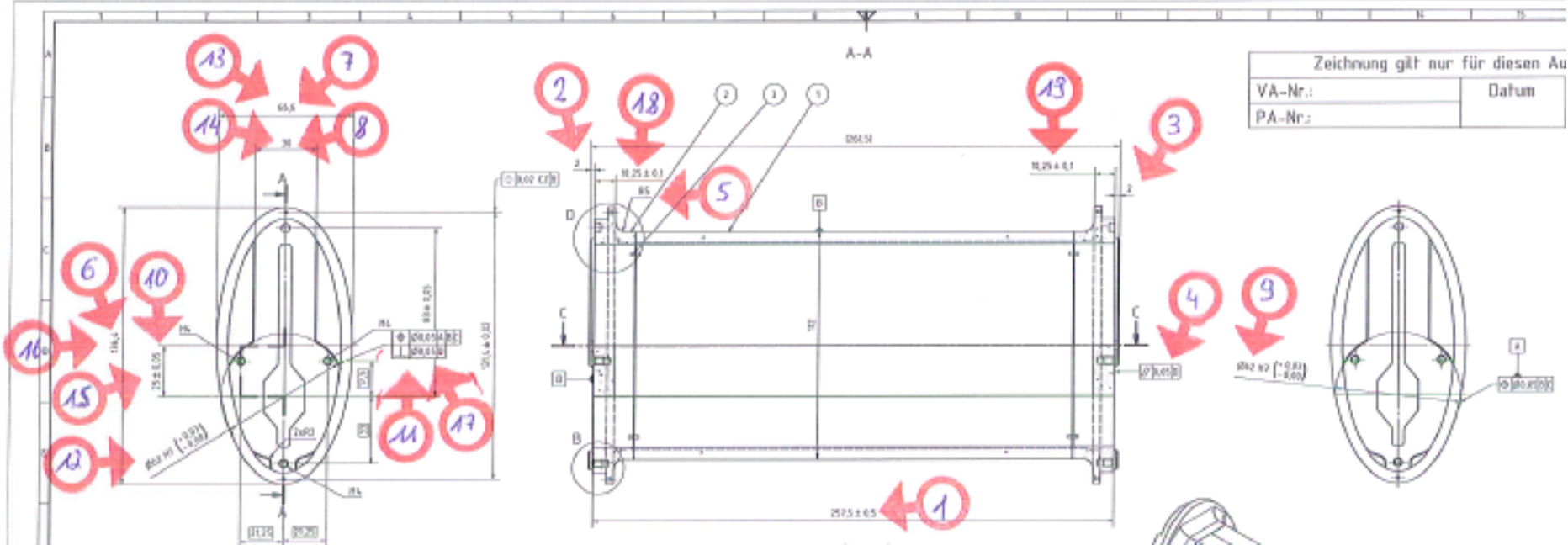





The next ceramic chamber was finished at the end of March 2019 and showing again a crack between both shelf's of the body. After looking for the milling process of the flanges it was decided to make the final milling before the glazing and don't do the milling of the outlet for the RF-Fingers.



With this action: “no milling of the RF-Finger”, no crack appeared anymore.

