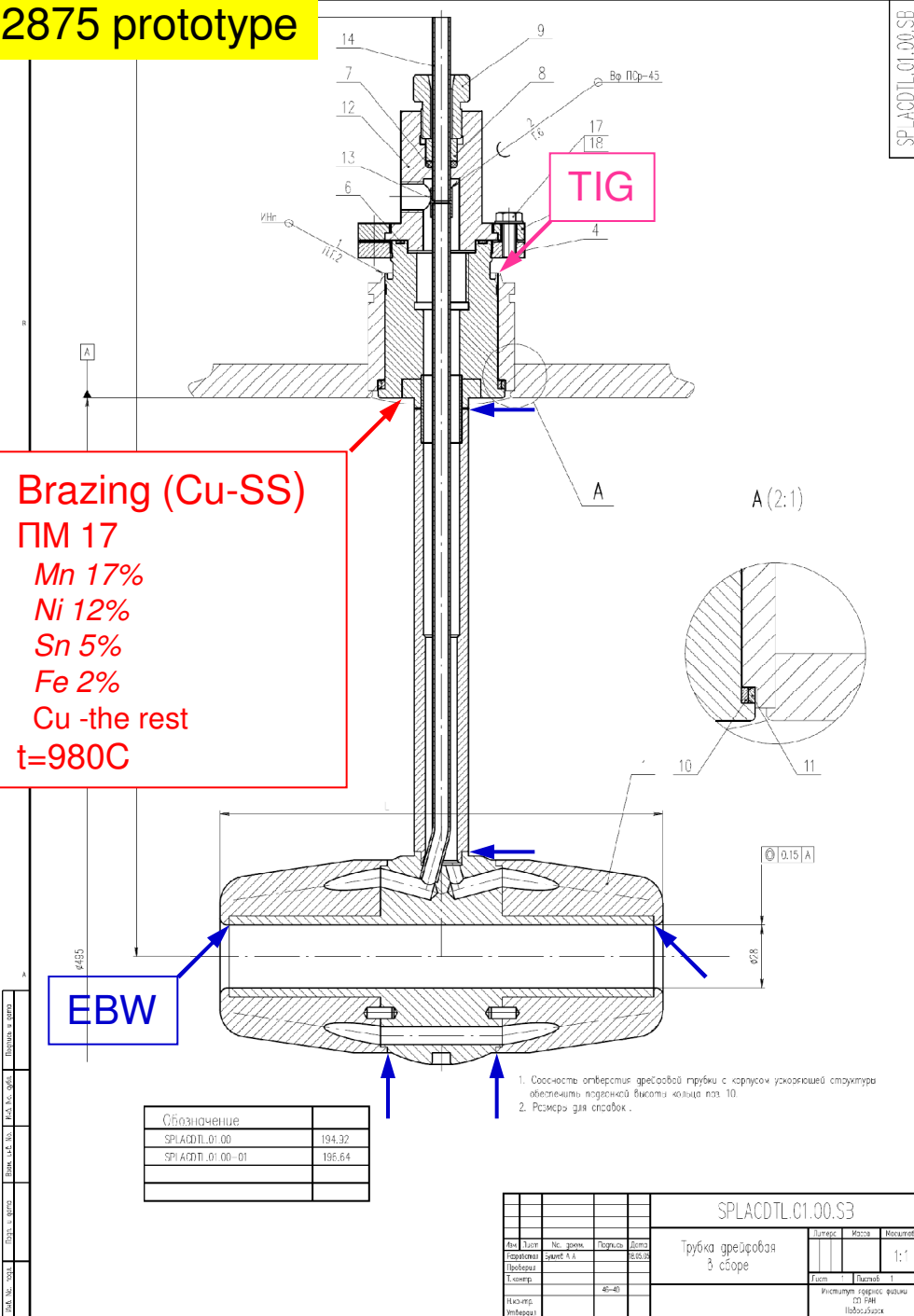


Drift tube mock-ups production

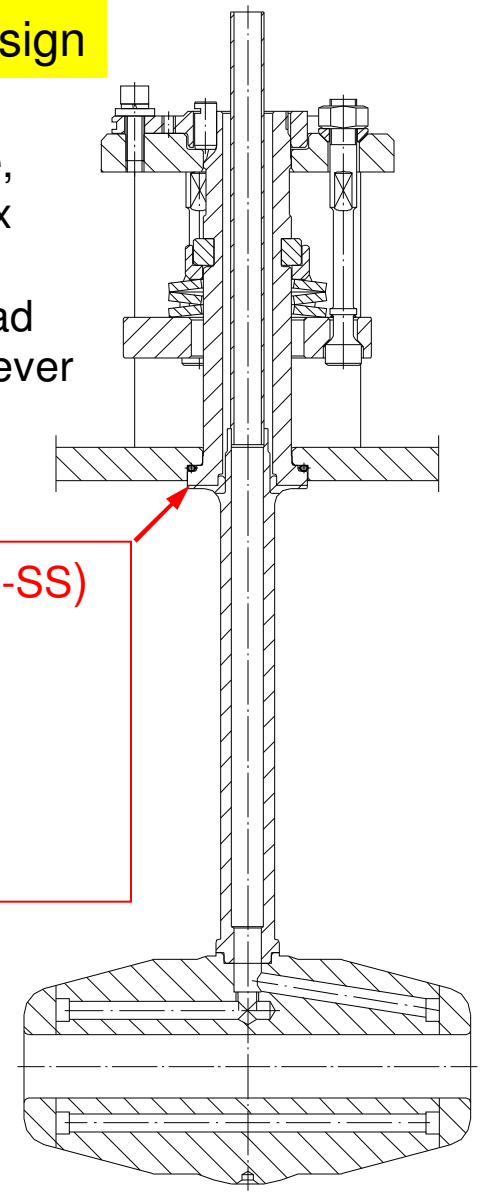
2875 prototype



3888/89 DT design

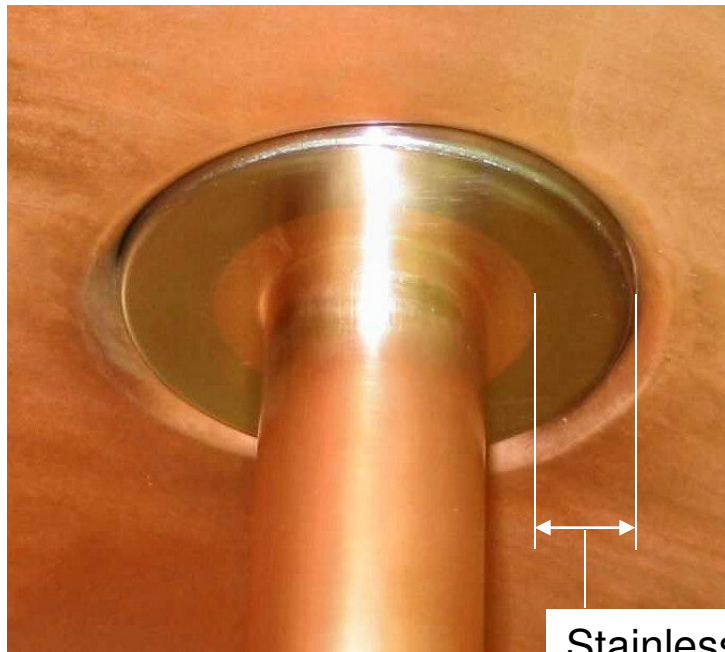
1. Dismountable, with Helicoflex joint
2. Brazing (Cu-SS) instead of EBW wherever possible

Brazing (Cu-SS)
 ПМ 17
 Mn 17%
 Ni 12%
 Sn 5%
 Fe 2%
 Cu - the rest
 t=980C



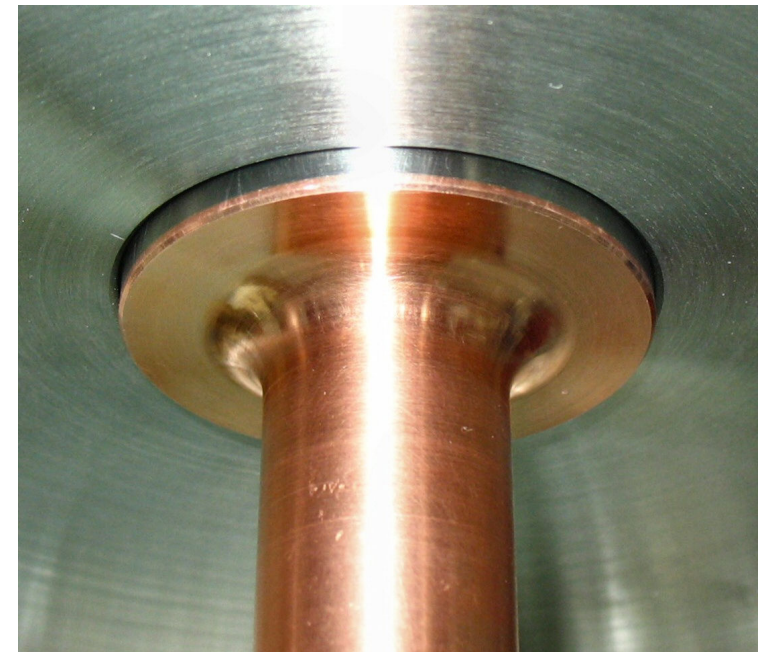
More on the next slide ...

2875 prototype



Stainless steel

3888/89 DT design

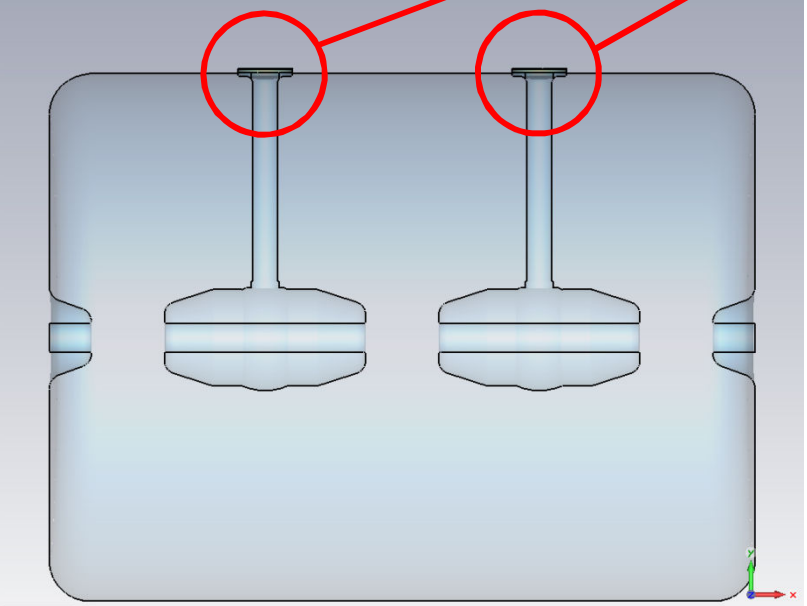


- Thicker stainless steel collar
- Less stainless steel exposed to rf fields

More on the next slide ...

