



**experience with UHV-leaks on 1500 units of
BPM-buttons at the ESRF in 2016**



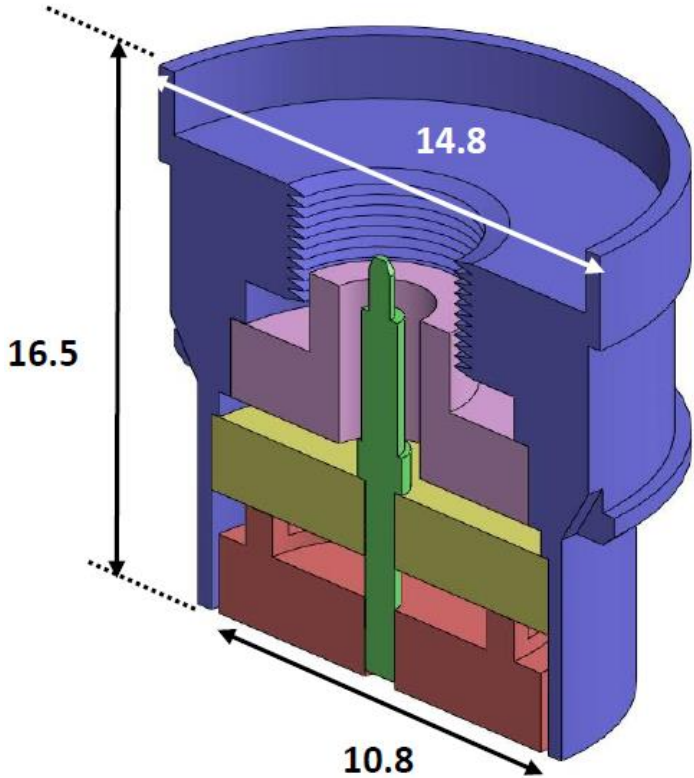
***Kees Scheidt, ESRF,
ASD, diagnostics group***

contents

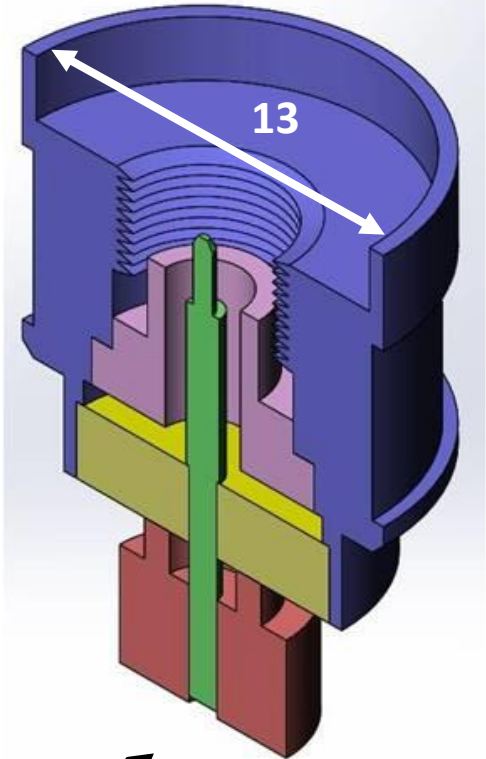
- 1) rapid review of our design considerations, prototypes, tender-exercise, specifications
- 2) **first experience** of leaks until **clear discovery** of the real cause, with X-ray CTs
Dec. 2016 - - - - - **→ May 2017**
- 3) sorting-out after massive CTs (on individual BPMs) is a partial failure ...
metalurgic analysis to confirm the unsuitable steel in more details
- 4) specific leak-test, down to $1E-10$ (mbar litre / sec) to really sort-out bad units
- 5) further discoveries with X-ray CTs on these BPM buttons
- 6) conclusion : lessons to learned ... and to be shared !
- 7) side issues : calibration techniques/methods (pre-commissioning)

OLD, served reliably >25 years

old button, serving since 1992,
~1000 in Storage Ring, ~300 in Booster



- smaller dimensions
- "skirt" removed
- stringent tolerances



1500

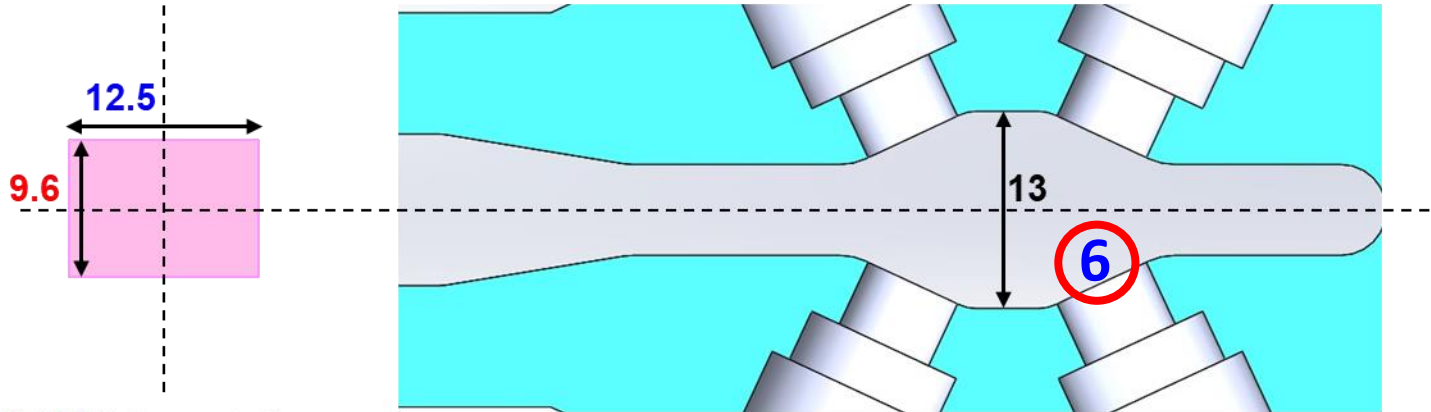
600 with 6mm
900 with 8mm

total costs < 400 Keuros
< 230 euros per unit

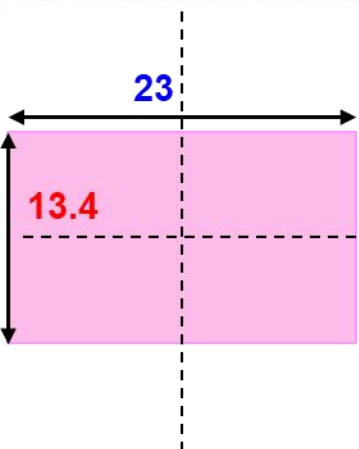
6 or 8mm buttons for 2 different geometries

$K_x = 4.7$
 $K_z = 7.4$

BPM no.
4 5 6 7

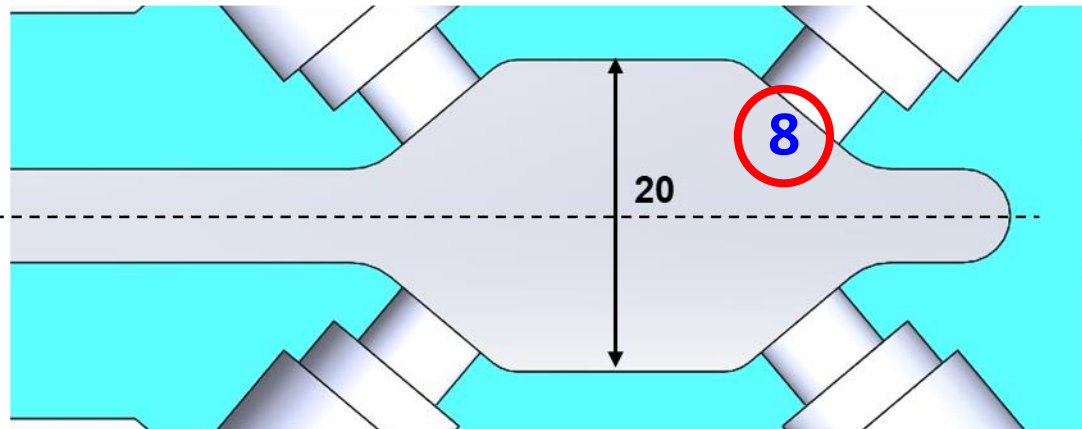


H & V distances between
the center of the 4 buttons



$K_x = 6.5$
 $K_z = 16.4 \dots$

BPM no.
1 2 3 8 9 10



PMB version

g6 = -6/-17um

Price : 10 235 Euros for 15 units
682 Euros/unit

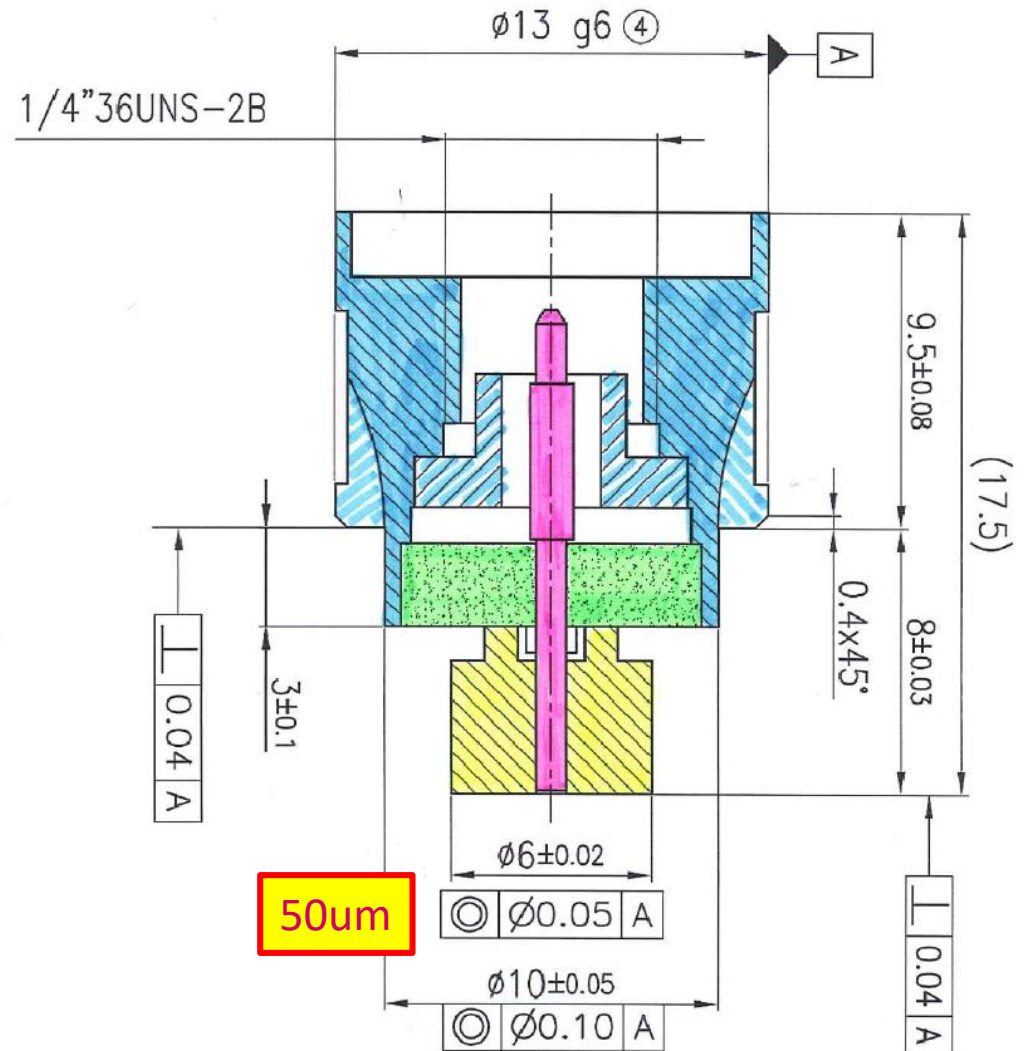
Expected unit price for >1000 units
229 Euros