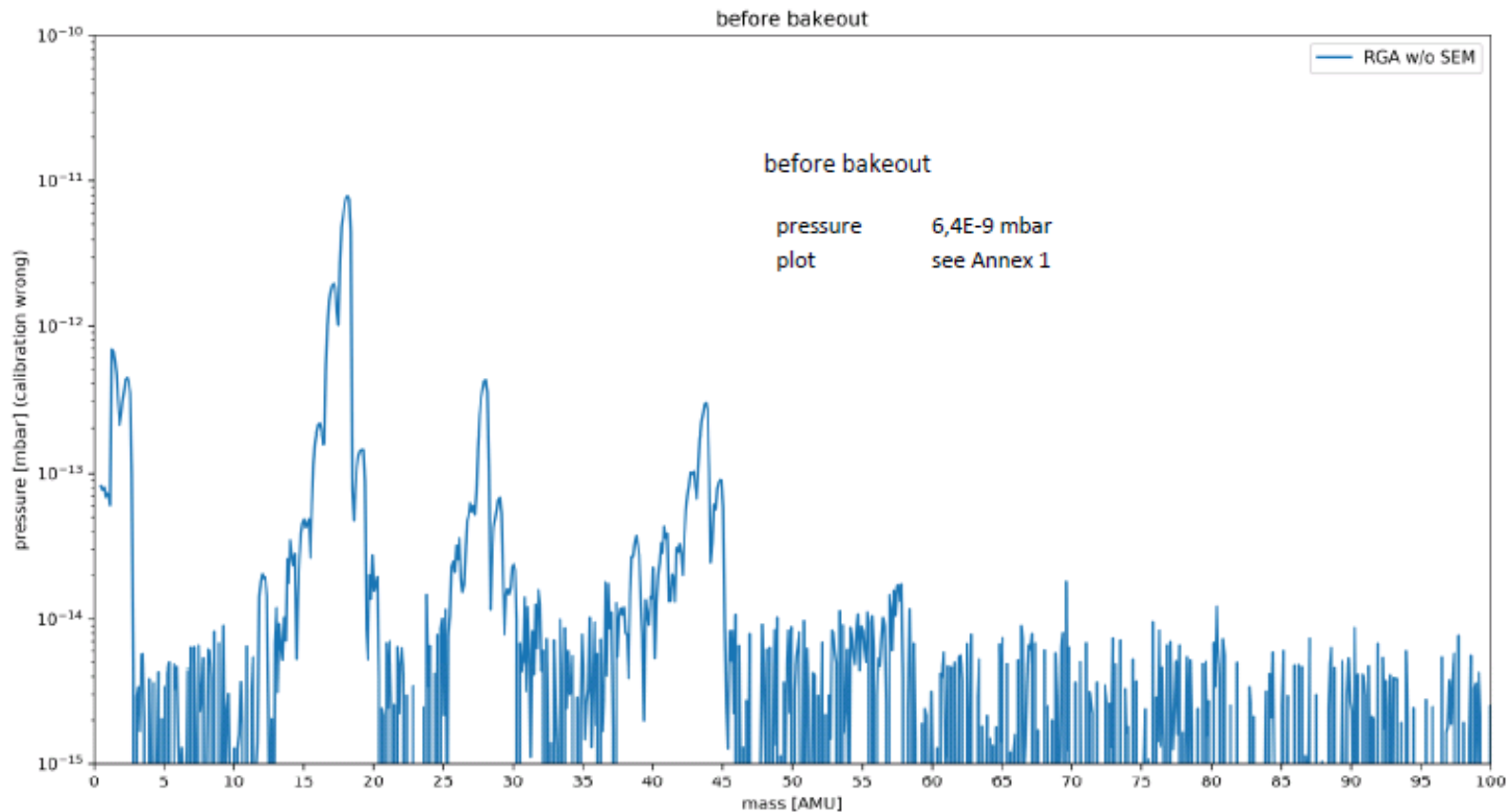


Zeichnung gilt nur für diesen Au	
VA-Nr.:	Datum
PA-Nr.:	

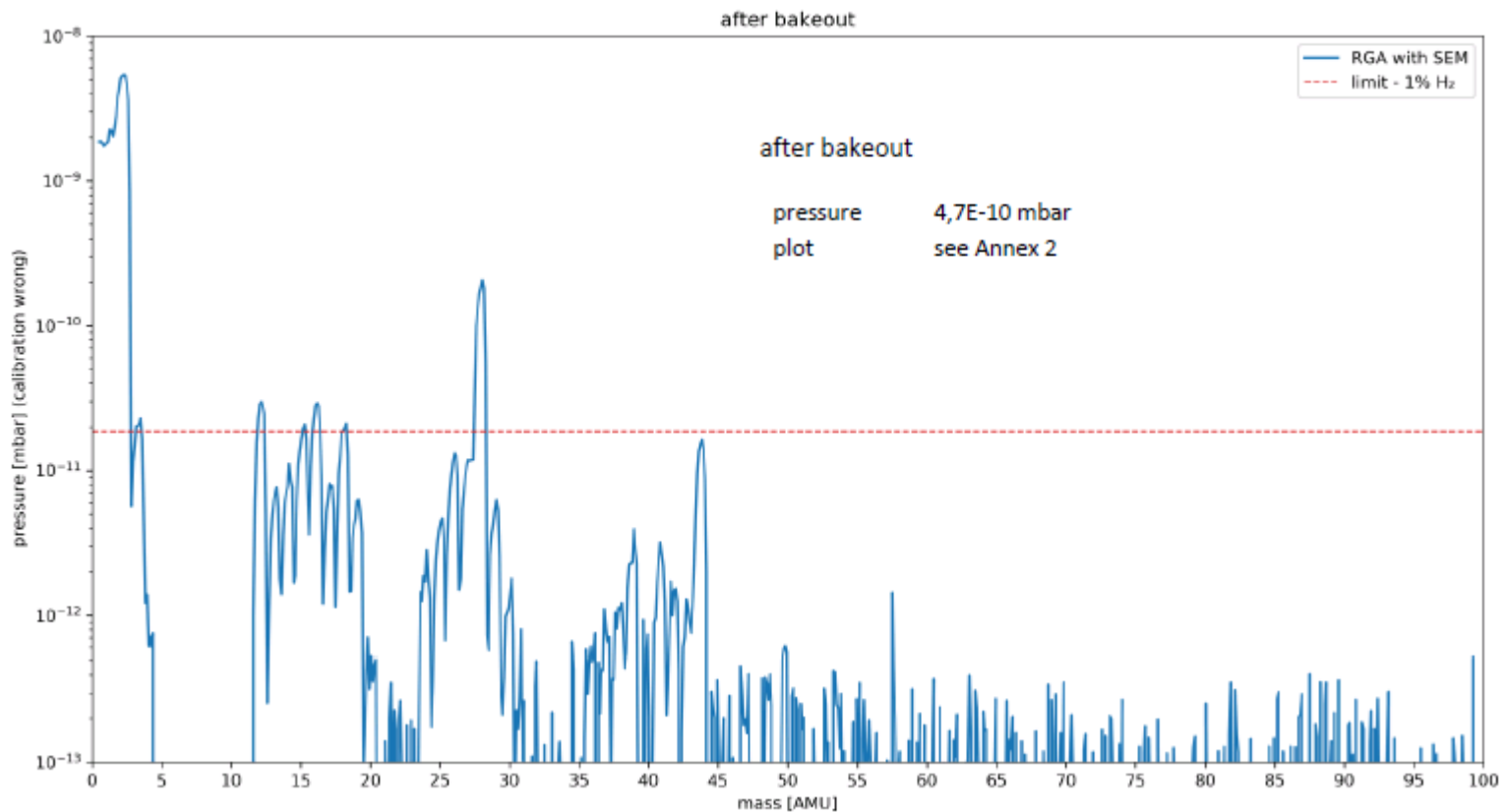
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		VERSIONNR.: P2019020		SERIENNR.: Tot.01		STAT ZÄHLER: 1	
Aktuelle Temperatur: 24.3 °C ± 0.49 °C ± 0.3 °C ± 0.1 °C Temperaturkonstante: 1st_P18							
1	MM	ABST1 - EBENE 257.5 UNTEN ZU EBENE 257.5 OBEN (Y_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	257.53	257.50	0.50	-0.50	0.03	0.00	
2	MM	ABST4 - EBENE 2ER ABSTAND UNTEN ZU EBENE 257.5 UNTEN (Y_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	2.02	2.00	0.10	-0.10	0.02	0.00	