Power loss estimation for the Helicoflex connection of stem and tank, where the joint sits on non-copper plated steel surfaces

ER, 10.08.2009



Losses over the region of interest (% of total losses in the tank)

	Cu	Stainless steel
Tank 1	0.317%	2.03%
Tank 21	0.195%	1.26%

More on the next slide ...

Material PEC
Type PEC
Therm.cond. PTC

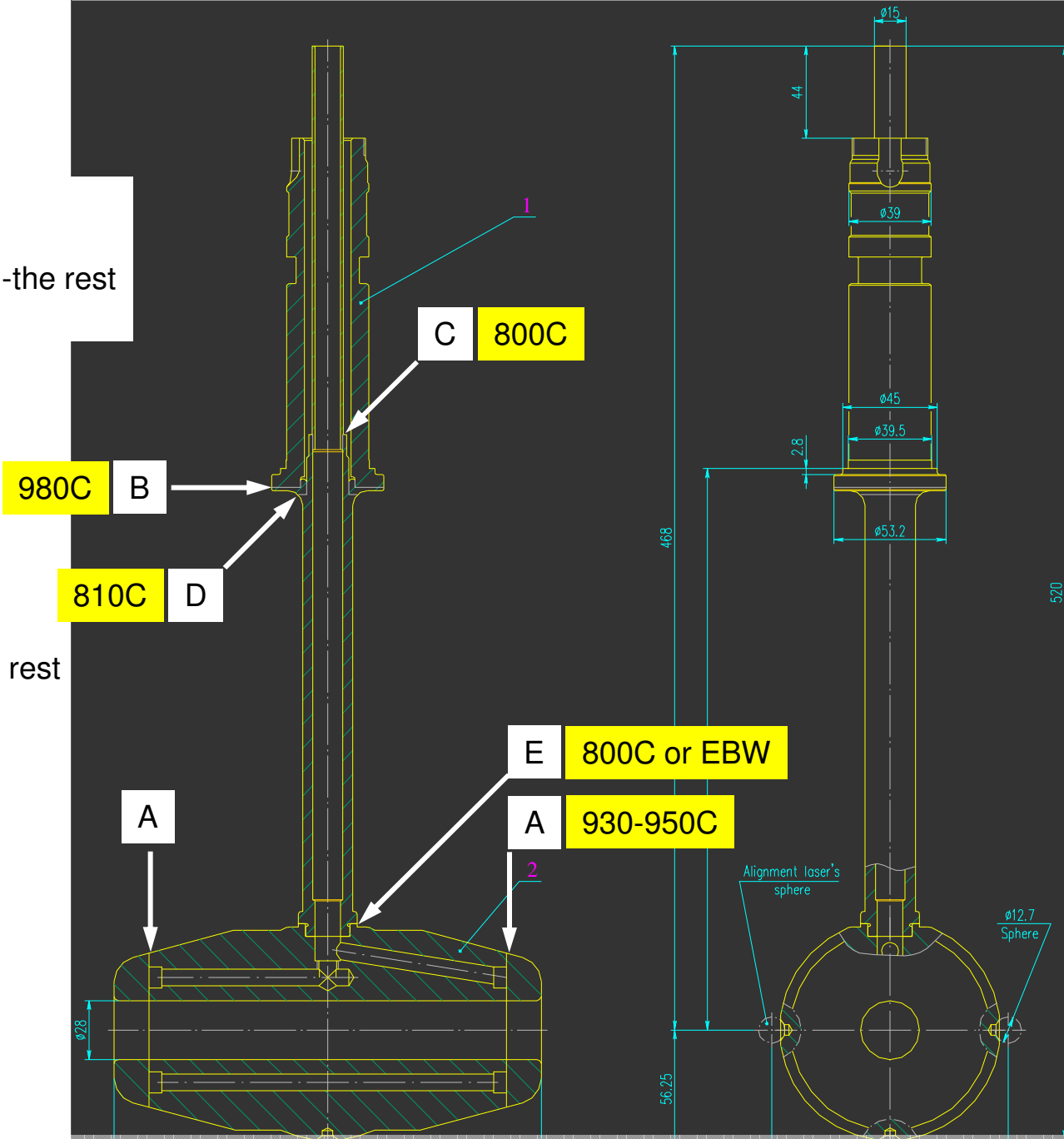
Joint A – Brazing (Cu-Cu)
ПЗЛМ 50В
Au 49.6-50.4%, Cu -the rest
t=930-950C

Joint B – Brazing (Cu-SS)
ПМ 17
Mn 17%, Ni 12%, Sn 5%, Fe 2%, Cu -the rest
t=980C

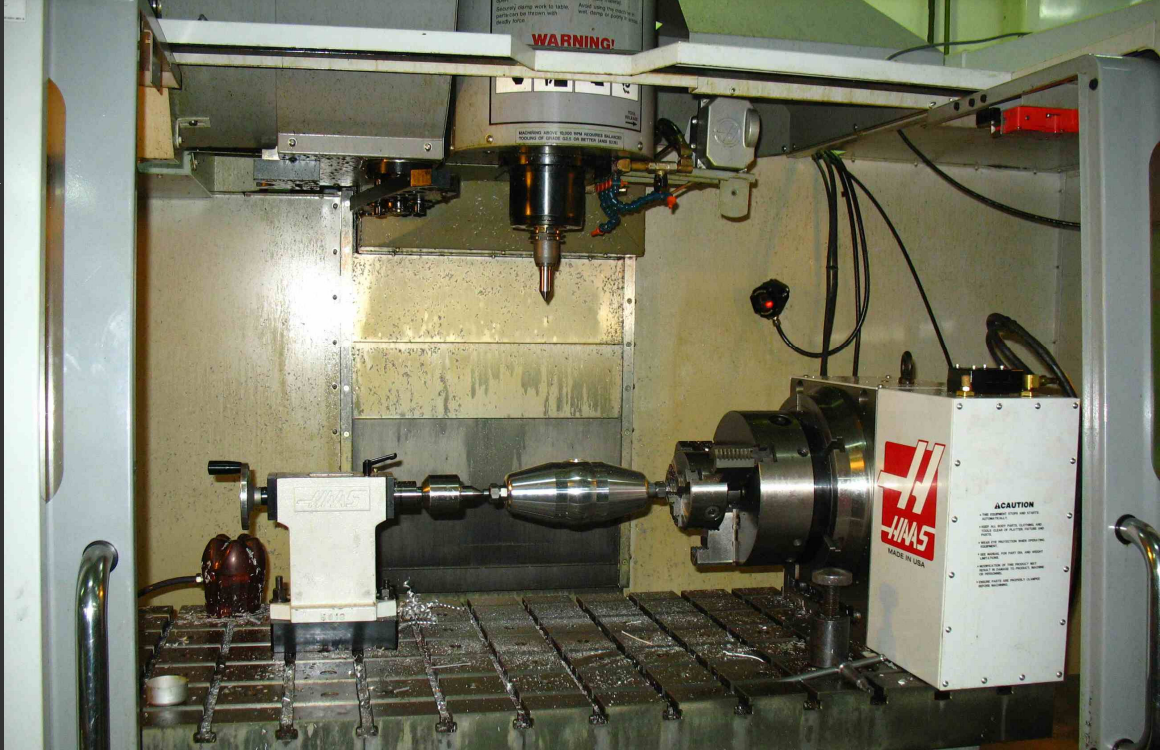
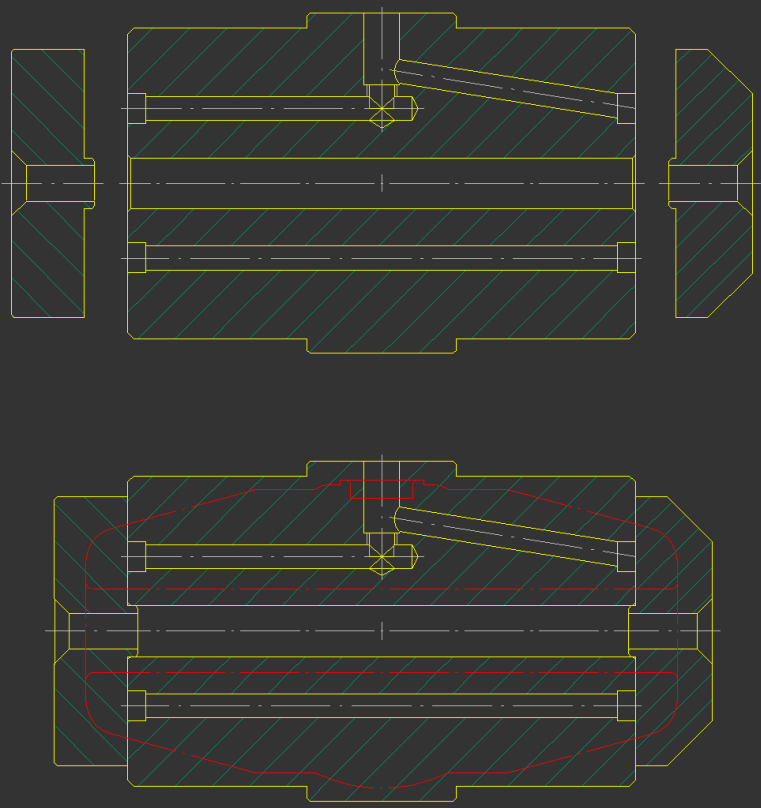
Joint C – Brazing (Cu-Cu)
ПСр 72
Ag 71.2-72.5%, Cu -the rest
t=800C