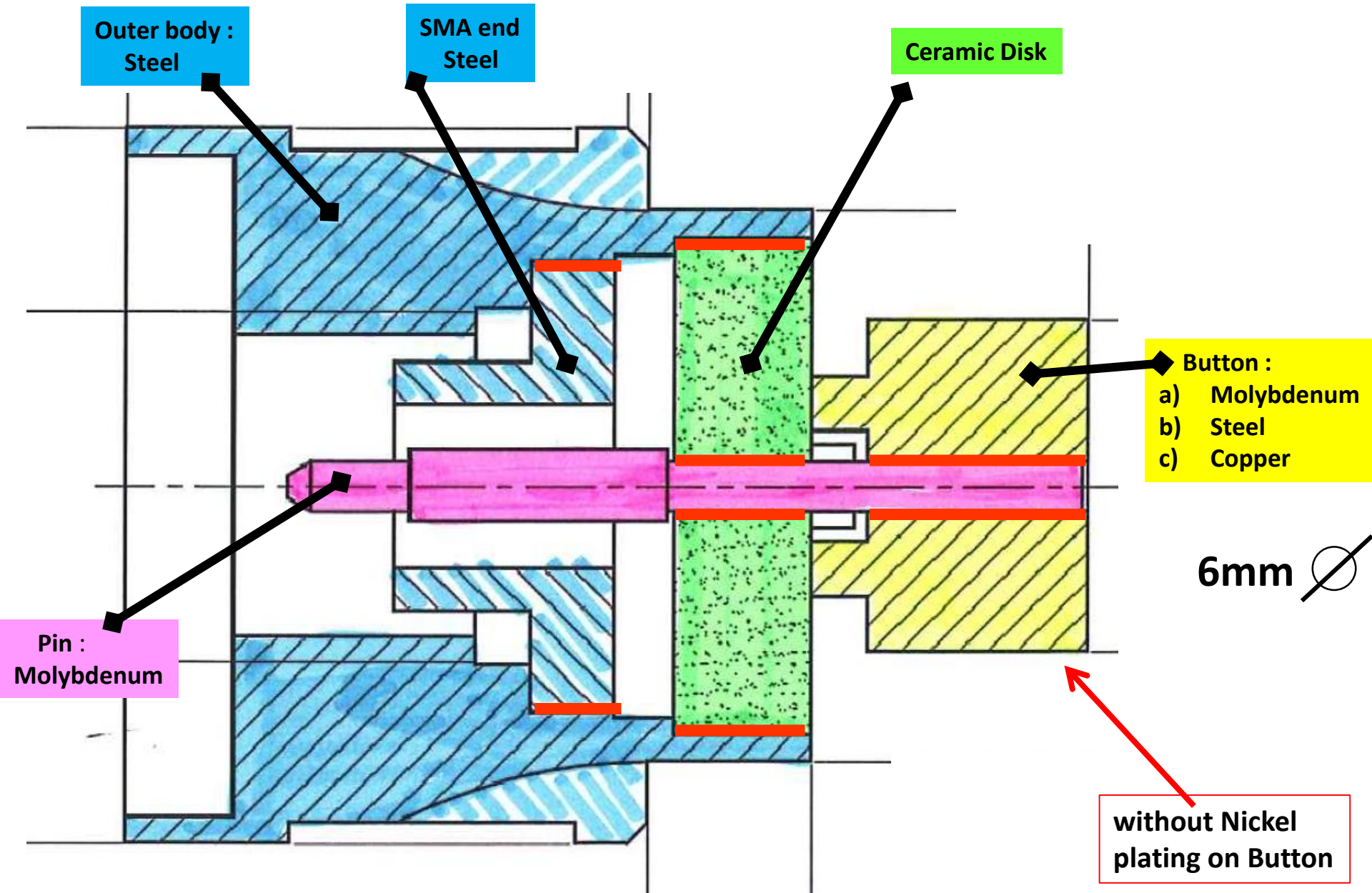
all tolerances accepted ,

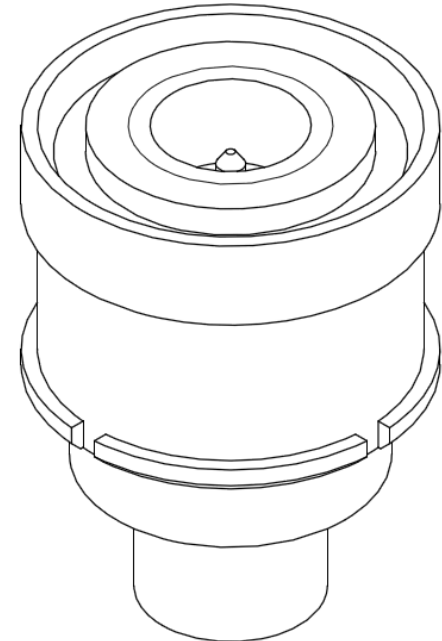
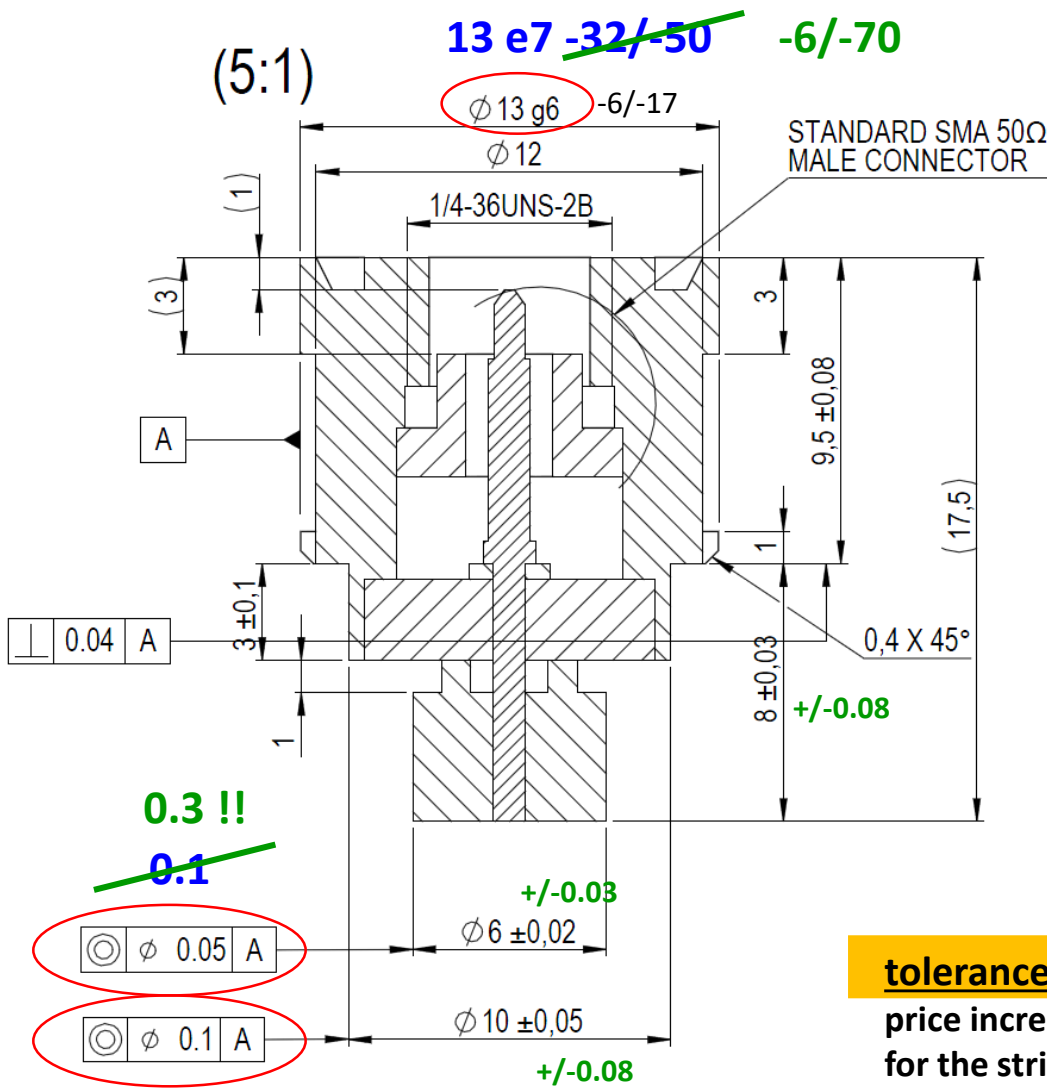
ordered (4/12/2013) ,

delivery next week,

installation in May shut-down







tolerances are problematic :

price increase from 830 to 1900 Euros for the stringent ESRF tolerances,

Finally agreement on button tolerance of 100um ... (and price is back to 830 Euros)

Brazing technology NOT the same with Kyocera :

15th Nov. 2013

Detail design for SMA connection will be studied later.

Stainless Steel 304L
(Ni plated for brazing purpose)

Stainless Steel 304L

Metallization (MoMn)

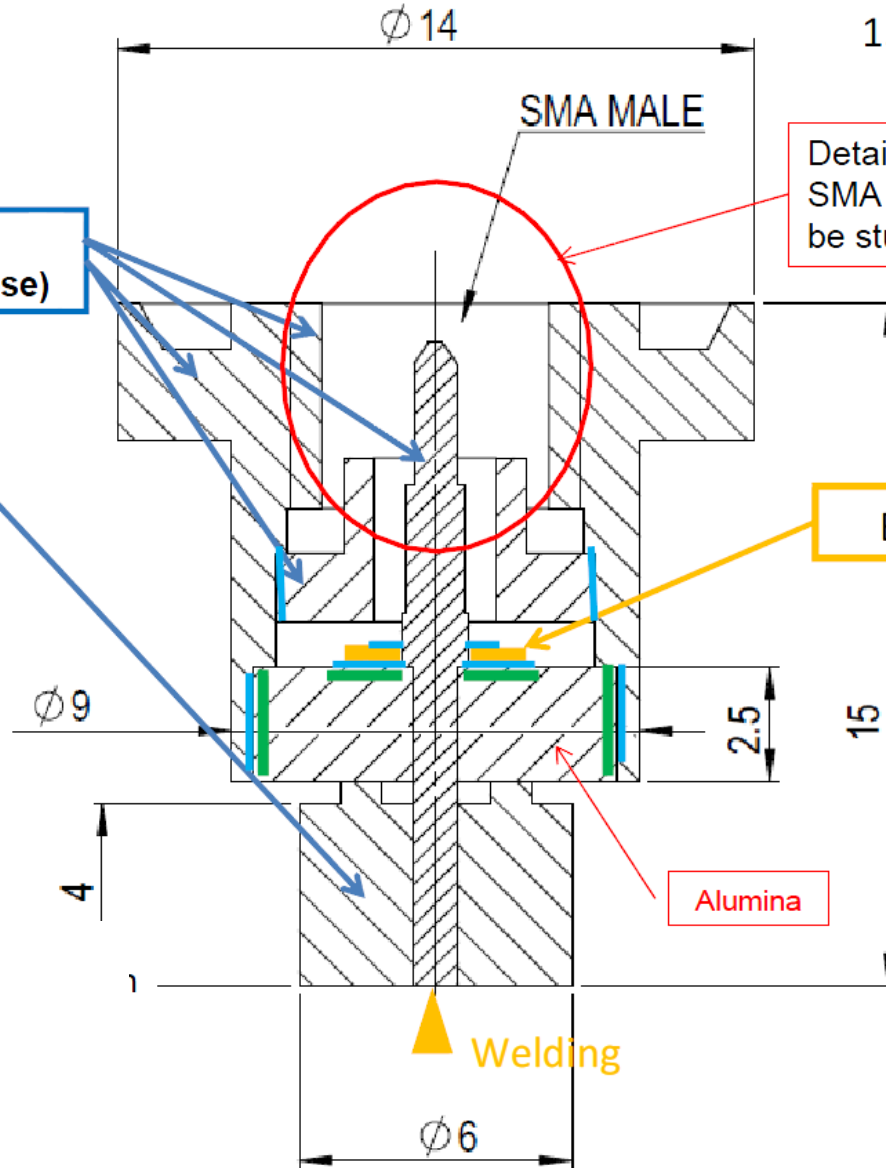
Brazing

Brim (Cu)

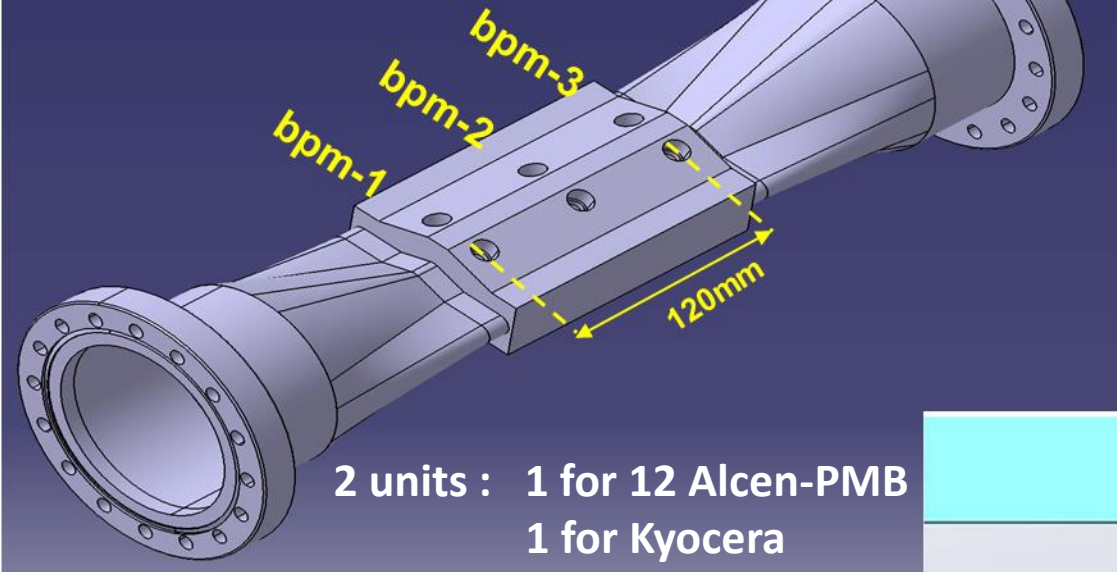
we did not like
this Cu brim ... !