3	MM	ABST9 - EBENE 2ER ABSTAND OBEN ZU EBENE 257.5 OBEN (Y_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	2.02	2.00	0.10	-0.10	0.02	0.00	
PCPARALL D		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
EBENE PARALL D		0.01	0.00	0.05	0.00	0.01	0.00
PCFRECHT...		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
LAGE1 - R 5		4.92	5.00	0.10	-0.10	-0.08	0.00
5	MM	ABST17 - PKT 136 OBEN 1 ZU PKT 136 OBEN 2 (X_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	136.32	136.40	0.50	-0.50	-0.08	0.00	
7	MM	ABST15 - PKT 66.6 OBEN 1 ZU PKT 66.6 OBEN 2 (Z_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	66.56	66.60	0.30	-0.30	-0.04	0.00	
8	MM	ABST14 - LIN 3D ABST OBEN 1 ZU LIN 3D ABST OBEN 2 (Z_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	30.00	30.00	0.20	-0.20	0.00	0.00	
PCFRECHT...		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
LAGE2 - KREIS_62_OBEN		62.03	62.00	0.03	0.00	0.03	0.00
9	MM	ABST16 - PKT OBEN NUT MITTE ZU KREIS_62_OBEN (X_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	25.04	25.00	0.05	-0.05	+0.04	0.00	
PCFRECHT...		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