Joint D – Brazing (Cu-Cu)
ПСрМПд 68-27-5В
Ag 67.5-68.5%, Pd 4.5-5.5%, Cu -the rest
t=810C

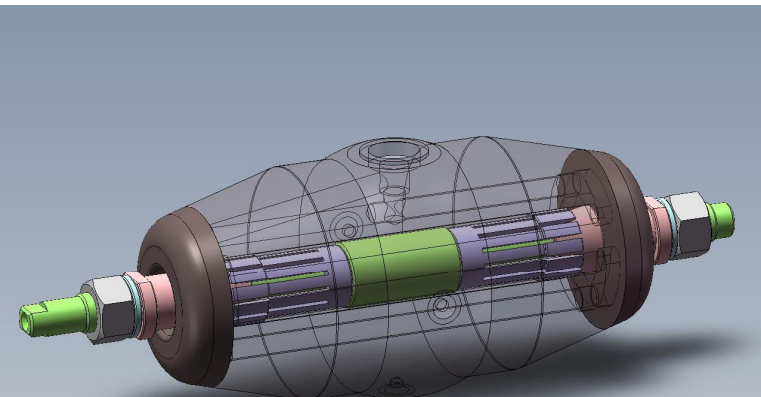
Joint E (the final joint)
– Brazing (Cu-Cu) or EBW
ПСр 72
Ag 71.2-72.5%, Cu -the rest
t=800C



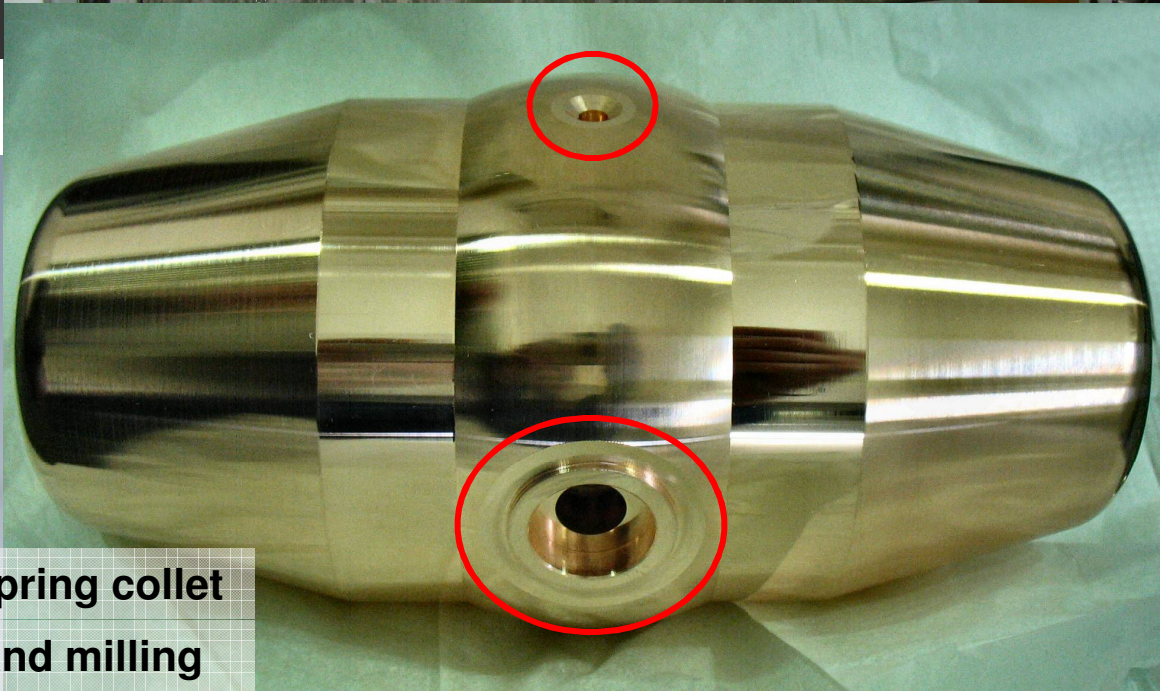
Too many “improvements”, need to prove the design and production technology !