Alumina

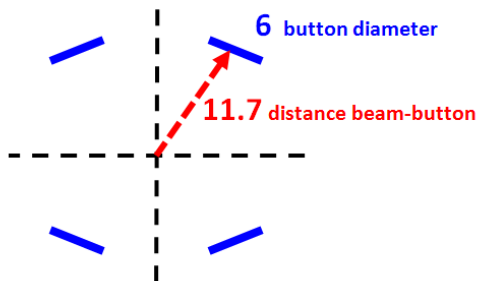
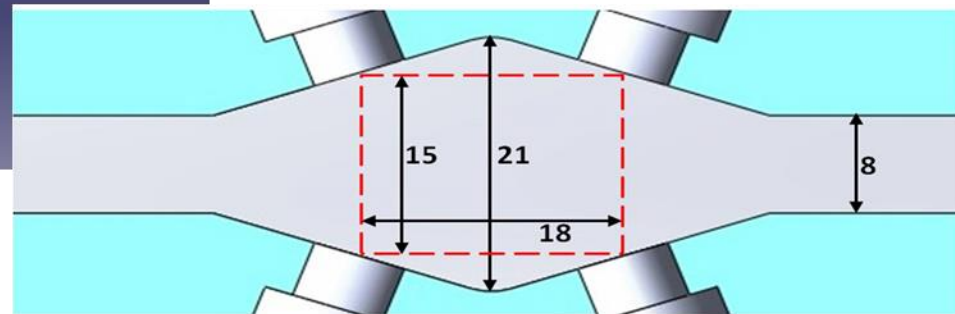
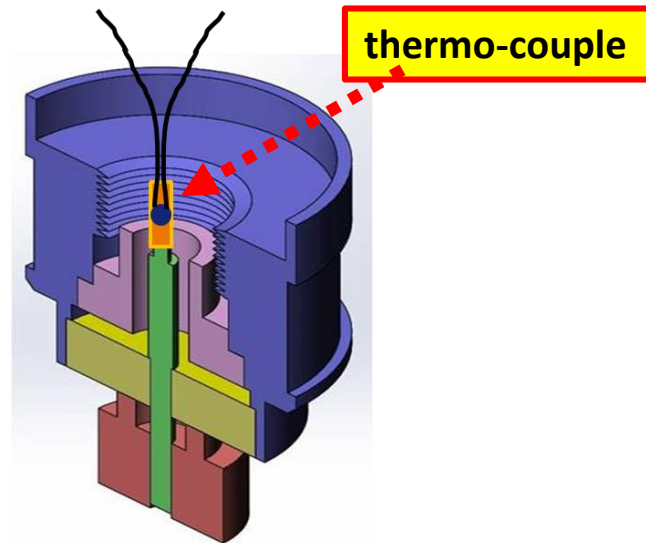
Welding



the Test-BPM-Chamber in the ID-25 straight section



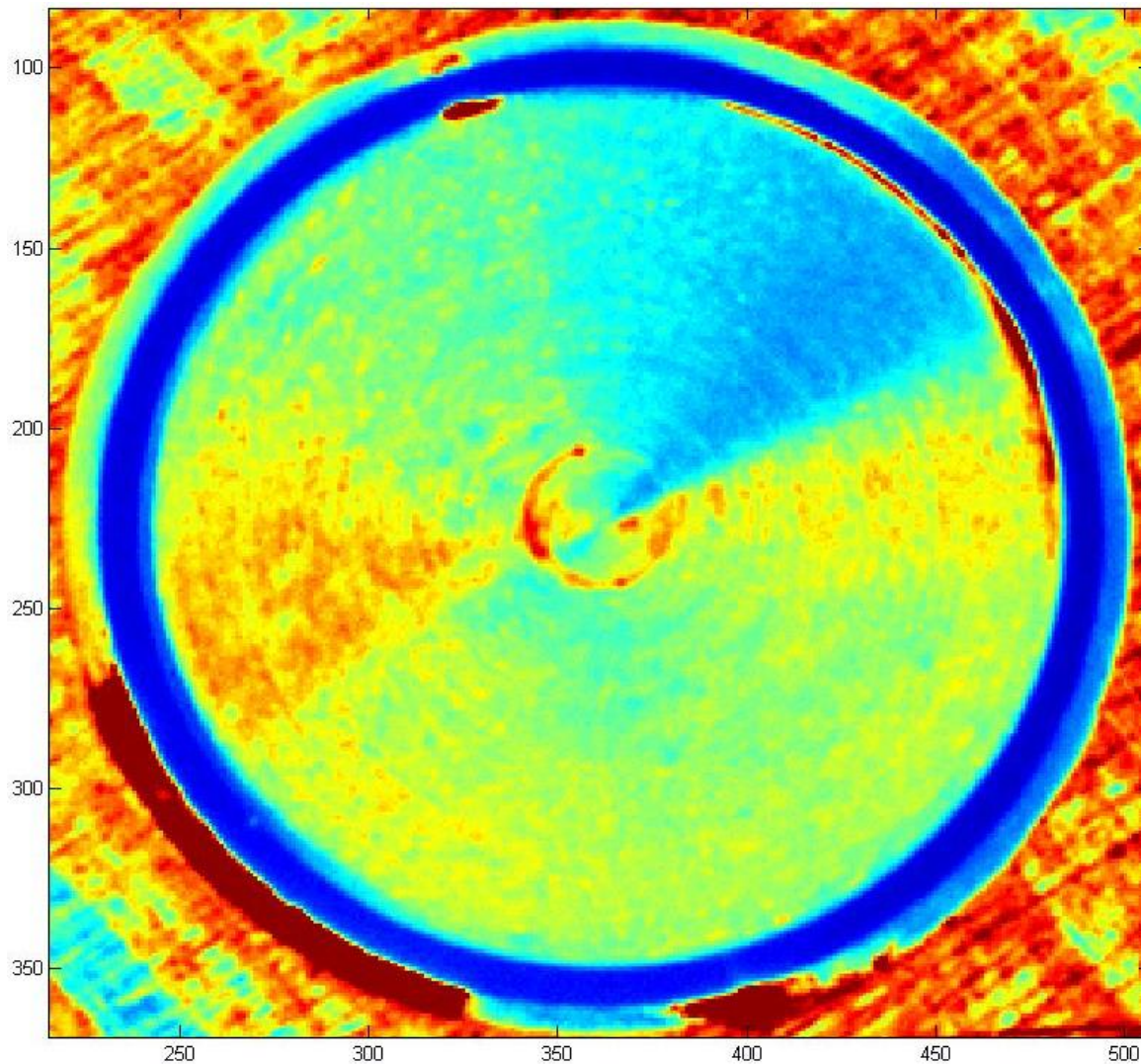
installed in Aug. 2014



$K_x = 6.5$
 $K_z = 12.4$

we tested fully : - 12 buttons from **Alcen-PMB** (French) → provider >25 years ago
and : - 12 buttons from **Kyocera** (Japan)

all measurements with beam OK, so ready for the tender-exercise :



gap = 250um



**delivery in plates holding 5 x 5 units
plates specified & furnished by the ESRF,
with the 25 lodging holes with same tolerances (as in real BPM-block)
facilitating an easy & rapid visual inspection of the concentricity**

procurement of 1500 units done with Alcen-PMB

at ESRF we inspect visually all units,
facilitated by packing in plates holding 5 x 5 units
main checks are on concentricity

later these units are shipped to the manufacturer of our chambers
mainly FMB (Berlin) but also PINK

just before Christmas 2016 :
alarm from FMB : several (about 10%) units are leaking ... !

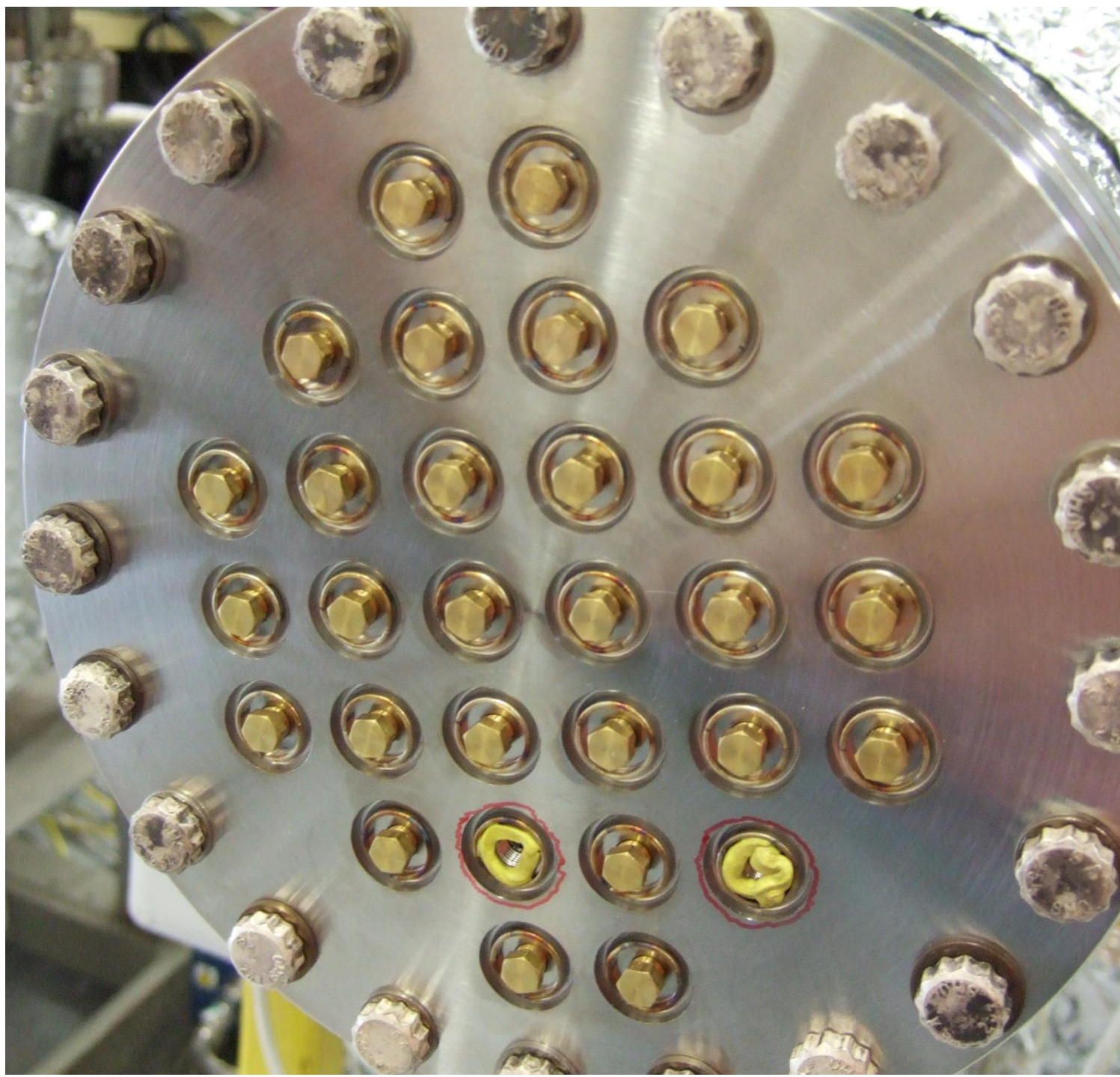
the ESRF sacrifices many units by welding 30 into a test-flange(s) and
trying to get : 1) statistics, 2) an insight of where the leak is situated ...

and : we also take a few units to a dedicated ESRF beamline
for Computed Tomography with X-rays upto 200KeV ...