LINES		0.00	0.00	0.05	0.00	0.00	0.00
PCFRECHT...		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
LAGE3 - KREIS 62 D H' UNTEN		62.01	62.00	0.03	0.00	0.01	0.00
12	D	62.01	62.00	0.03	0.00	0.01	0.00

13	MM	ABST18 - PKT 66.6 1 UNTEN ZU PKT 66.6 2 UNTEN (Z_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	66.50	66.60	0.30	-0.30	-0.10	0.00	
14	MM	ABST21 - LIN3D ABST UNTEN 1 ZU LIN3D ABST UNTEN 2 (Z_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	30.09	30.00	0.20	-0.20	0.09	0.00	
15	MM	ABST22 - PKT MITTE NUT UNTEN ZU PKT 62 D UNTEN MITTE					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	25.04	25.00	0.05	-0.05	0.04	0.00	
16	MM	ABST25 - PKT136.4 UNTEN 1 ZU PKT136.4 UNTEN 2 (X_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	136.37	136.40	0.50	-0.50	-0.03	0.00	
PCFRECHT...		MM					
Element		MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL
LINES		0.01	0.00	0.05	0.00	0.01	0.00
17	MM	ABST11 - EBENE 3D BREITE UNTEN ZU EBENE 3D BREITE OBEN (Z_ACHSE)					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	30.04	30.00	0.20	-0.20	0.04	0.00	
18	MM	ABST12 - PKT10 ZU PKT11					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	10.23	10.25	0.10	-0.10	-0.02	0.00	