Machining drift tube body



**DT is fixed on the shaft with finger spring collet
Same assembly is used for turning and milling**



***Stem and drift tube body connection
Option 1 - EBW***

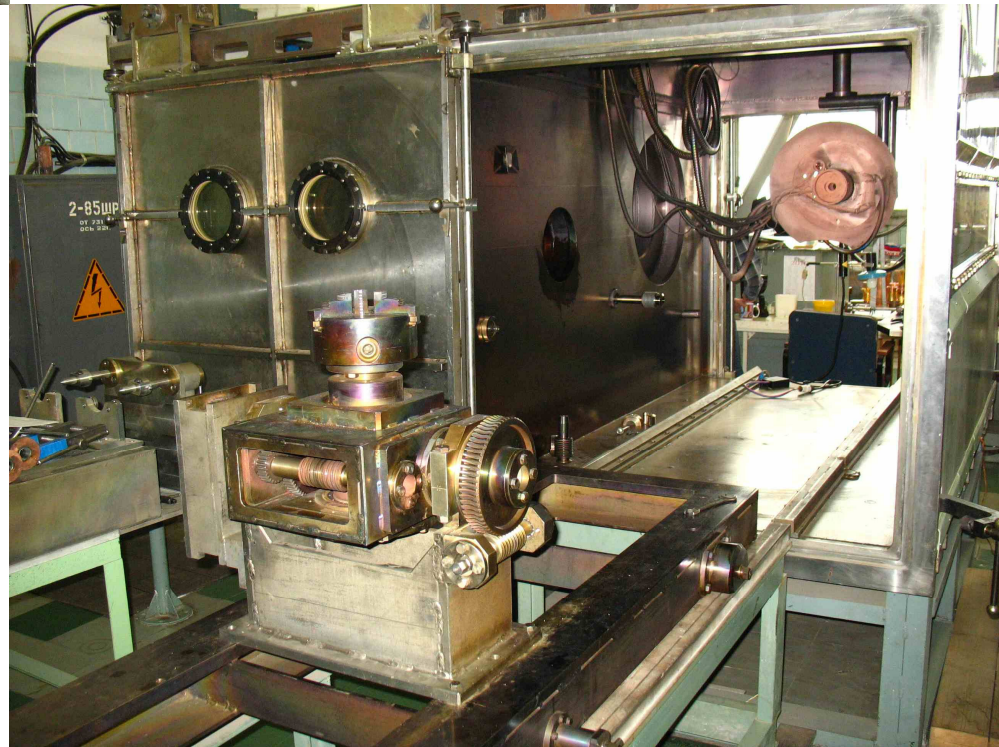


EBW machine at BINP

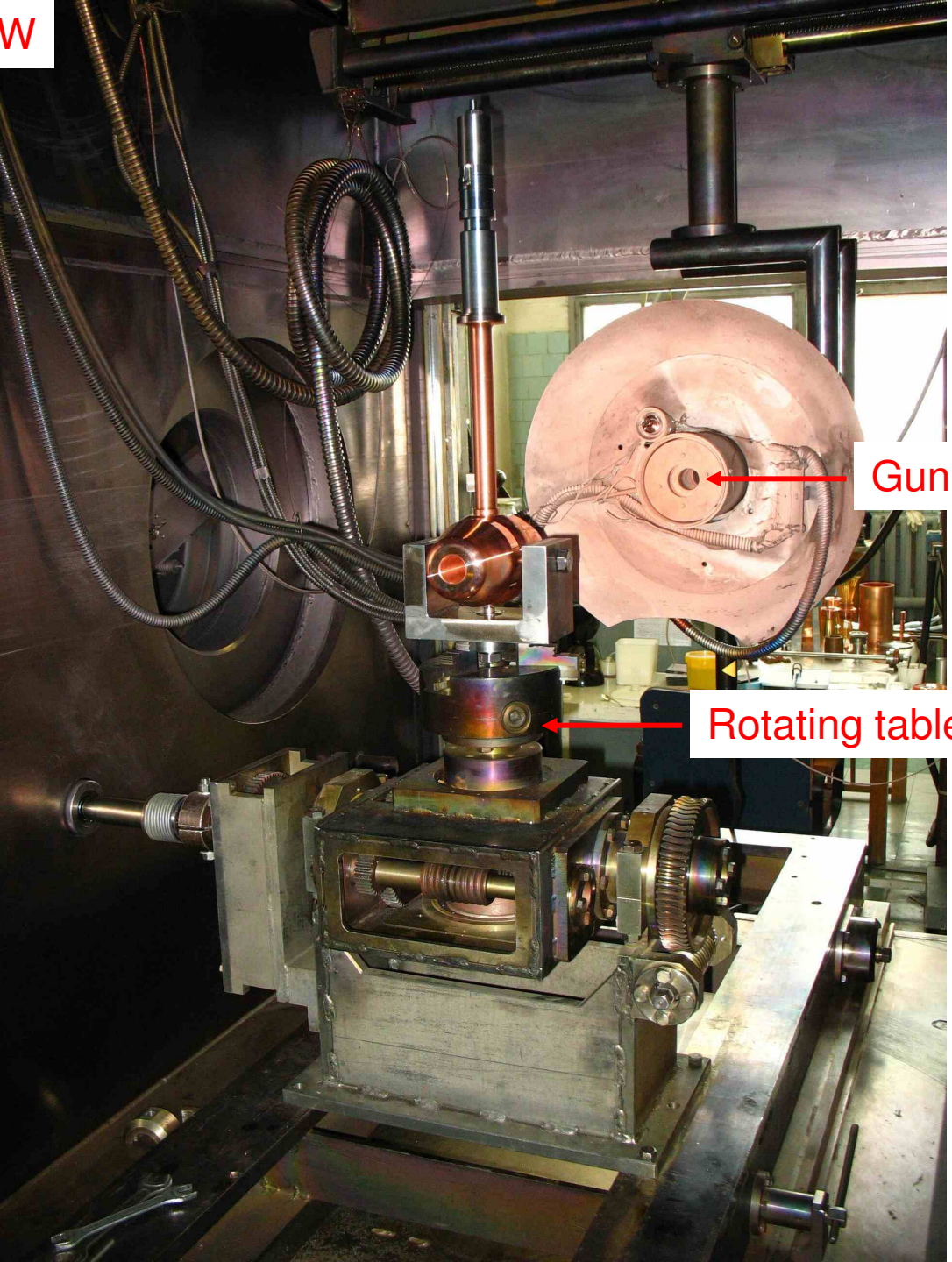
Chamber: 1.2 x 1.2 x 2m

Vacuum: 10^{-3} Pa

Gun: 60kV DC, 150mA max



Drift tube at the EBW



Gun

Rotating table

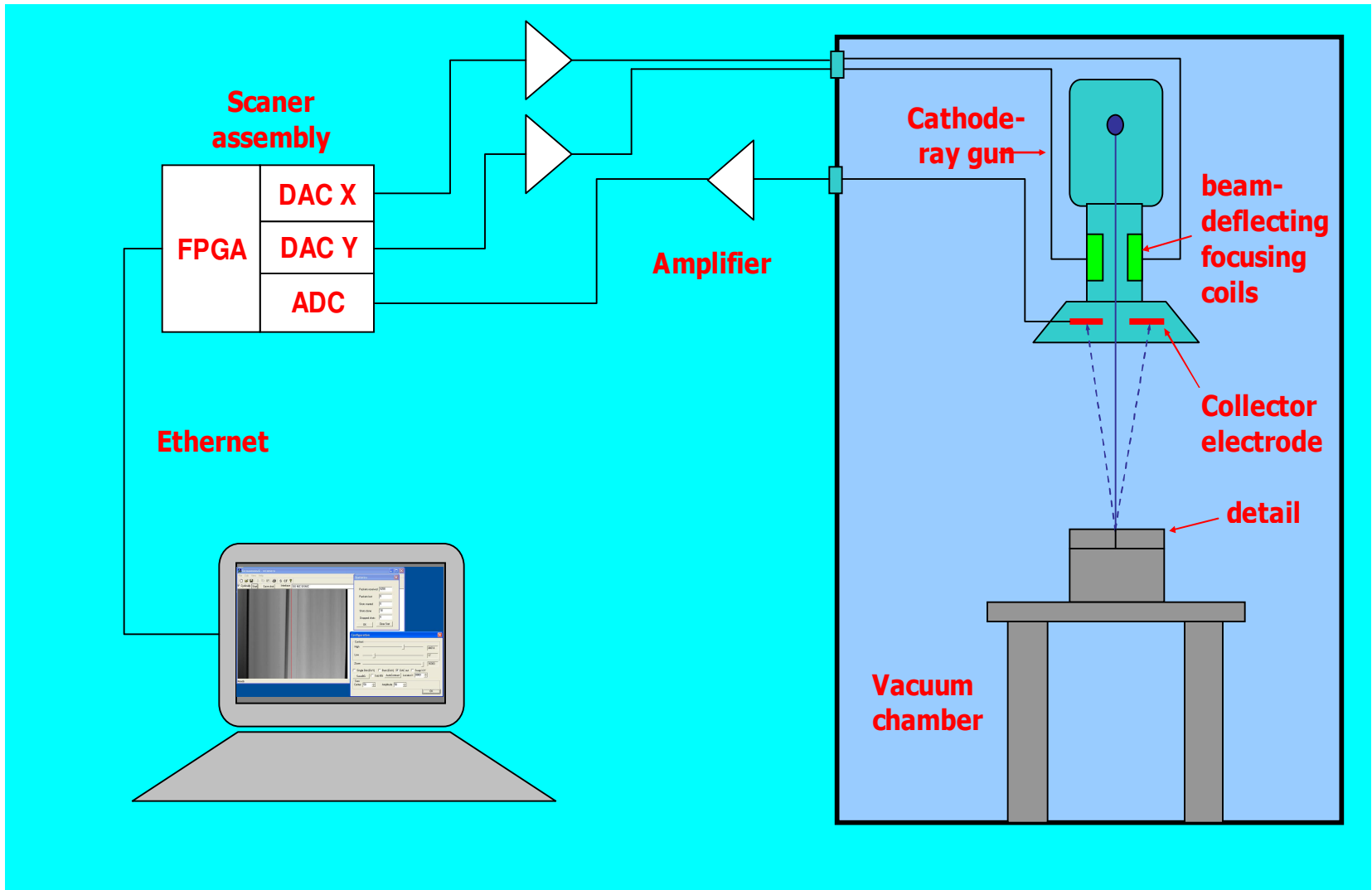
A close-up photograph of a metal stem being welded to a drift tube joint. The stem is a vertical, cylindrical metal rod with a polished, reflective surface. It is positioned vertically, and a horizontal metal component, likely the drift tube, is being welded to its base. The welding process is captured in a way that shows the texture of the weld and the surrounding metal surfaces. The background is blurred, showing a light blue wall and some indistinct shapes, suggesting a laboratory or industrial setting.

Stem to drift tube joint – single pass, no “smoothing”

Challenges:

1. Precise aiming, controlled welding depth
2. Preserving stem to drift tube axis perpendicularity

EBW aiming system



EBW aiming system

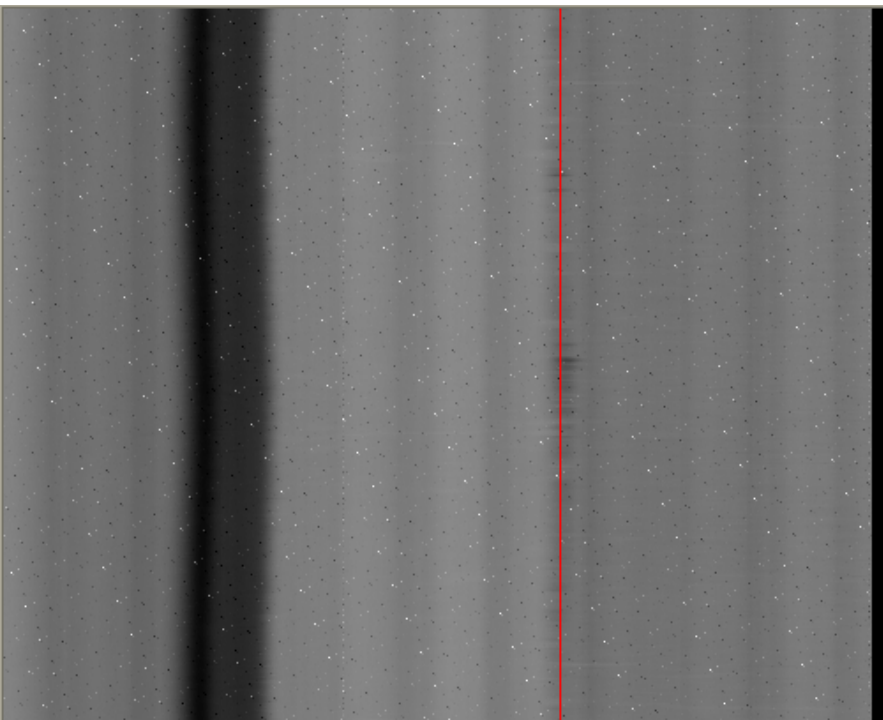
Low beam current one-dimensional scanning
(across the joint) while rotating the parts



Line of sight

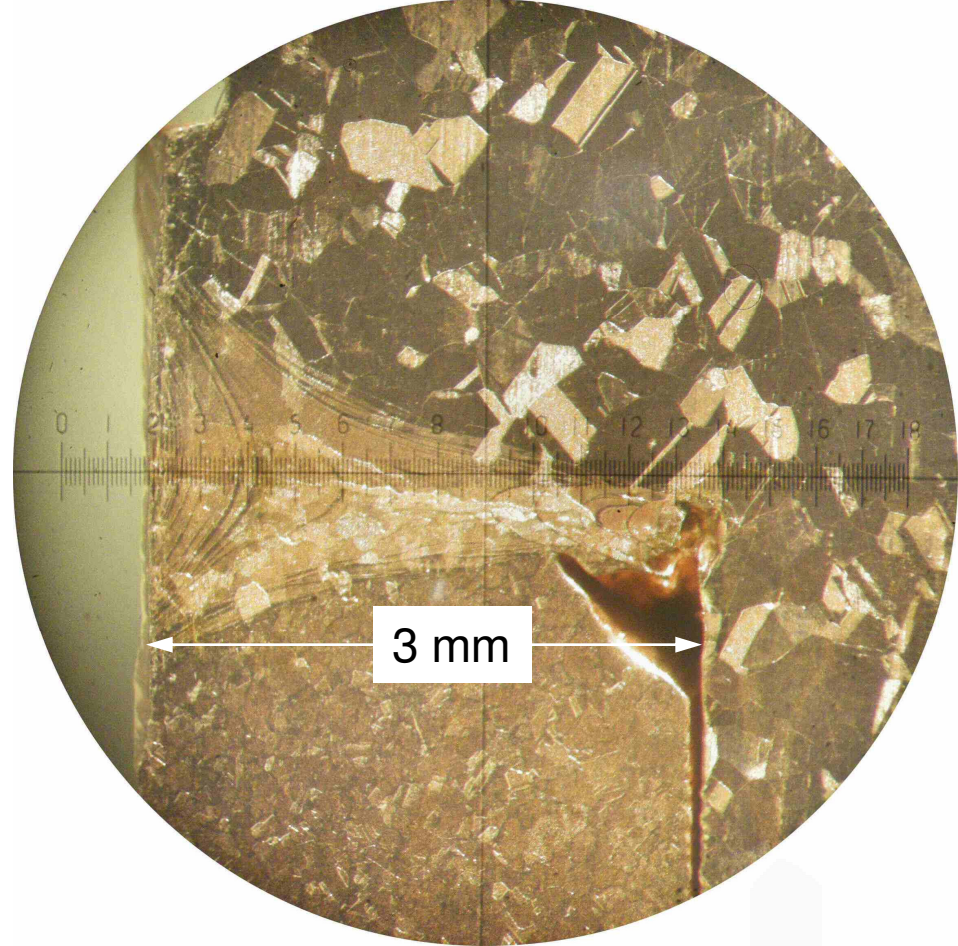
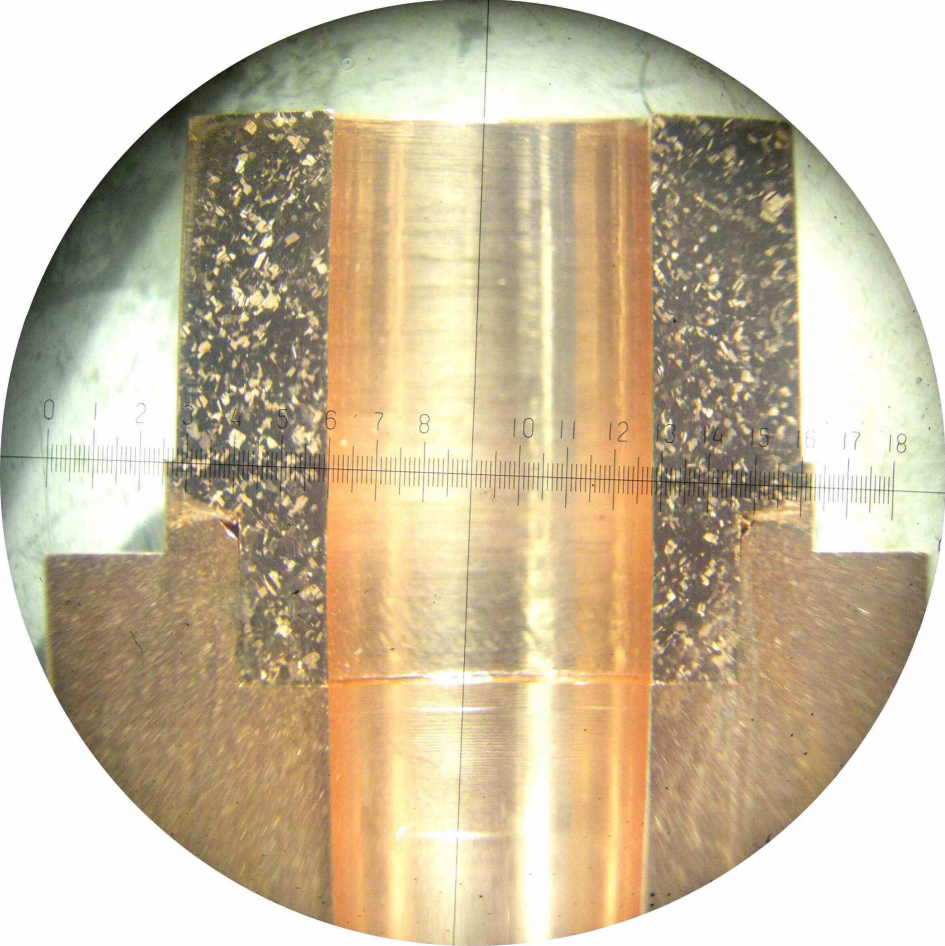
The diagram shows a dark, grainy background representing a scanning field. A vertical red line is positioned on the left side. A horizontal green arrow points from the text 'Line of sight' to the red line. A vertical green arrow points from the text 'Joint' to a vertical line in the center of the image.