2014

2015

2016



30 BPMs in one
CF150 flange

done 2 x
so **60 units** tested
→ **5 leaks**

the leaking spots
are confirmed to
be in the lip-corner

in total 4 flanges
used for such tests
i.e. 120 units
sacrificed !!

hints of “cracks in sharp corners ...”
proofed to be **wrong** (later)

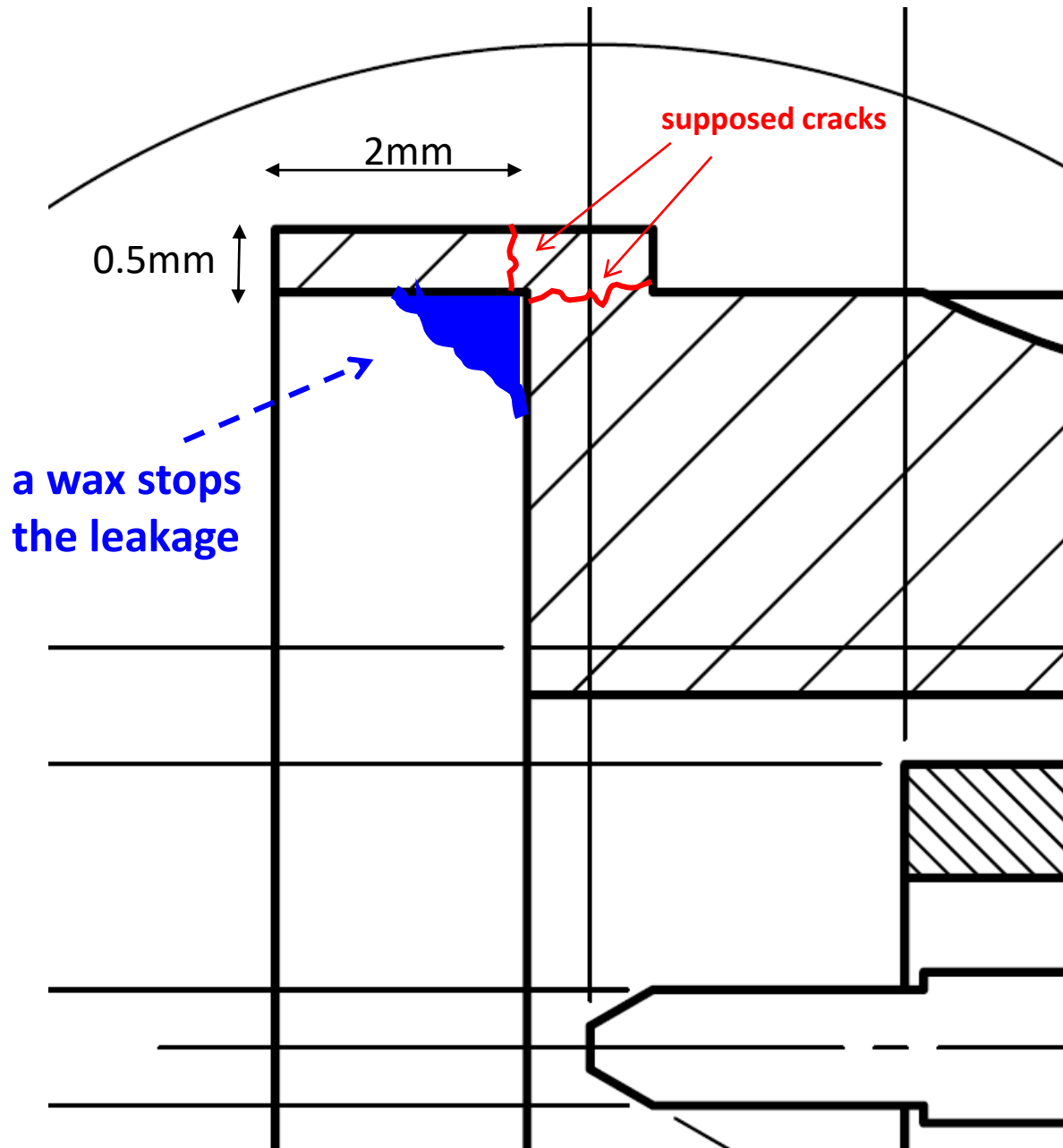
end December 2016

vacuum wax applied : the leak is stopped !



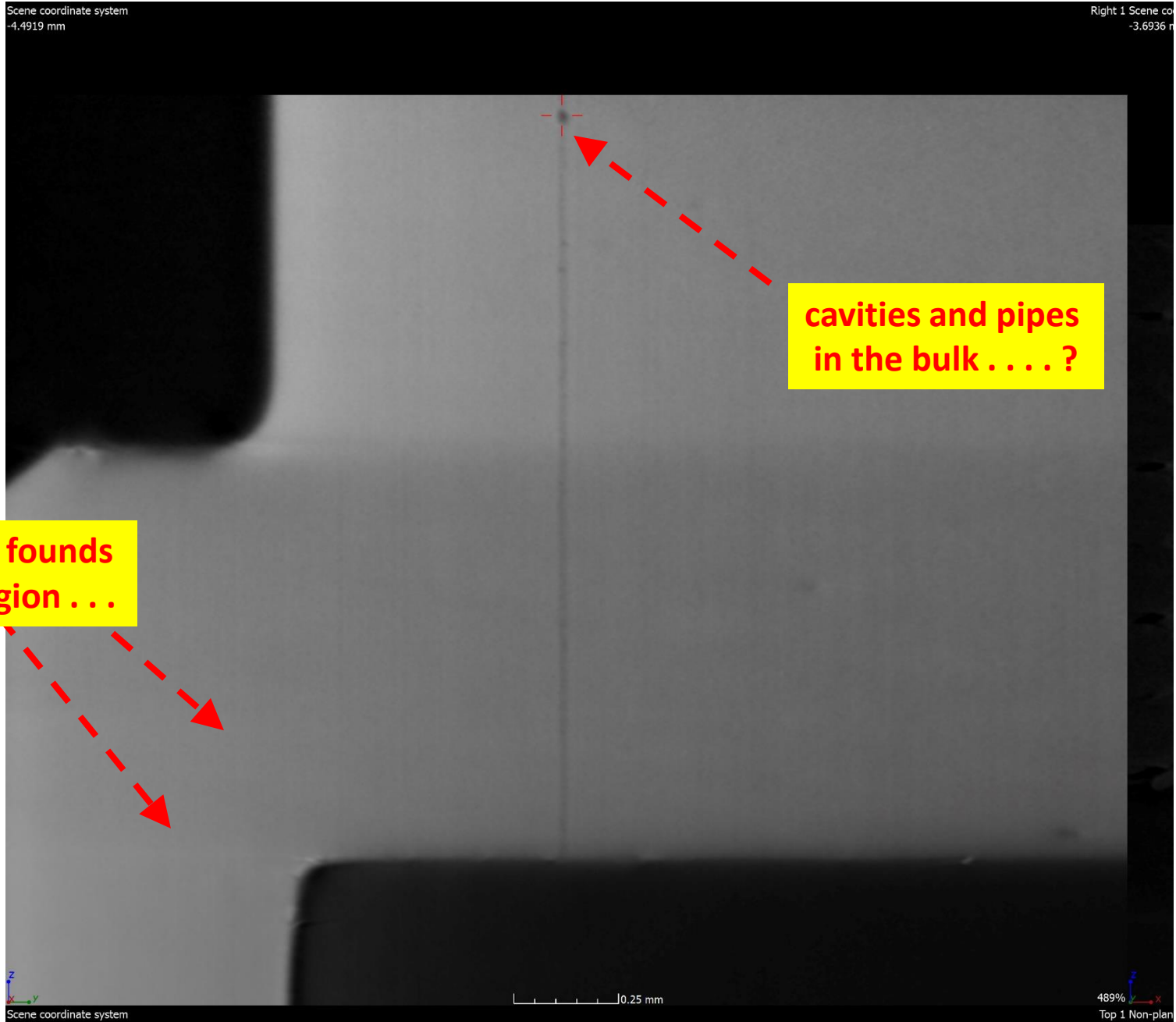
the vacuum wax is applied in the corner, i.e. between
the transition of the lip & the main body,
the leak (fracture) must be situated there, not on the welding

vacuum wax applied :
the leak is stopped !



FMB experience : 4 failures out of 16 buttons welded → 25% failure-rate

X-ray tomography done at a dedicated ESRF beamline on a leaking BPM-button :