19	MM	ABST13 - PKT12 ZU PKT13					
ACH	MESS	NENNWERT	OTOL	UTDL	ABW	AJUSTOL	
M	10.24	10.25	0.10	-0.10	-0.01	0.00	

RGA - Shaker Chamber - 88.50.0066_E - SR1439

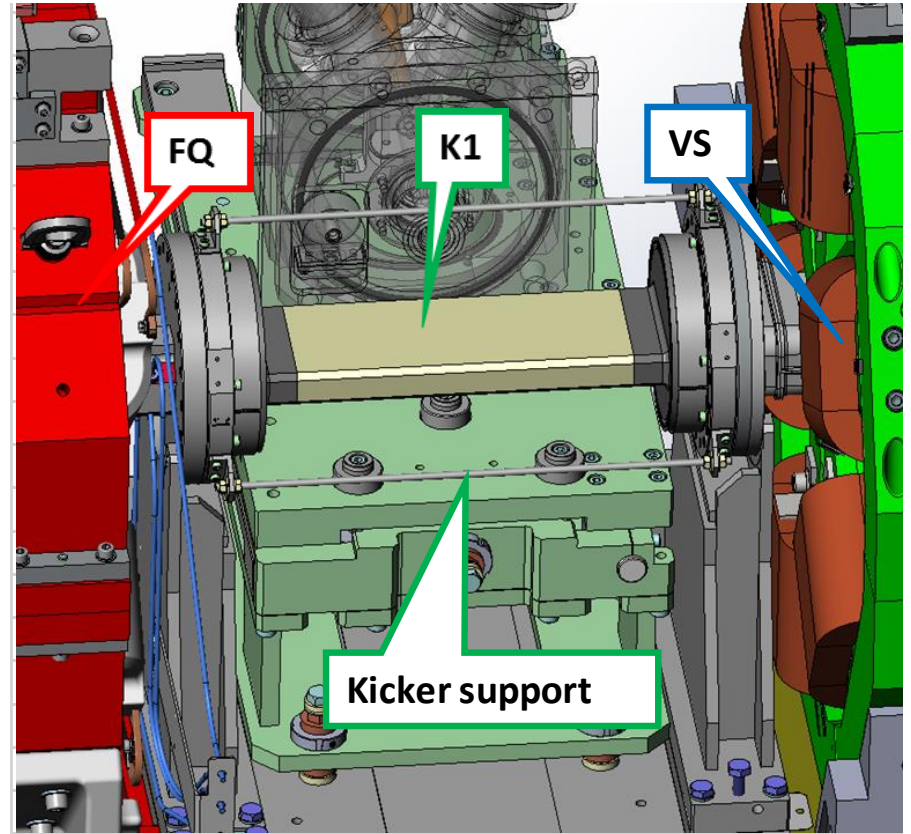
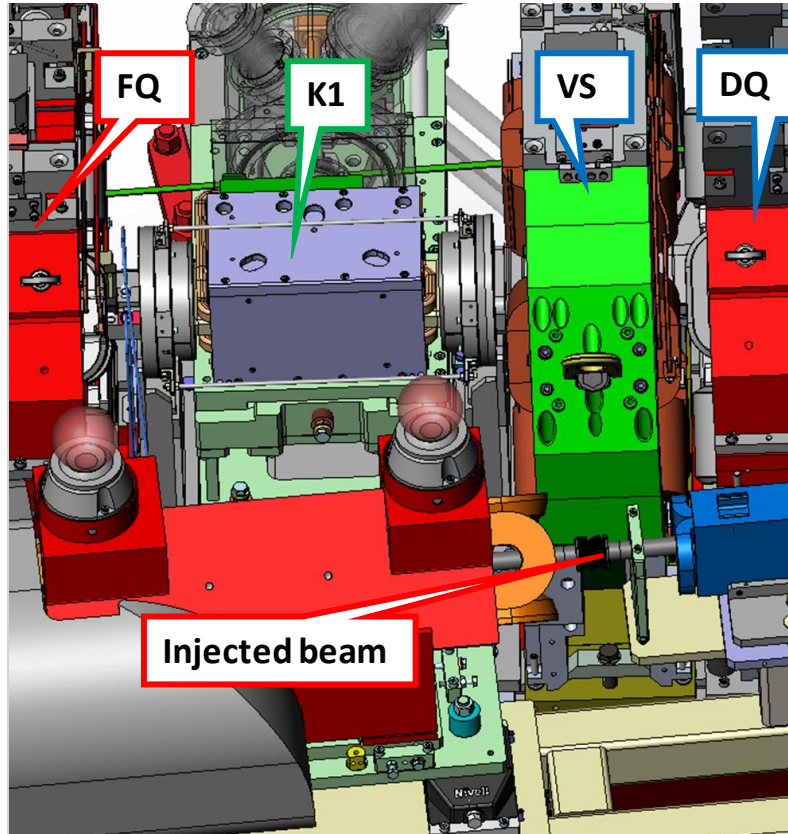


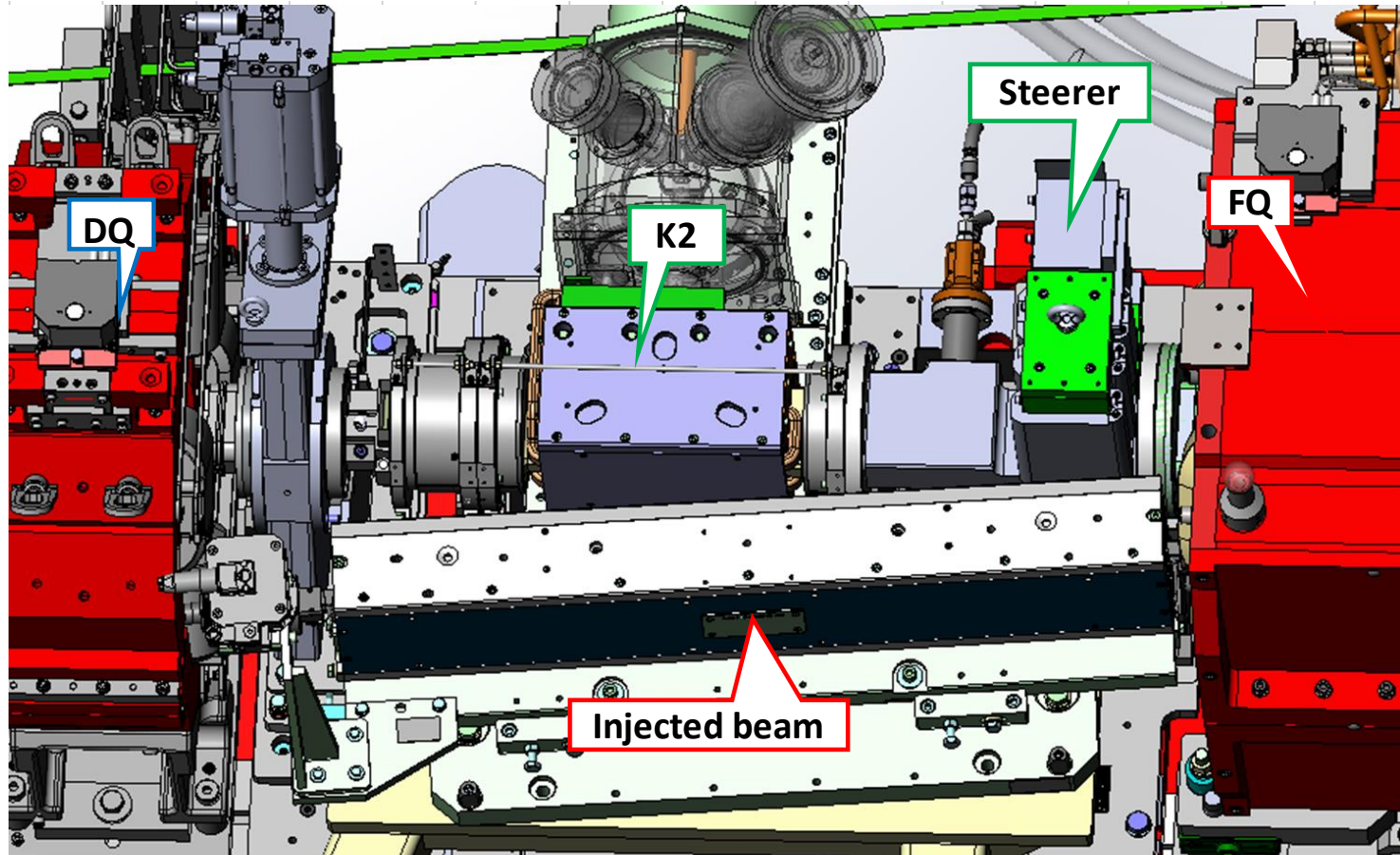
RGA - Shaker Chamber - 88.50.0066_E - SR1439

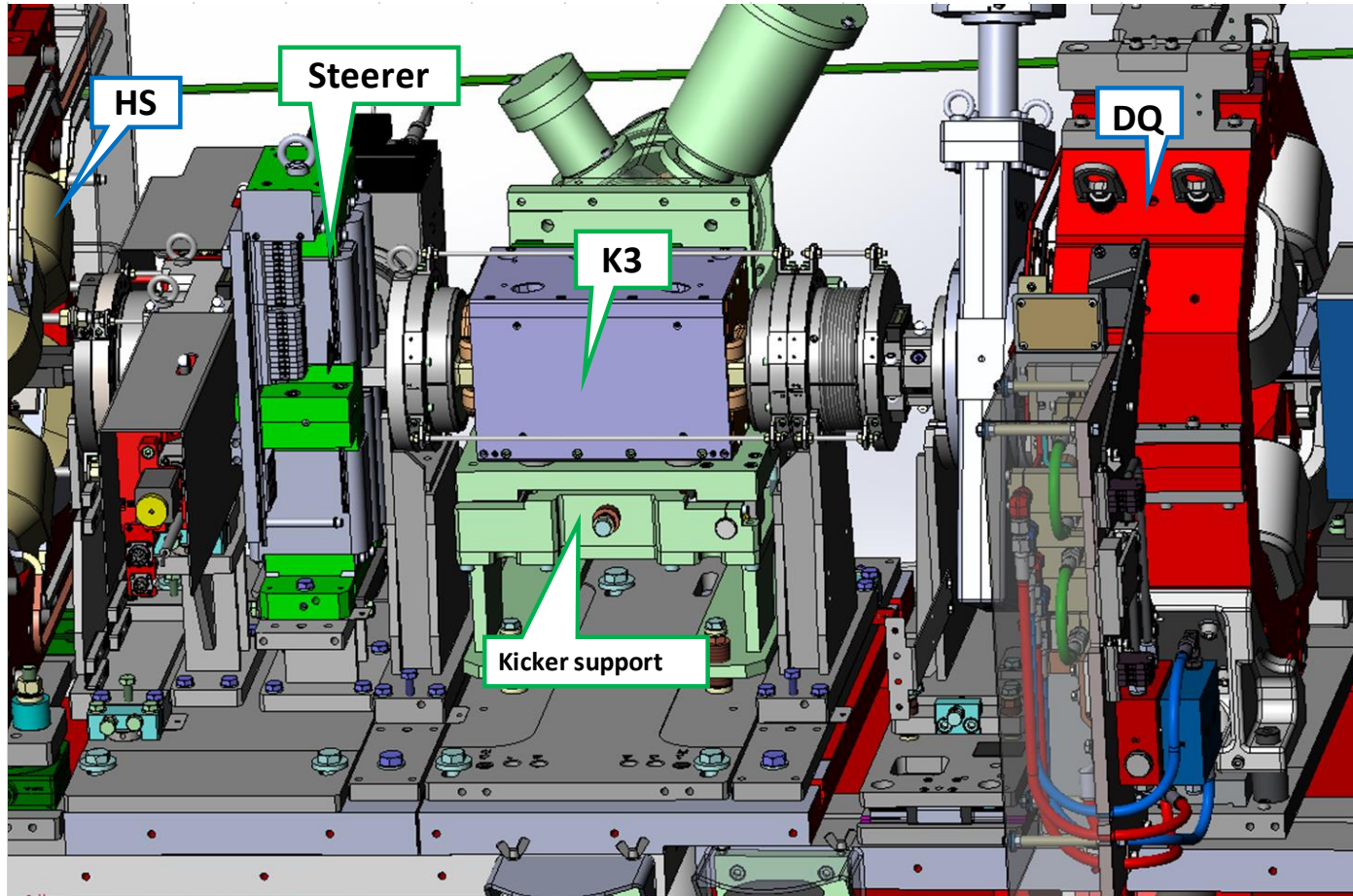


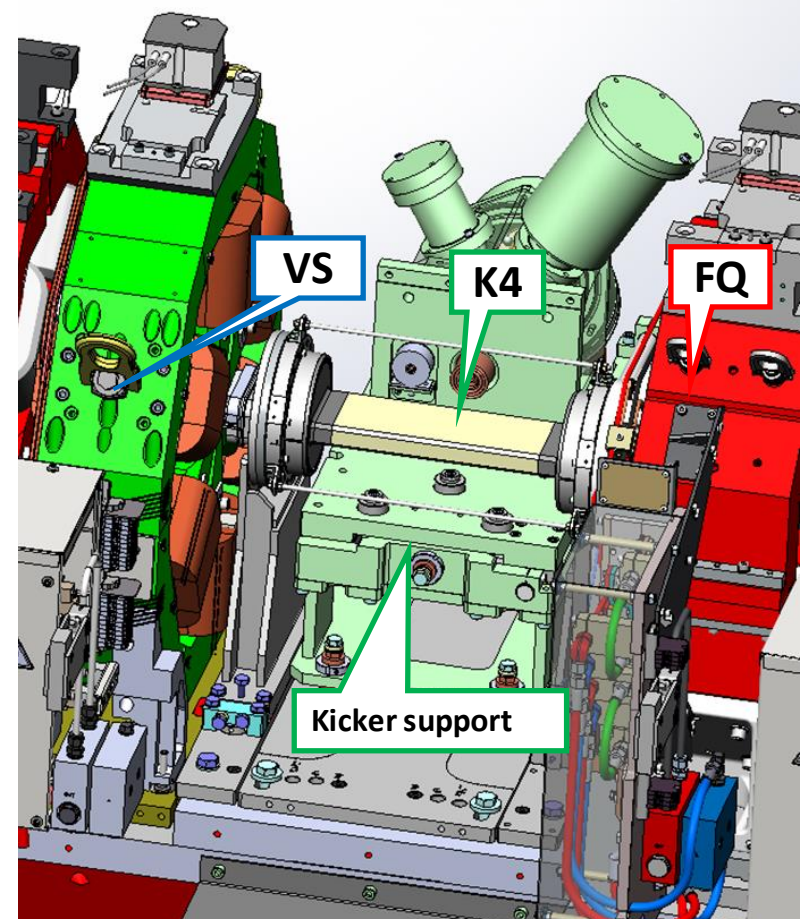
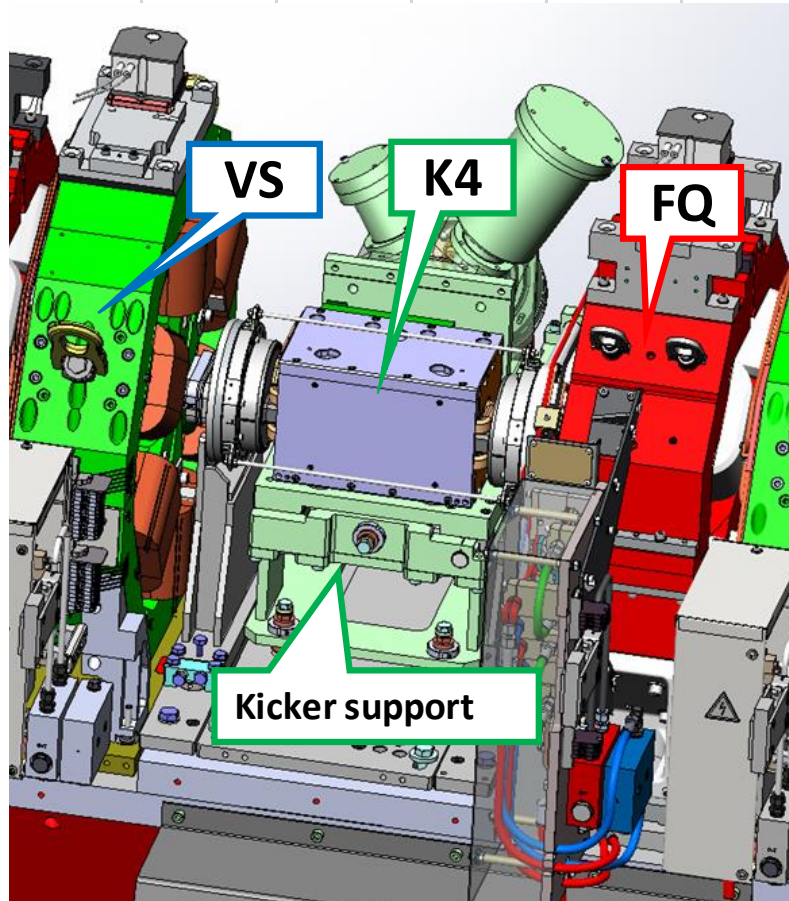
We are now in CW 28

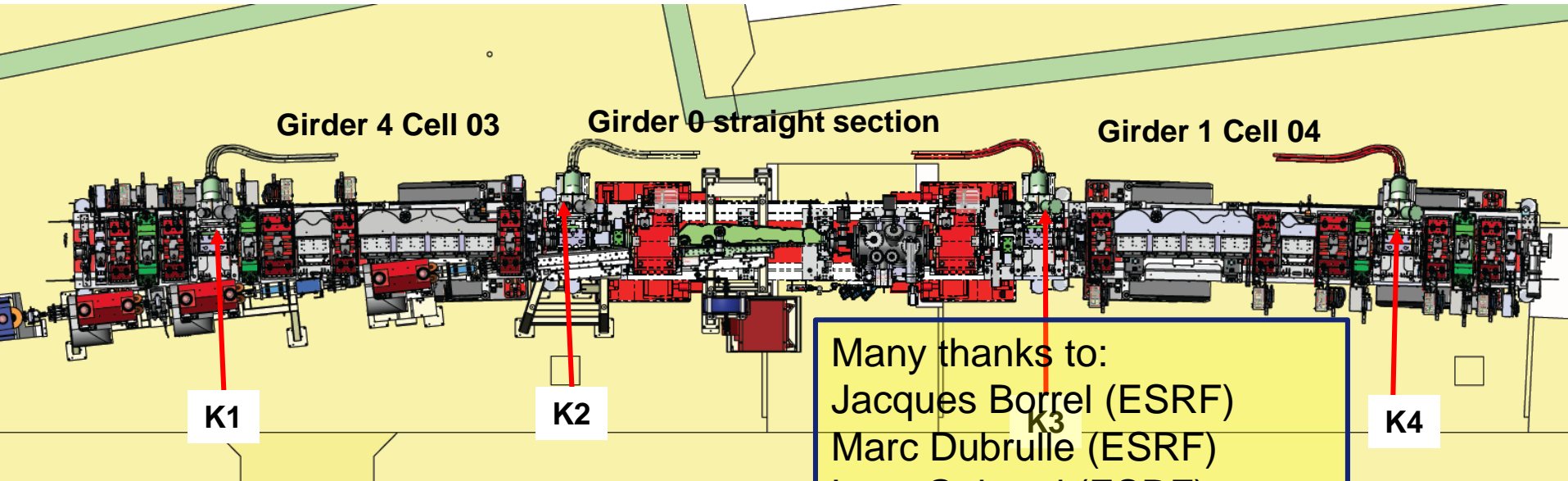
Chamber type	Chamber number	Friatec	ComVat	Reuters	Polyteknik
		Ceramics	Flanges	Welding	Coating
Kicker K2-K3	1	done	done	done	CW32
Kicker K2-K3	2	done	done	done	CW35
Kicker K2-K3	3	CW27	done	CW29	CW39
Kicker K2-K3	4	CW34	done	CW36	CW44
Kicker K1-K4	1	done	done	done	CW33
Kicker K1-K4	2	done	done	done	CW34
Kicker K1-K4	3	done	done	done	CW37
Kicker K1-K4	4	CW27	done	CW33	CW33
Shaker	1	done	done	done	CW28
Shaker	2	done	done	done	CW38
Shaker	3	done		CW32	CW41
Vertic. Kicker	1	done		CW31	CW42
Vertic. Kicker	2	done		CW30	CW40











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