Joint

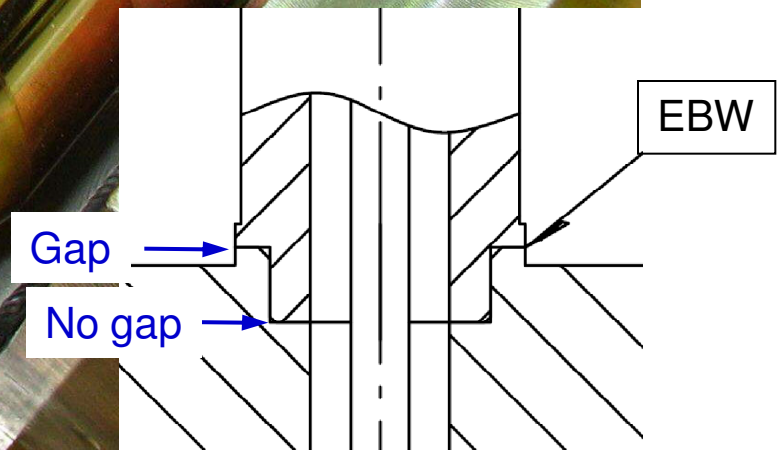
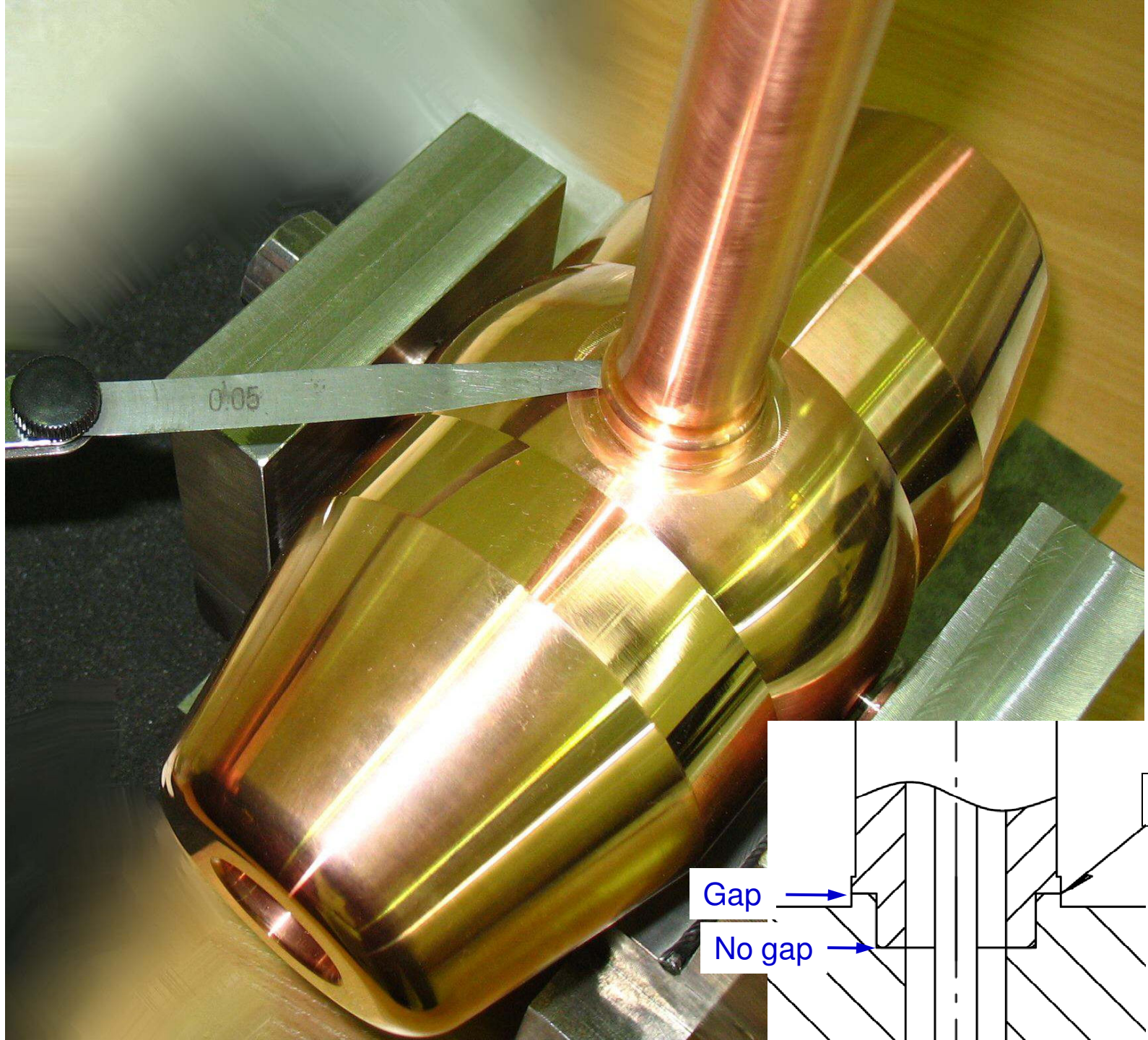


Aiming precision checked on samples is
better than 0.2 mm

This diagram is identical to the one above, showing a dark background with a vertical red line on the left and a vertical green line in the center. The text 'Line of sight' and 'Joint' are present but not explicitly labeled with arrows in this version.

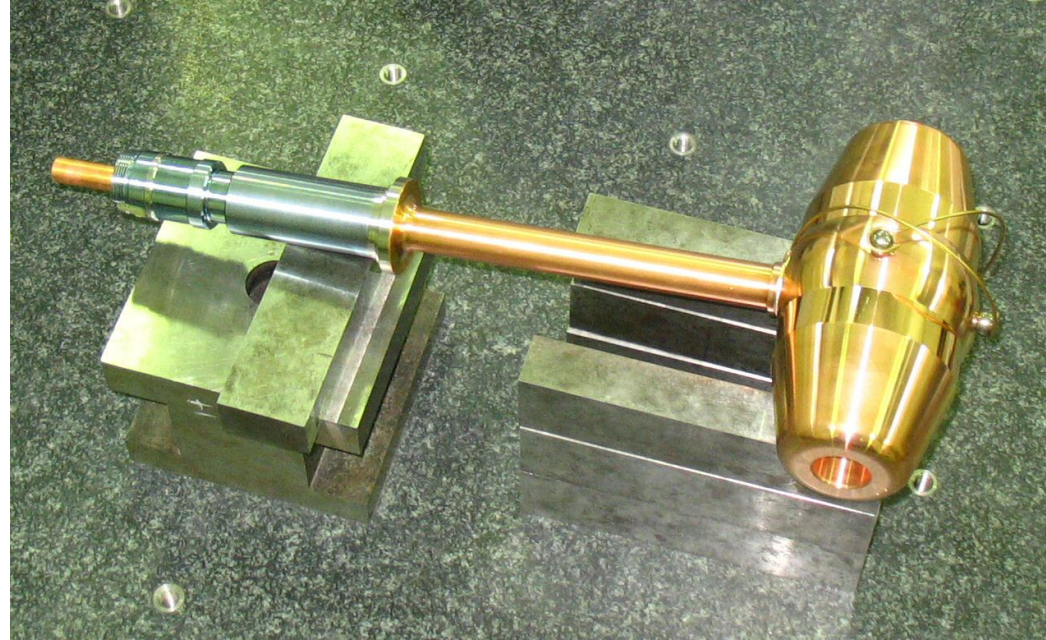


Stem to drift tube joint witness sample
(same welding regimes)