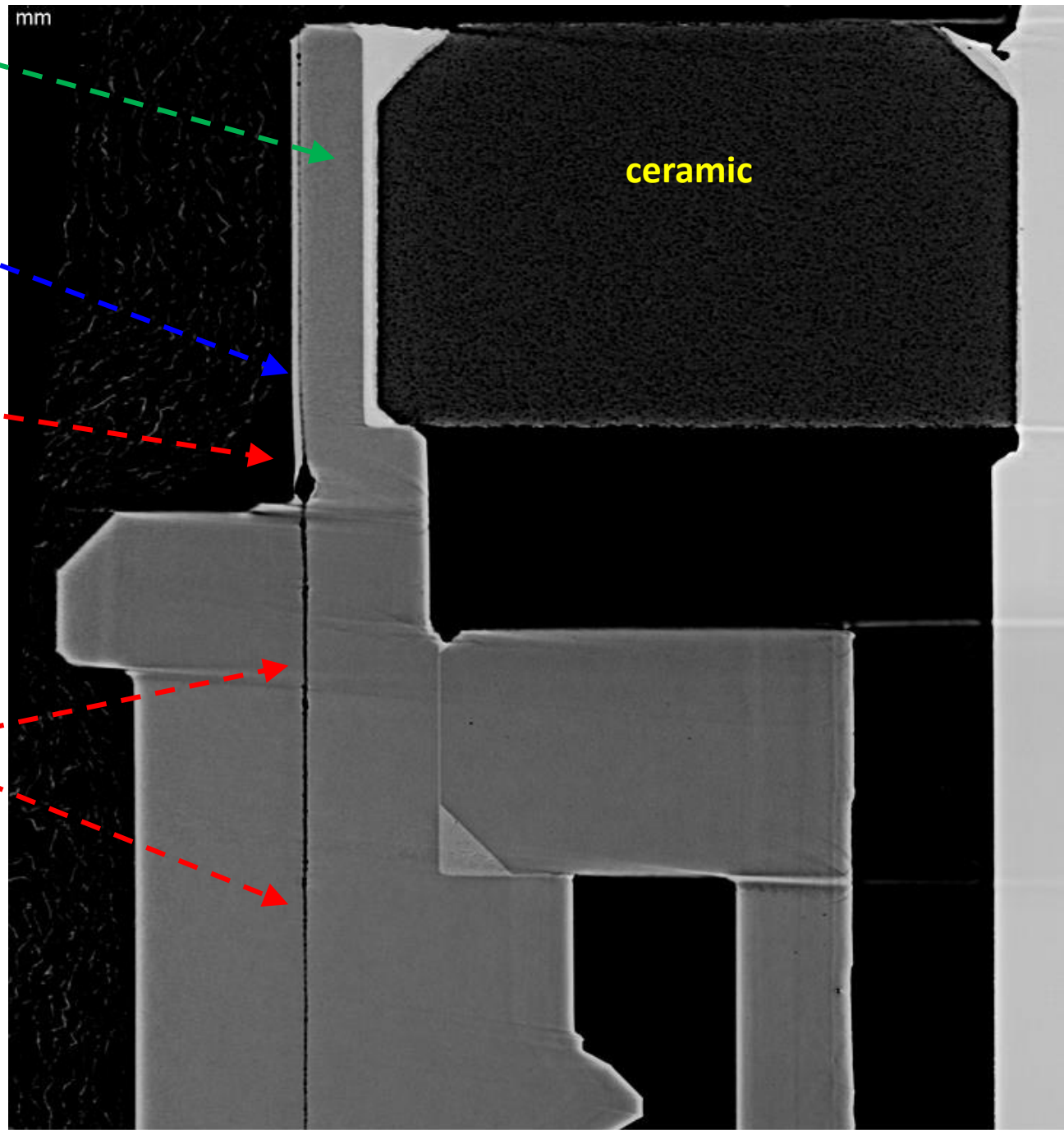


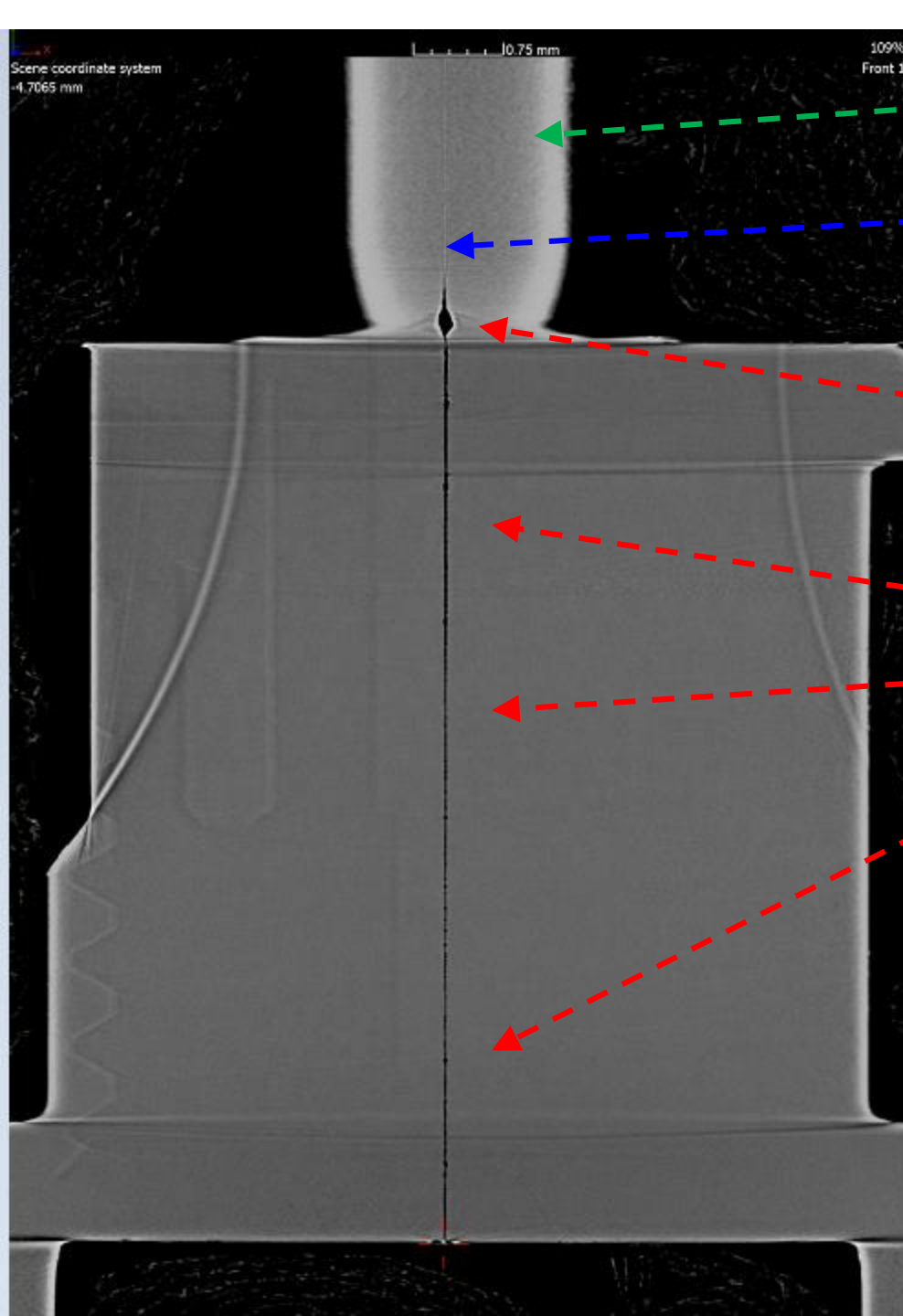
cylinder around the ceramic

**the crack changes
angle/orientation
after the cavity**

big cavity

**the crack/pipe/channel
traverses the full depth
of the steel outer-body**



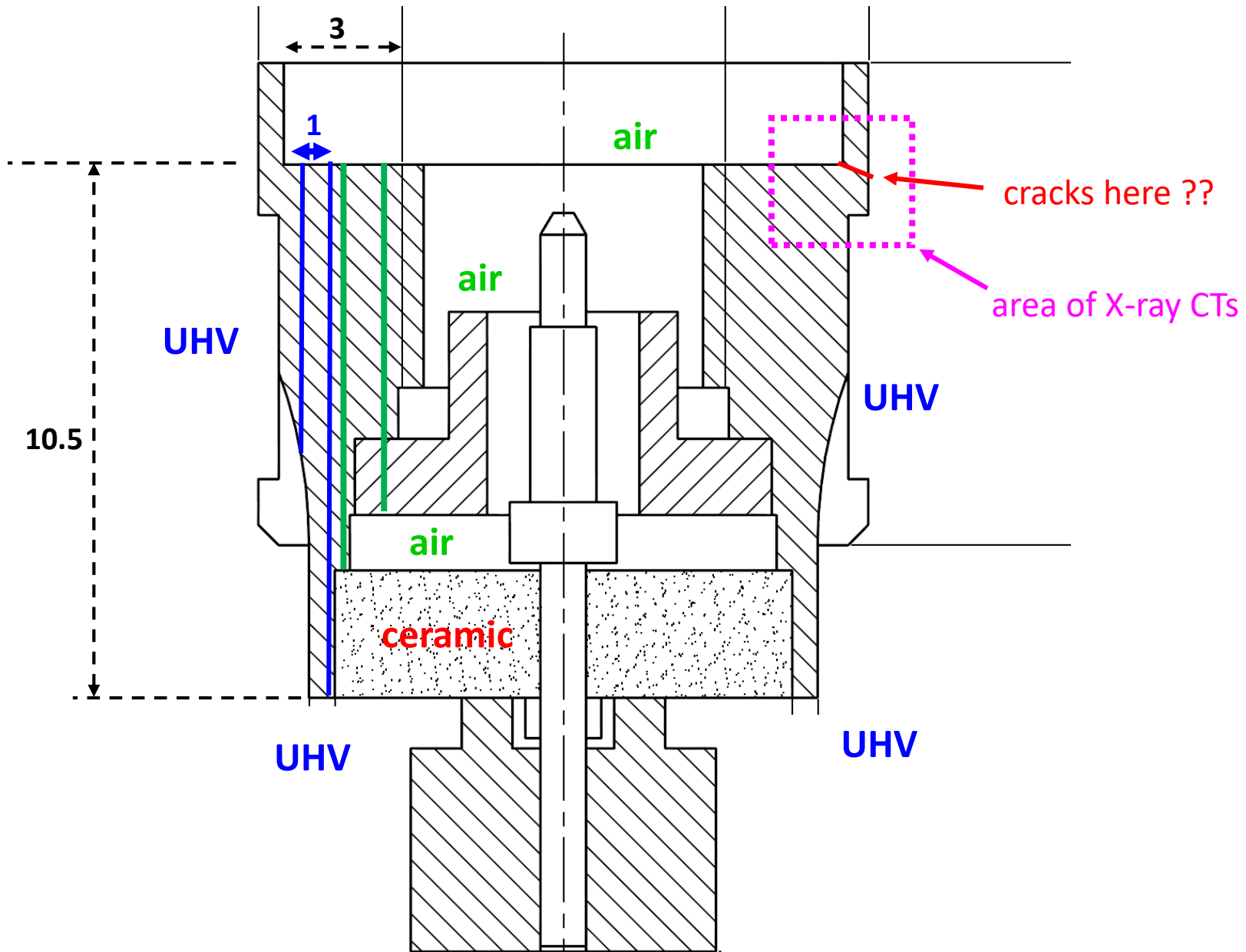


cylinder around the ceramic

**the crack is not visible, at this point, in this slice
since it changed angle/orientation
(after the cavity) see previous slide**

big cavity

**the crack/pipe/channel
traverses the full depth
of the steel outer-body
>10mm**



if bulk defects (vertical channels/lines) are responsible for UHV leaks then only the **blue lines** can, NOT the **green lines** (not connecting with UHV)

summer 2017 :

massive CTs on >1000 individual BPMs ... ! → intensive manipulations
then analysis of these huge CT data → is intensive work despite partial automation
to classify the units in 4 groups : bad - strong-risk - small risk - **OK**
this took several weeks
then only **OK class** (80%) were send to FMB to continue the welding of chambers

But : leaks continued to occur ... !

this sorting after CT scans & analysis was a partial failure ...

in parallel : **metalurgic analysis to confirm the unsuitable steel in more details
that also explained why CT-scans could not reveal all bad cases**

see next slides

**final solution : configure a specific leak-test, obviously non-destructive
down to 1E-10 (mbar litre / sec) sensitivity
that is practically feasible and reliable
to really sort-out these bad units**

done by colleagues in ESRF Front-End group, with success !!

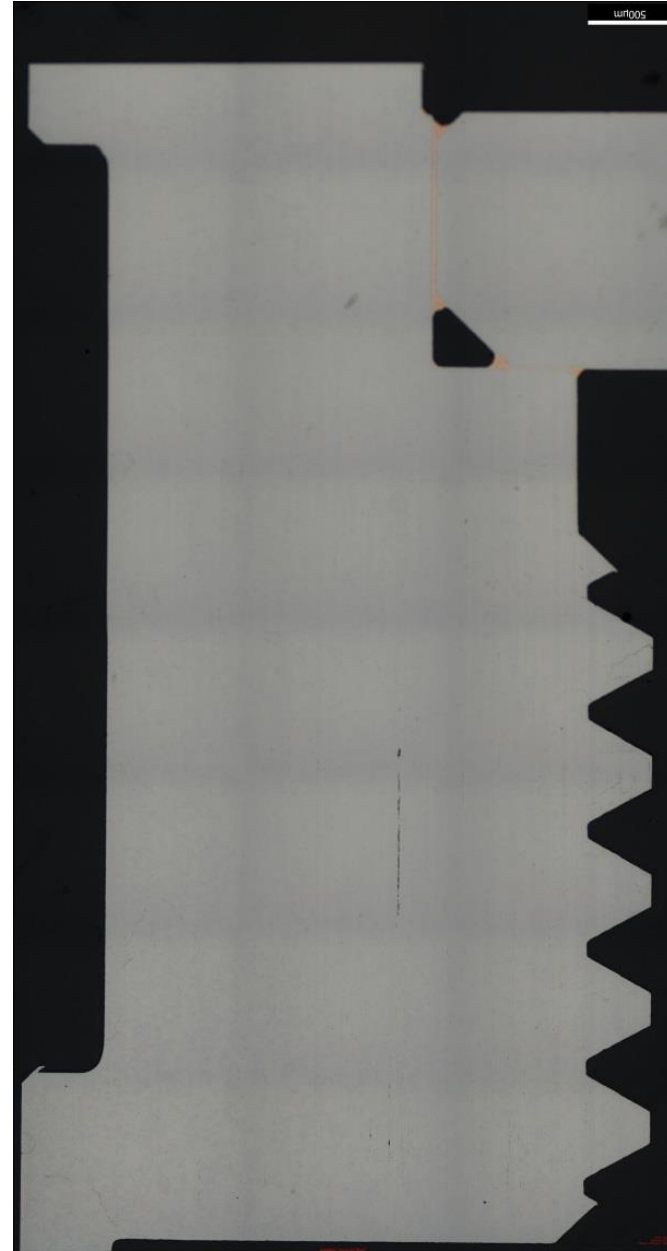
**also : the ESRF bought in 2 batches (2017 & 2018) about 400 more BPM-buttons
from PMB-Alcen to make up for all losses with this leakage problem**