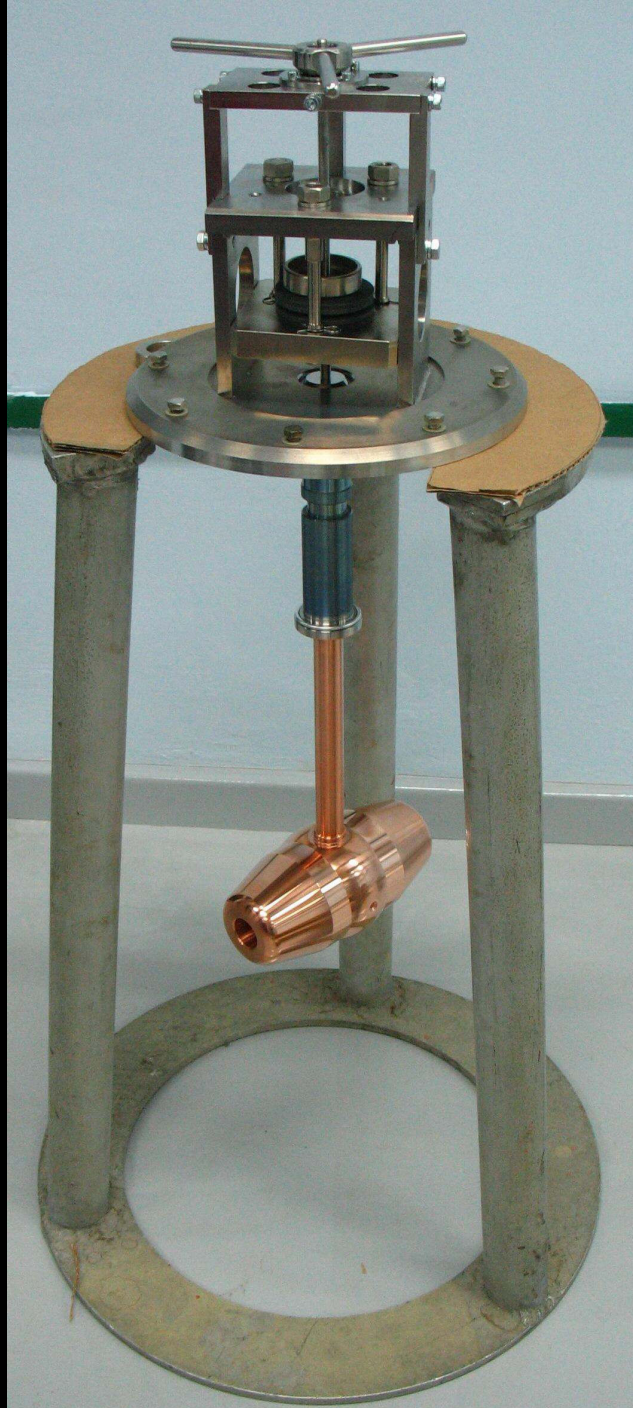
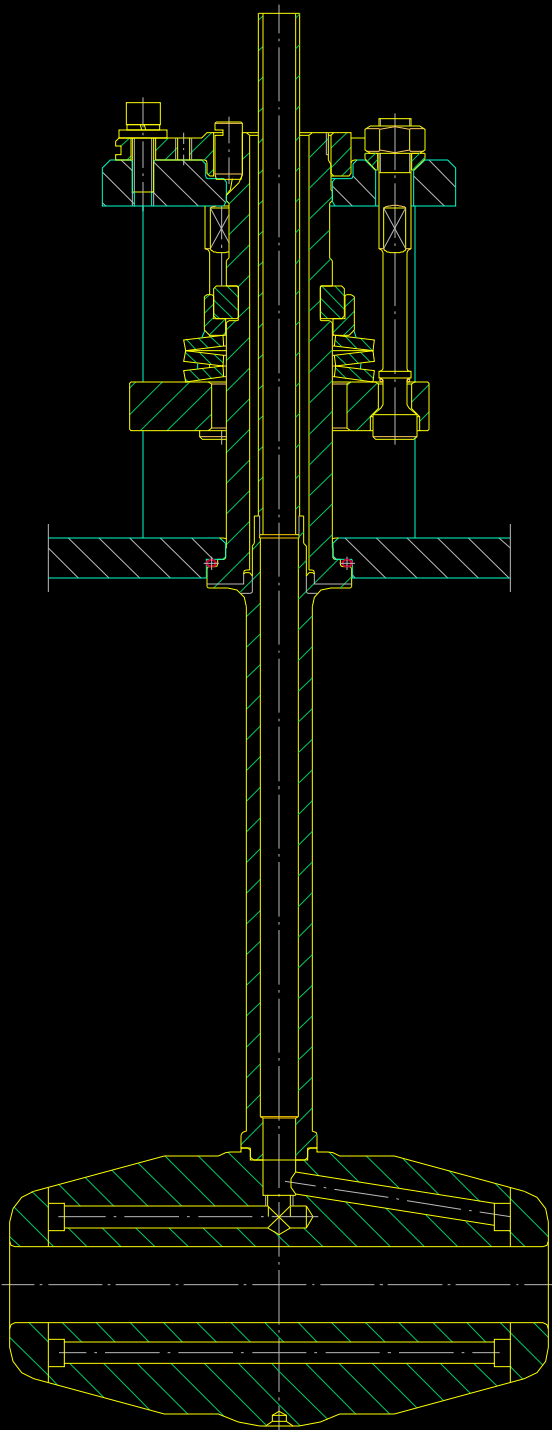




Inclination due to EBW is 4'



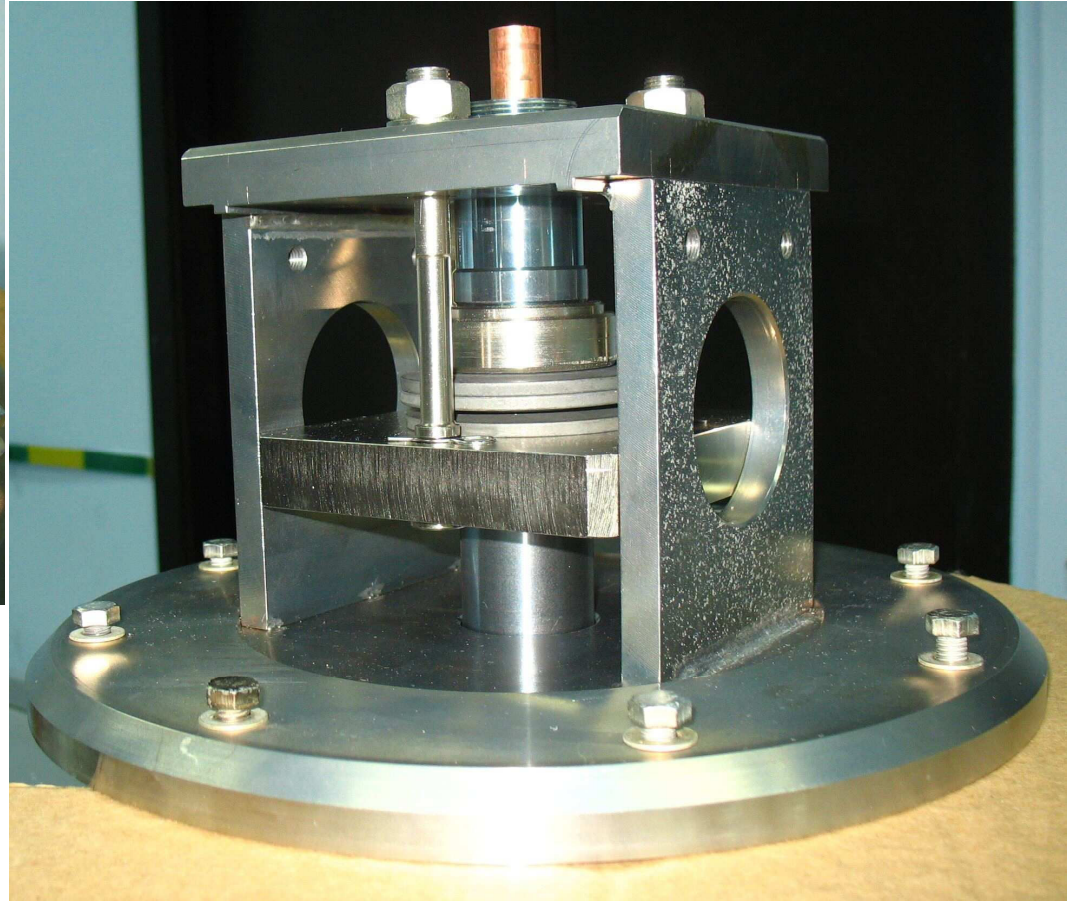
Balls from a ball-bearing instead laser tracker targets



DT test assembly



DT test assembly



Summary

We started seeking an alternative to EBW mainly because at the time of 2875 prototype production EBW machine and technology at BINP did not look reliable enough for DT welding. But we started an upgrade of EBW and now definitely are much more advanced in EBW than we used to be. So EBW in principle seems to be appropriate for every joint, may be except of one (see next slide).

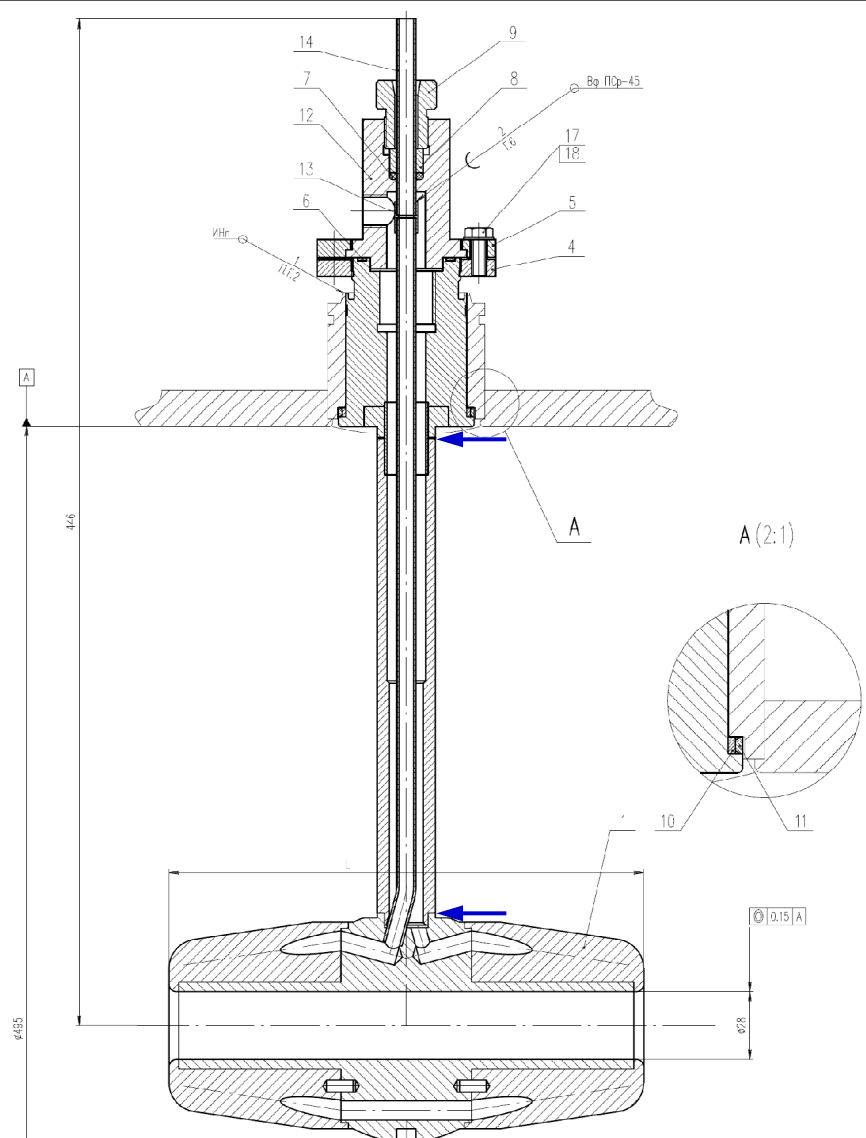
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But we also accepted that DT are to be machined after joining the parts in order to get into the “tunable” frequency range. This calls for brazing (rather than EB-welding) the DT bodies.

For the stem EBW looks more appropriate than brazing from “technological” point of view. But... (see next slide)

SP_ACDTL_01.00.SB



1. Способность отверстия древесной трубки с «корпусом» усложняющей структуры обеспечить заданной высоты кольца поз. 10.
2. Размеры для сборки.

Обозначение	
SPLACDTL_01_00	194.32
SPLACDTL_01_00-01	196.64

SPLACDTL_01.00.S3					Лист	Изда	Масштаб
Имя	Тюль	№. докум.	Получен	Дата	1	1	1:1
Проектиров	Судет	4.А	8.03.18				
Т. номер		45-40			Исполн	Провер	
Исполн					Институт гидроэкологии		
Исполн					СП ИАИ		
					Издательство		

But if we used EBW for the upper joint an inclination due to EBW (~4') would bring the bottom end of the stem by 0.3 mm off the beam axis. So we tend to brazing the upper joint with subsequent machining to make sure the stem is straight. Unless we foresee bending the stem afterwards.

Although for the lower joint the situation is less critical.

Summary

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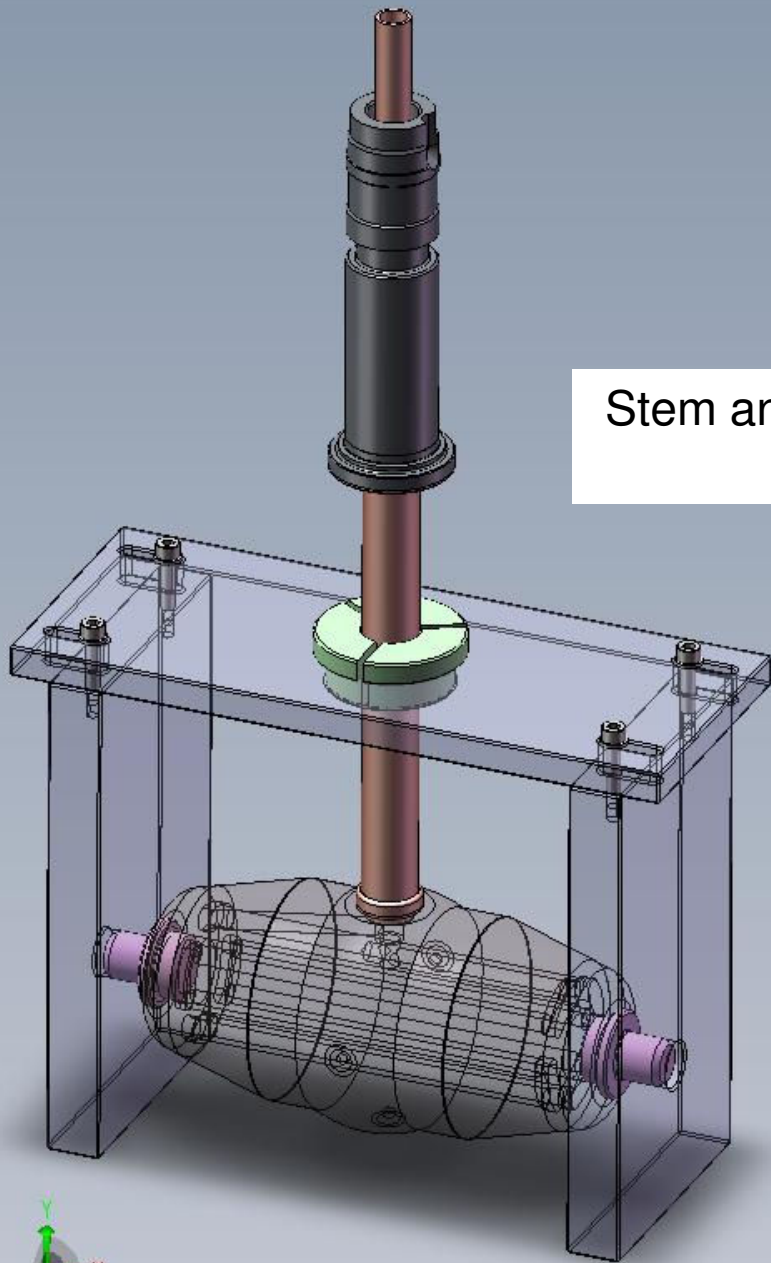
Conclusions

We are in favour of brazing the DT body (with golden alloy).

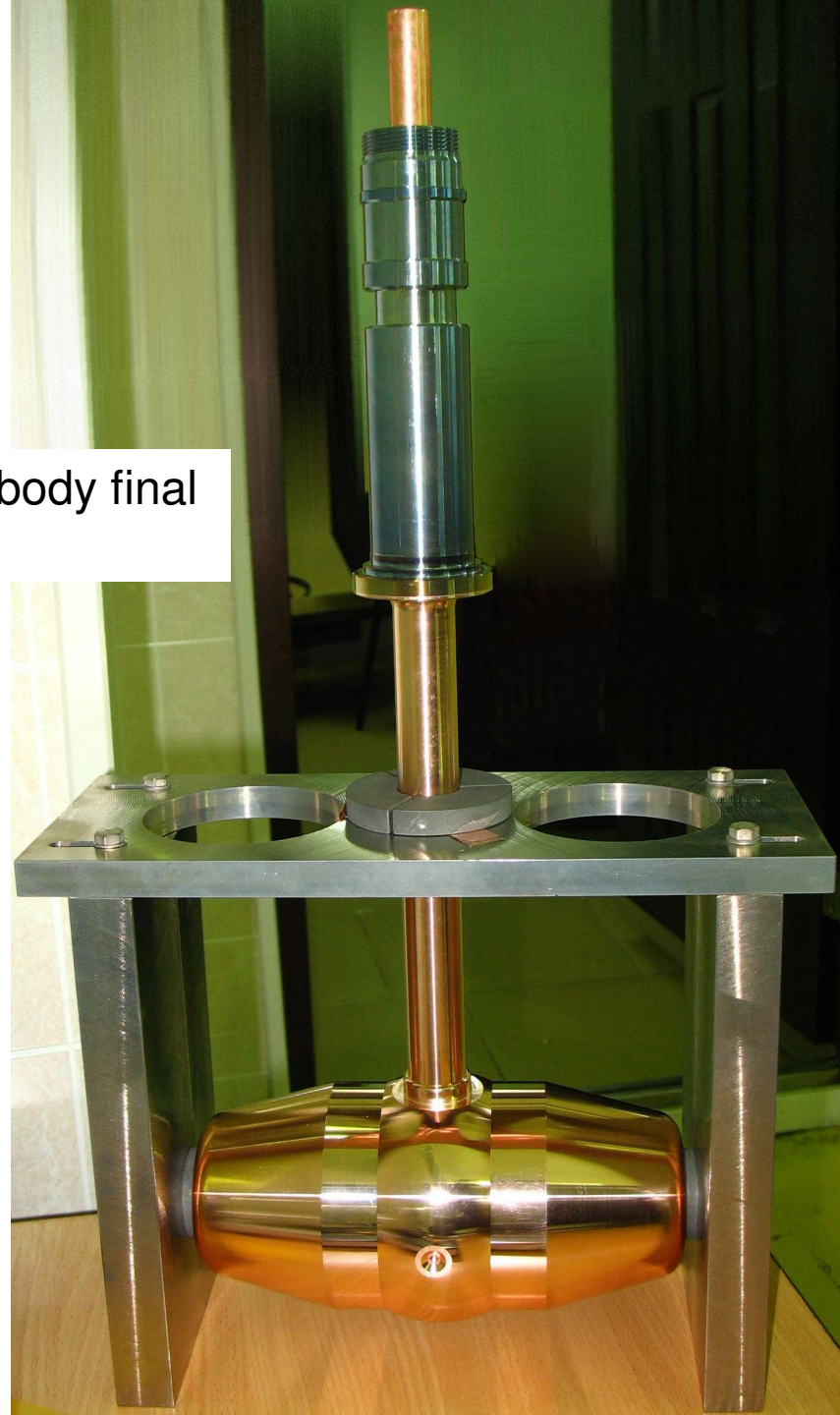
We tend to brazing the stem upper joint (with silver alloy).