ZOOM
*many vertical channels
can be seen now ...*

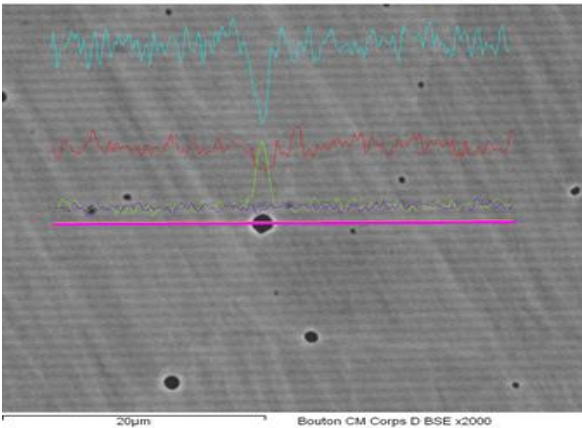
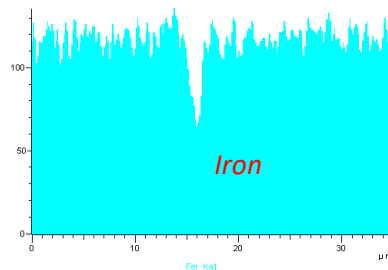
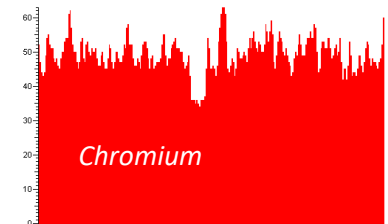
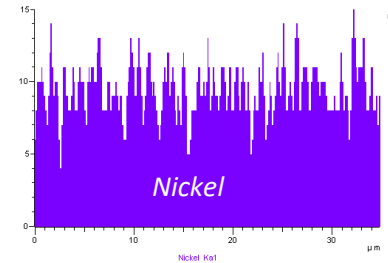
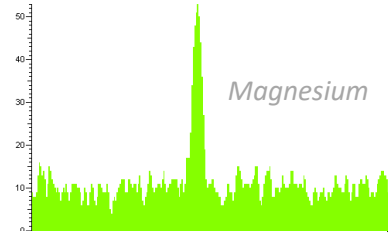
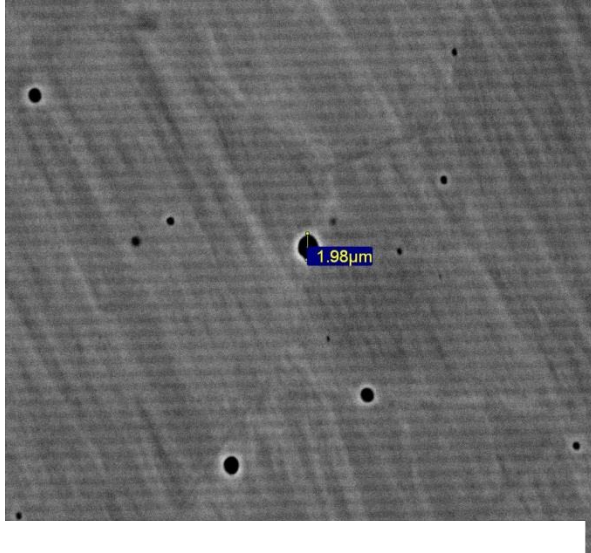


*after chemical etching
image from binocular microscope*

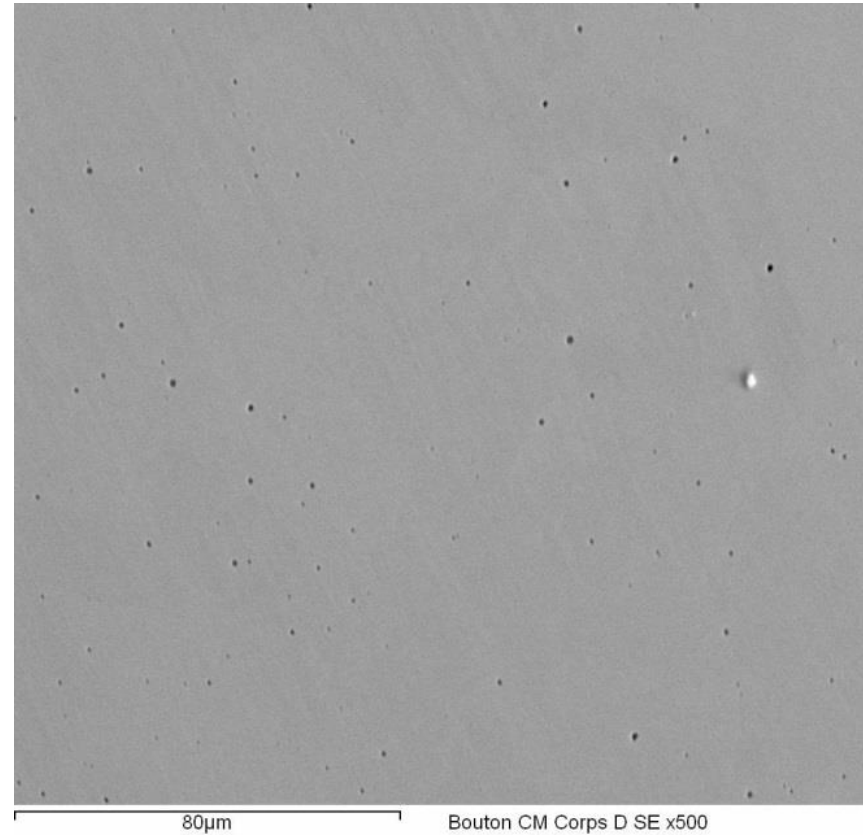


*before chemical etching,
image from binocular microscope*

Bouton CM –Bride Coupe transv Observation MEB ech non attaqué chim



40 μm



*transverse cut in BPM-body
image from electron-beam-microscope
before chemical etching
many holes observable ...
all are less than 2 μm diameter ...*

26 10 2017 JM *how many of them are channels ... ???*

CERTIFICAT DE RECEPTION 3.1
INSPECTION CERTIFICATE 3.1
ABNAHMEPRUEFZEUGNIS 3.1

EN 10204 / 3.1

UGITECH
Providing special steel solutions

Ugine
Avenue Paul Girod - CS
90100
73403 Ugine Cedex
France

UGITECH
Providing special steel solutions

N° lot MM / Chargen / Batch
1715TS0400

Ordre de fab. / Auftrag / Prod. Order
A1715TS04000

N° coulé / Schmelzen Nr / Heat N°
637902

Marque d'usine
Herstellereichen
Supplier's Mark
UGITECH

Poligon de l'expert
Prüfstempel
Inspector's stamp
IQ

Certification - Werkzeugs - Certificate
AD 2000-MERKBLATT W0
Pressure Equipment Directive
2014/68/EU Annex I Section 4.3
ISO 9001
ISO/TS 18949

Produit
Erzeugnisform
UGIPIRE 4307Q BARRE RECTIFIEE POLIE HYPERTREMPÉ DÉF. À FROID H9 ROND(E) 16,000MM L

Product
UGIPIRE 4307Q STAB GESCHLIFFEN POLIERT ABGESCHRECKT KALTVERFORMT H9 RUND 16,000MM LONG. 3,000M

UGIPIRE 4307Q BAR GROUND POLISHED SOLUT® ANNEALED & COLD WORKED H9 RUND 16,000MM LONG. 3,000M

Client - Besteller - Purchaser
15636 DAYOT FREDERIC

N° cde client - Kundenbestellnummer - Purchase order number
829 OF 10420

Commande - Bestellung - Order
821042 10

Norme de référence / Besugsnorm / Standard for reference
* UNS S30403-A-ASTM A278
Elaboration ESR
suivent ASTM E45 (> <) = à 1,5

/A278M -16a
Inclusions de type A B C D
- lot 1715TS0400 conforme*

Spécification client / Kundenspezifikation / Customer's specification
4307 QHP HY 2G AERO O 27/01/2016

Nombre Stueckzahl Pieces Nbr	Profil Profil Shape	Dimension Ausmassung Dimension	Longueur Laenge Length	Poids Gewicht Weight
18	RO	16,000 MM 21-1	3,000 21-2	10 KG 22

Mode d'élaboration Erzeugungstyp Melting process EAF + AOD + CC + ESR 38	N° prélevement Probenummer Test number DRS6	Demandé / Vorschritt / Required															
		% C	% Si	% Mn	% Ni	% CR	% MO	% CU	% S	% P	% N	% NB					
		0,0300	1,0000	2,0000	10,0000	19,0000	0,5000	0,7500	0,0250	0,0190	0,4610	1,6030	9,8400	18,6330	0,2240	0,0490	0,0002
		0,0350	0,1000														
		0,0182	0,0080	0,0080													
		76	77	78	79	80	81	82	83	84	85	86	86	87			

Nous déclarons que la fourniture citée est conforme aux exigences du contrat et que, après vérifications et essais, elle répond en tout point, aux exigences spécifiées, aux normes et règlements applicables, sauf exceptions, réserves ou dérogations énumérées dans la présente déclaration de conformité ; Document validé par signature électronique. Produit fabriqué dans le respect du règlement REACH.

We declare that the mentioned product is in compliance with the requirements of the contract and that, after checks and tests, it meets in all respects the specified requirements and applicable standards and regulations, except reservations or exceptions as listed in the declaration of conformity ; Document validated by electronic signature. Material manufactured in full compliance with the REACH regulation.

Ugine le 08.06.2017
L'inspecteur Qualité
Der Qualitätsprüfer

let 30/17

CERTIFICAT DE RECEPTION 3.1
INSPECTION CERTIFICATE 3.1
ABNAHMEPRUEFZEUGNIS 3.1

EN 10204 / 3.1

UGITECH
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Ugine
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90100
73403 Ugine Cedex
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N° lot MM / Chargen / Batch
1715TS0400

Ordre de fab. / Auftrag / Prod. Order
A1715TS04000

N° coulé / Schmelzen Nr / Heat N°
637902

Marque d'usine
Herstellereichen
Supplier's Mark
UGITECH

Poligon de l'expert
Prüfstempel
Inspector's stamp
IQ

Certification - Werkzeugs - Certificate
AD 2000-MERKBLATT W0
Pressure Equipment Directive
2014/68/EU Annex I Section 4.3
ISO 9001
ISO/TS 18949

Produit
Erzeugnisform
UGIPIRE 4307Q BARRE RECTIFIEE POLIE HYPERTREMPÉ DÉF. À FROID H9 ROND(E) 16,000MM LONG. 3,000M + ONG. 3,000M + 50,000MM -0,000MM

Product
UGIPIRE 4307Q STAB GESCHLIFFEN POLIERT ABGESCHRECKT KALTVERFORMT H9 RUND 16,000MM LONG. 3,000M

Client - Besteller - Purchaser
15636 DAYOT FREDERIC

N° cde client - Kundenbestellnummer - Purchase order number
829 OF 10420

Commande - Bestellung - Order
821042 10

Norme de référence / Besugsnorm / Standard for reference
* UNS S30403-A-ASTM A278
Elaboration ESR
suivent ASTM E45 (> <) = à 1,5

/A278M -16a
Inclusions de type A B C D
- lot 1715TS0400 conforme*

Spécification client / Kundenspezifikation / Customer's specification
4307 QHP HY 2G AERO O 27/01/2016

Limite d'élasticité Stützspanne Yield Strength 0,2% 1%	RM Zugfestigkeit Tensile	Allongement Bruchdehnung Elongation	Striction Einschnürung Red area	Dureté-Haerte-Hardness
Mpa	Mpa	%	%	HB HV HRB HRC
207 210	517 640	45 45	50	140 215
432 464	630 627	51 52	53 54	80 78
415 460	627	52	54	201

A l'état de livraison / Lieferzustand / As delivered
Hypertrempé déf. à froid

A l'état de référence / treatment on test sample / Probestellenbehandlung

Taux de corroyage
Forging ratio
Verschmiedungsgrad
185,1

Resilience-Kerbschlagzähigkeit-Notch Toughness

Type Form Type	T°C	Sens Direction	Min	Valeurs individuelles Einzelwerte Individual values	Moyenne Mittelwert Average	Expansion latérale Seitliche Breitung Lateral Expansion
31	33	32	95		35	36
			J 100 60			J

A l'état de référence / treatment on test sample / Probestellenbehandlung

CORROSION INTERCRISTALLINE SUIVANT ISO 3651-2 & ASTM A262 PRACTICE E : CONFORME

TAILLE DE GRAIN SUIVANT ASTM E112 (> = 3) = 3 - 5

INCLUSIONS NON METALLIQUES SUIVANT ASTM E45/A :

INCLUSIONS DE TYPE : A FINE = < 1 ; A EPAISSE = < 1

INCLUSIONS DE TYPE : B FINE = 1 ; B EPAISSE = < 1

INCLUSIONS DE TYPE : C FINE = 1 ; C EPAISSE = < 1

INCLUSIONS DE TYPE : D FINE = 1,5 ; D EPAISSE = 1

FERRITE < = 8%

MACROSTRUCTURE SUIVANT ASTM A604 CONFORME

MICRO TEST STRUCTURE OK

CONTROLE PAR COURANT DE FOUCAULT 100 % - EN 10277 -1 CL.3 : CONFORME

ULTRASON SUIVANT IGC 04.25.115B CL. A : CONFORME - METHODE NON QUALIFIEE SUR 50 MM EN EXTREMITES

CONTROLE ANTI-MELANGE : CONFORME

steel for the 225 units
Questions on :
grain-size, ferrite contents (magnetism) ...
a few more samples please

N° certifies d'origine/Ur-Los Werkzeugeigenschaft/Original certificate number
81793830 900001

Poids lot original/Ur-Los Gewicht/Original batch weight
718 KG

Ugine le 08.06.2017
L'inspecteur Qualité
Der Qualitätsprüfer

The quality inspector
H. PETIT

We declare that the mentioned product is in compliance with the requirements of the contract and that, after checks and tests, it meets in all respects the specified requirements and applicable standards and regulations, except reservations or exceptions as listed in the declaration of conformity ; Document validated by electronic signature. Material manufactured in full compliance with the REACH regulation.

Ugine le 08.06.2017
L'inspecteur Qualité
Der Qualitätsprüfer

The quality inspector
H. PETIT

THYSSENKRUPP MATERIALS FRANCE S.A.S.
Z.A. DE PARIWEST - 6, AV. GUTENBERG
78310 MAUREPAS CEDEX - FRANCIA

Trade Mark - Zeichen des Lieferwerkes
Anagrama del suministrador



Works Inspector Stamp - Werkssachverständiger
Sello del Inspector



Certificate type - APZ Nach Certificado tipo		EN 10204/3.1		Certificate n° - Prüf-Nr Certificado n°		323612		Date - Datum - Fecha		13 - 09 - 2017					
Our order N° Werks - Nr N° de Referencia		644463		Heat Schmelze Colada		438887		Your order N° Bestell - Nr Pedido N°		01/07/1355					
Steel Grade Werkstoff Calidad				X-2-CRNIMO-17-12-2 / 1.4404 MECAMAX				According to Entsprechend Corresponde				EN 10.272-2007.			
Shape and Size - Gegenstad Perfil y dimension			Tolerance - Toleranz Tolerancia			Bundles Bunde Bultos		Bars Stäbe Barras		Weight Gewicht Peso		566 Kg			
ROUND 15 mm			h 9 /DIN 671 /EN 10278			1									
Requirements - Anforderungen - Exigencias															
EN 10.088-3.2014. ASTM A 479 / A 479M-15. ASME SA 479 / SA 479M-15 ASTM A 276/A 276M-16a. N° tpstock/4401/4404/01 Rev.4 du 20/04/2013. ASTM A 182/A 182M-16. ASME SA 182 / SA 182M-15 1.4401-Type 316-Type 316L-F.316-F.316L. PED 2014/68/EU, Annex I, Parag.4.3/DGR 2014/68/EU						Anhang I Absatz 4.3 Certificate/Zertifikat Nr. 348/2008/MUC									
Melting process / Erschmelzungsart / Proceso de Fusión				Heat treatment / Wärmebehandlung / Tratamiento térmico											
E.A.F. / A.O.D.				1060C 4H/Std WATER/WASSER/AGUA											
Solution annealed/Abgeschreckt/Hipertemple-Cold drawn/Gezogen/Estirado-Polished/Poliert/Pulido-															
Test results - Ergebnis der Prüfungen - Resultados de los ensayos															
Dimension of Specimen Abmessungen des Probestabes Medida de las probetas		Rp0,2% N/mm2 MPA	Rp 1% N/mm2 MPA	Rm N/mm2 MPA	A %L 5D	A %L 4D	Z %	Hardness Härte HBw	Impact test / Kerschschlag / Resiliencia ISO V Jules						
RD. 10,00 mm.		Min. 200	235	500	20										
		Max.		900			315								
Temperature °C 20	Spec. N° Probe Nr. Pro N°	1	649	708	744	26		71	241						
	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N	Co				
Min.						16,50	2,00	10,00							
Max.	0,030	1,00	2,00	0,045	0,030	18,50	2,50	13,00		0,1000					
	0,022	0,44	1,56	0,031	0,026	16,50	2,01	10,00	0,44	0,0440	0,23				
Visual and dimensional inspection Besichtigung und Ausmessung Control visual y dimensional			Radioactivity inspection Radioaktivitätskontrolle Control de Radioactividad			Antimixing test Spektroskop Verwechslungspr Antimezcla			Grain Size Korngröße Tamaño de grano						
O.K.			O.K.			O.K.			8-9 ASTM E-112-13						
Remarks - Bemerkungen - Observaciones															
IC test acc./IK prüfung nach ASTM A 262 E.15. OK IC test acc./IK prüfung nach EN ISO 3651-2/98 Met.A. OK "No Lead Addition" Crack control/Rissgeprüft acc. EN 10277-1 class 2. OK Reduction Ratio: 119 : 1										EDV / EDP Acc. EN 10.204 Marian Tejedo Quality Mng.					
Works Inspector															

new steel for a possible future order proposed by the ESRF

PMB confirmed that this steel is OK for them

X-ray CT scan to be planned as soon as this steel is delivered to the ESRF

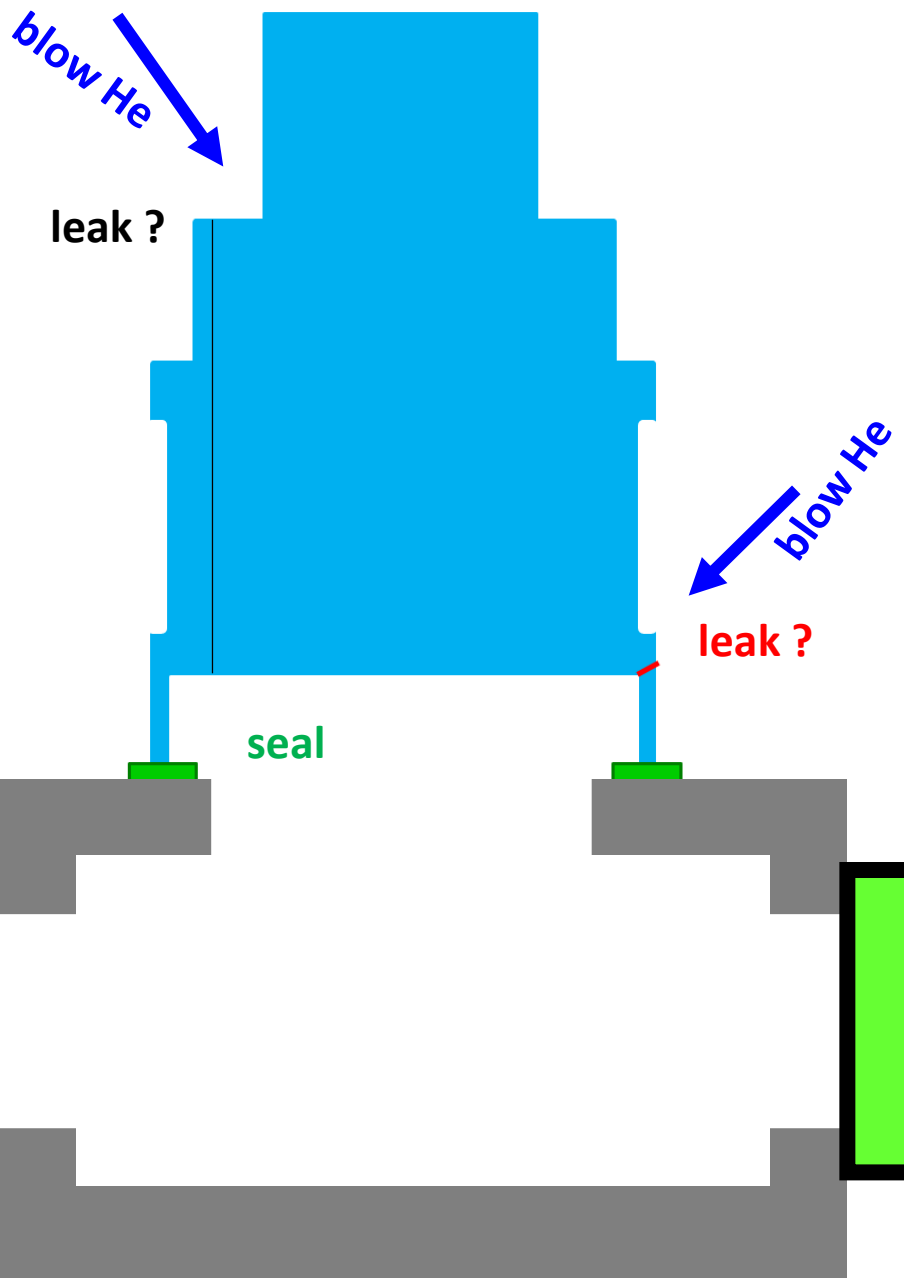
the very unfortunate occurrence of ultra-small channels in our BPMs outer-body is due to the combination of :

- gaseous impurities (bubbles, inclusions) presence in the bulk**
- technique of extruding into bars or rods (not into slabs)**
- absence of any UHV remelting technique**

Also : re-organization of the steel market(s) in Europe & worldwide and their main protagonists since 10 years

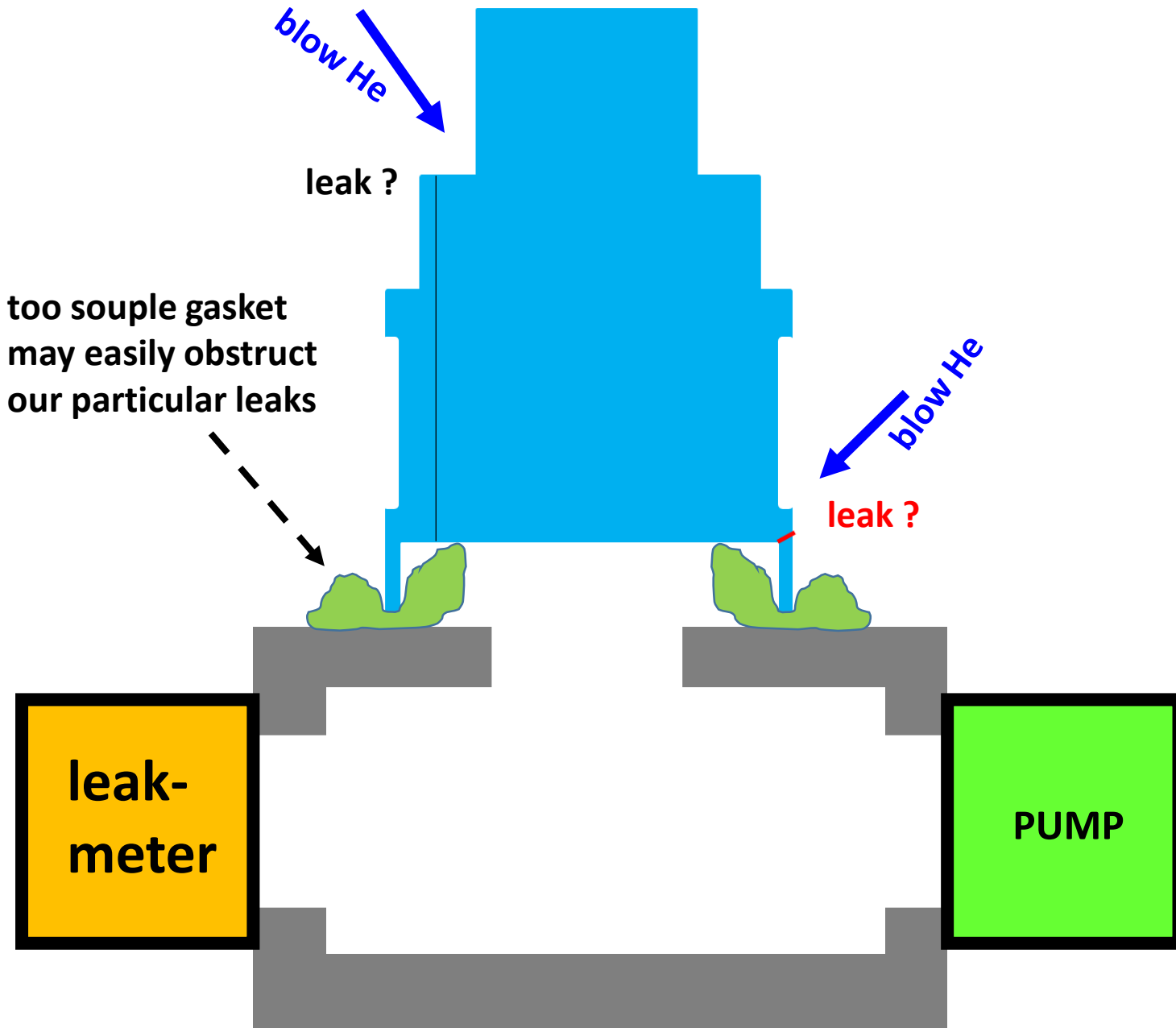
→ certain steel qualities are not as what they were in the past users have to now (better) examine the specs & certificates