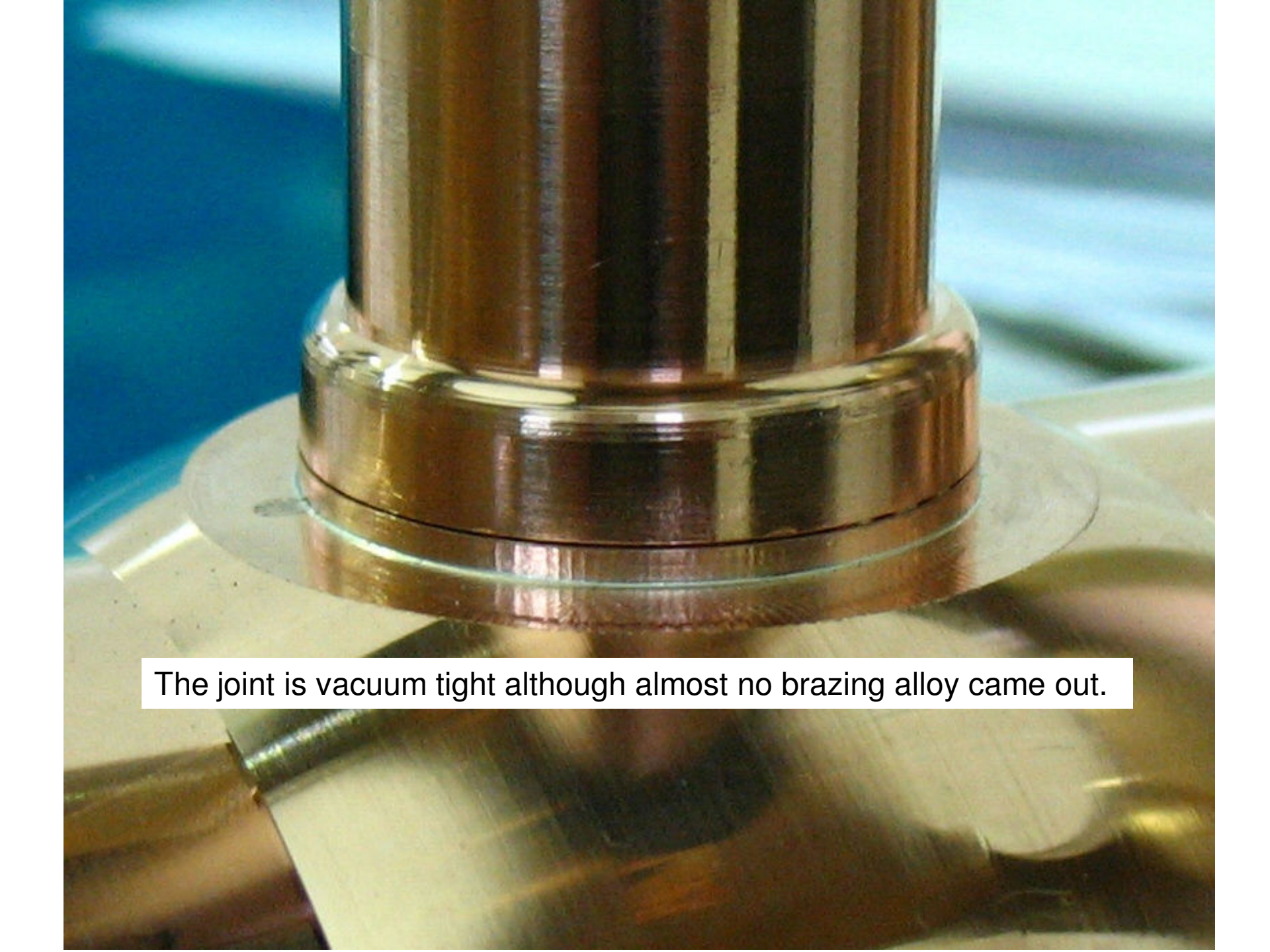
We are quite confident about EB-welding of the stem to DT joint.

***Stem and drift tube body connection
Option 2 - Brazing***



Stem and drift tube body final
brazing



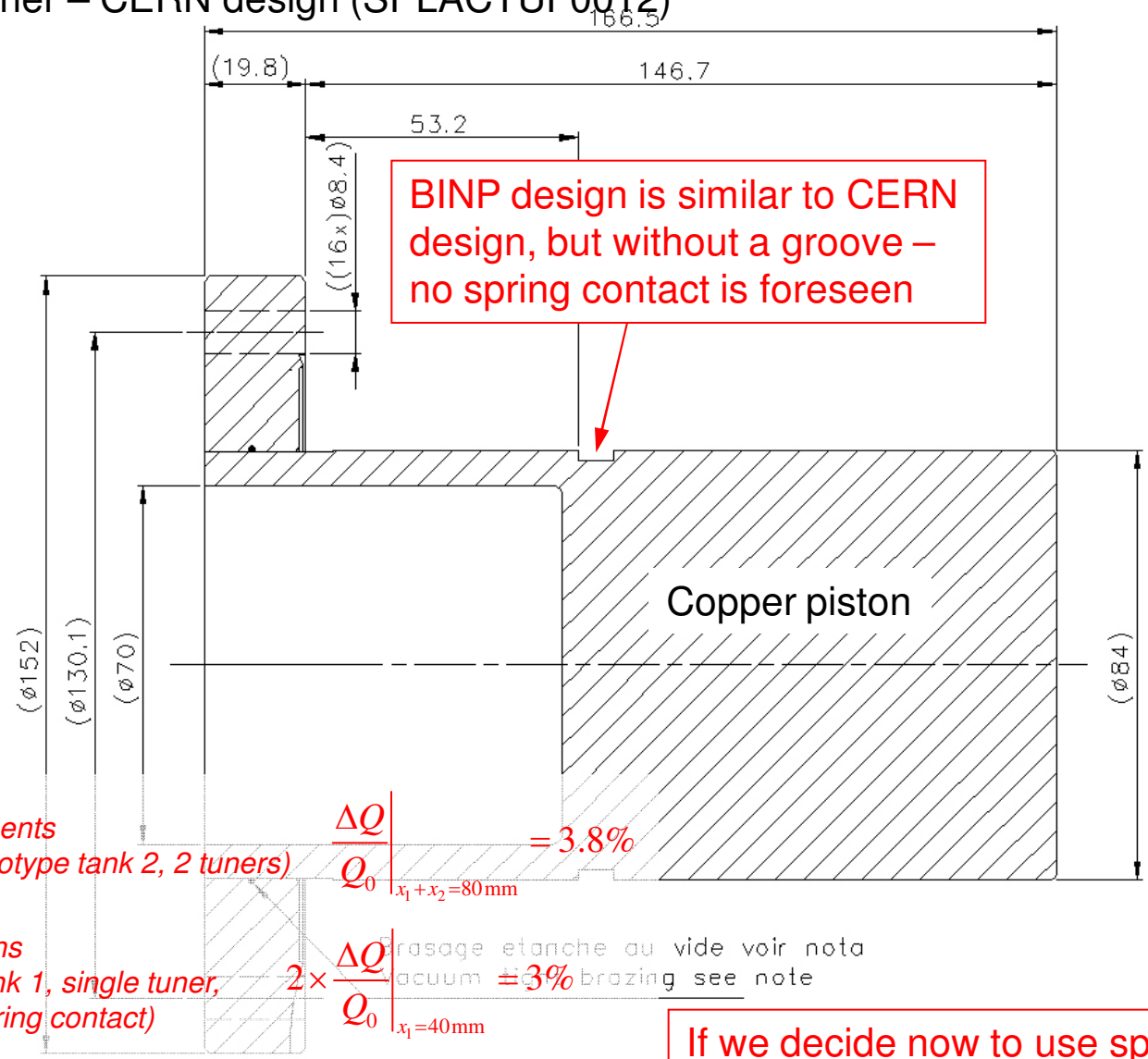
A close-up photograph of a vacuum-tight joint between two copper components. The upper component is a vertical cylindrical tube with a slightly flared bottom edge. It is seated on a circular copper base. The joint is formed by a thin, uniform layer of copper that has fused to the inner surface of the tube's bottom edge and the top surface of the base. The copper has a bright, metallic sheen. The background is a blurred blue surface.

The joint is vacuum tight although almost no brazing alloy came out.

More design issues

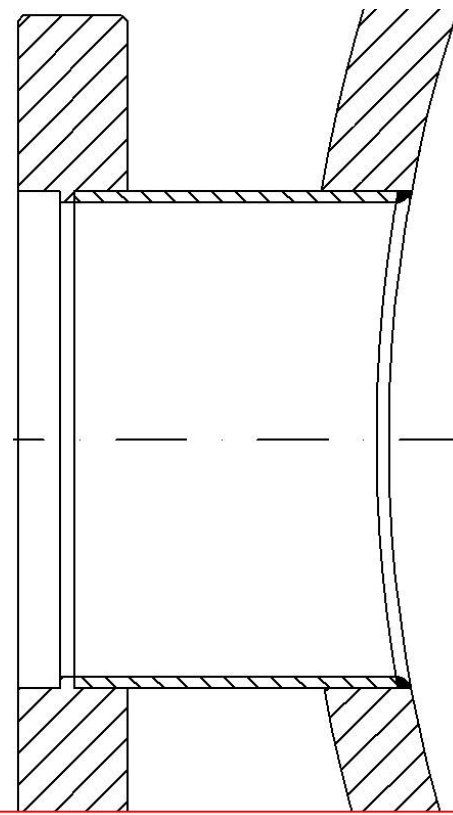
Ports / Tuner

Fixed tuner – CERN design (SPLACTUF0012)



BINP design is similar to CERN design, but without a groove – no spring contact is foreseen

Copper piston



Measurements
(ISTC prototype tank 2, 2 tuners)

$$\frac{\Delta Q}{Q_0} \Big|_{x_1+x_2=80\text{mm}} = 3.8\%$$

Calculations
(Linac4 tank 1, single tuner, without spring contact)

$$2 \times \frac{\Delta Q}{Q_0} \Big|_{x_1=40\text{mm}} = 3\%$$

brassage étanche au vide voir nota
vacuum \neq 3% brazing see note

Calculations
(Linac4 tank 1, single tuner, with spring contact)

$$2 \times \frac{\Delta Q}{Q_0} \Big|_{x_1=40\text{mm}} = 1.5\%$$

If we decide now to use spring contacts or reserve the possibility to take the decision later on, we need to specify precisely the groove dimensions and the port inner diameter.