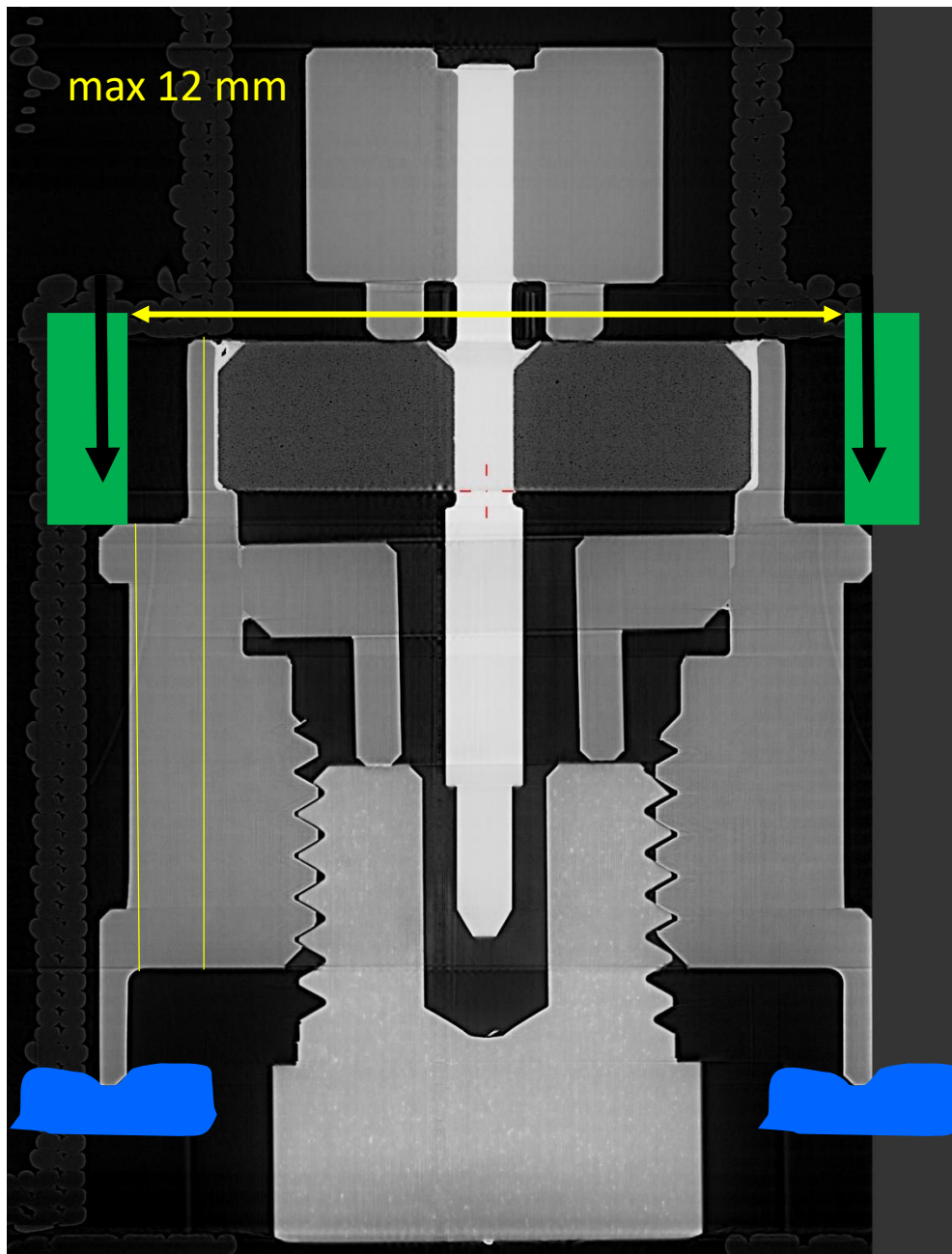
<https://cds.cern.ch/record/983744/files/p117.pdf>



how do you do the leak test ?

up-to what precision & reliability ?





in Yellow : the possible leaking channels

in Green : the ring that presses the BPM downwards

in Blue : the gasket

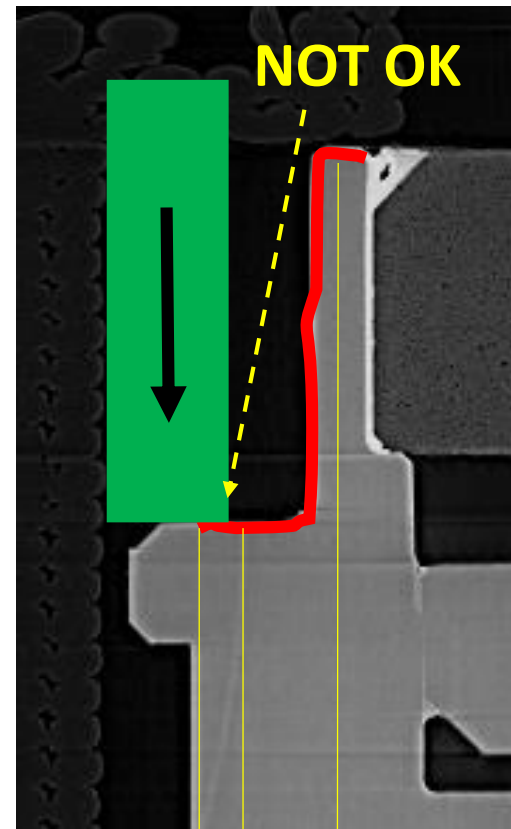
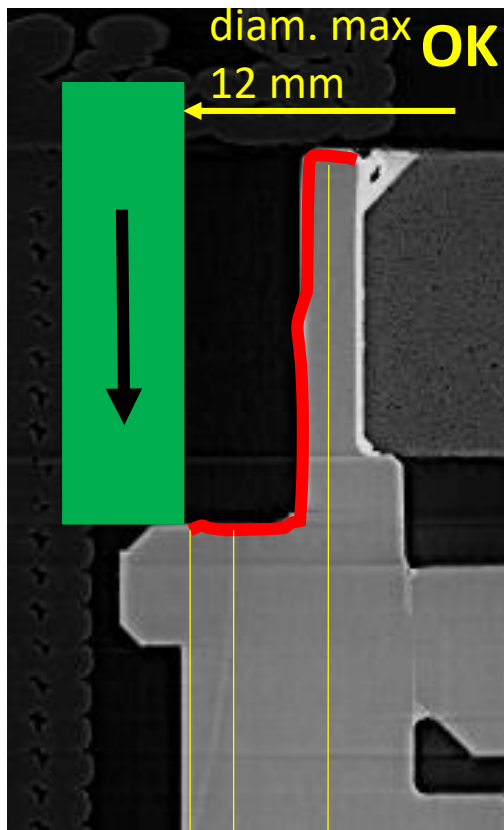
done by colleagues in
ESRF Front-End group,
with success !!

on about 700units
10min/unit

in Yellow : the possible leaking channels

in Red : surface where the channels can reach UHV

in Green : the ring that presses the BPM downwards



ESRF has requirement on hermeticity of **1 E-10 mbar litre / sec**

hermeticity specification of **Kyocera** :

go/pass limitation $1.3\text{E-}10$ Pa m³ / sec

→ **$1.3\text{E-}9$ mbar litre / sec**

hermeticity specification of **PMB-Alcen** :

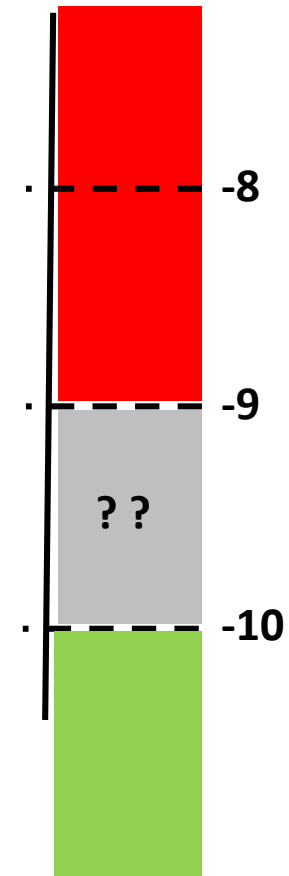
FAT tests only down to :

1 E-9 mbar litre / sec

Note :

we had chambers rejected after leak-test on the final FAT
of only **2 E-10 mbar litre / sec**

**ideally : BPM-button manufacturer should extent the quality
of their leak-tests by 1 magnitude, down to 1 E-10**



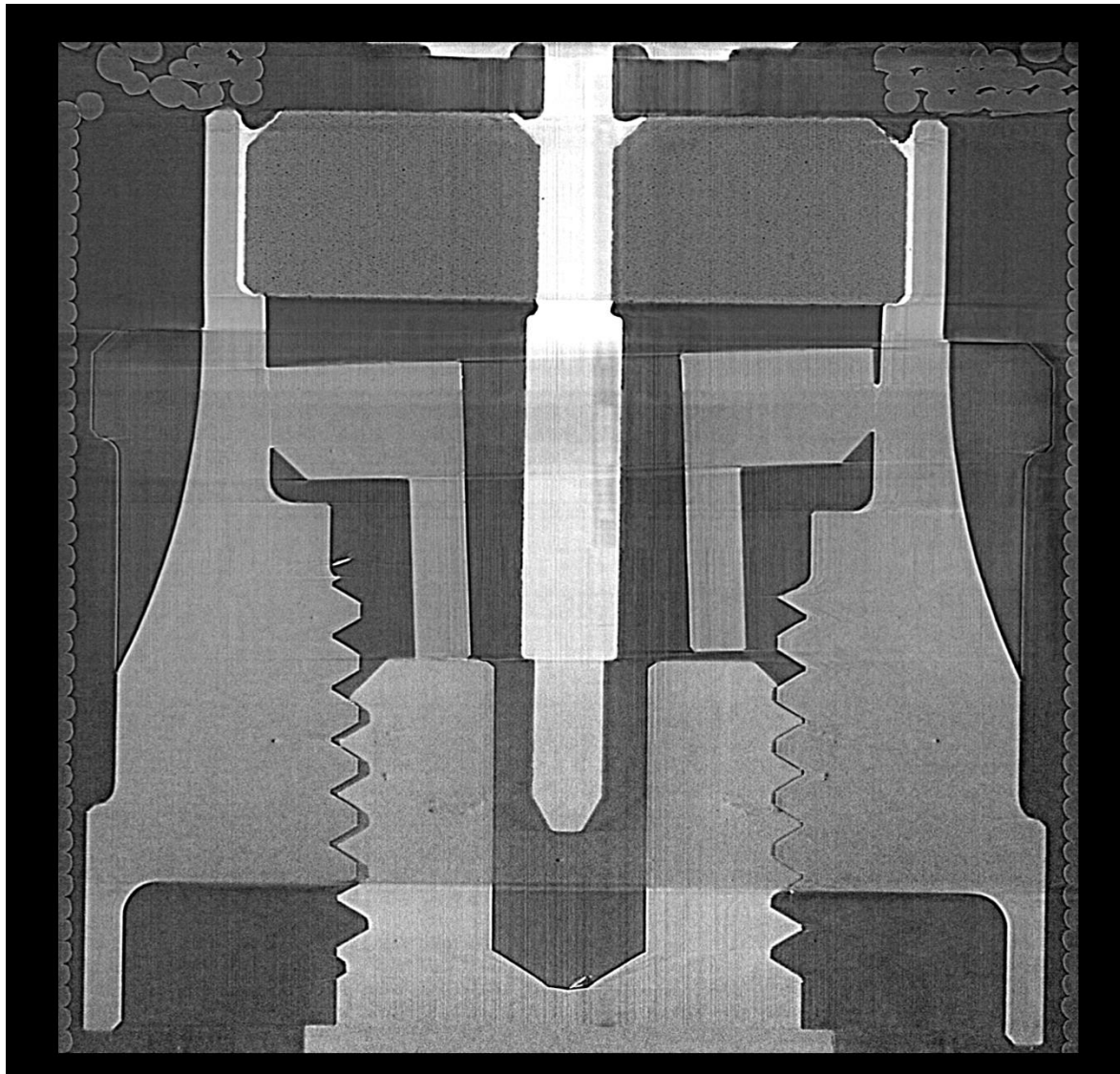
next 3 slides :

other questions on precision & reproducibility

after the tomographs show

un-expected features

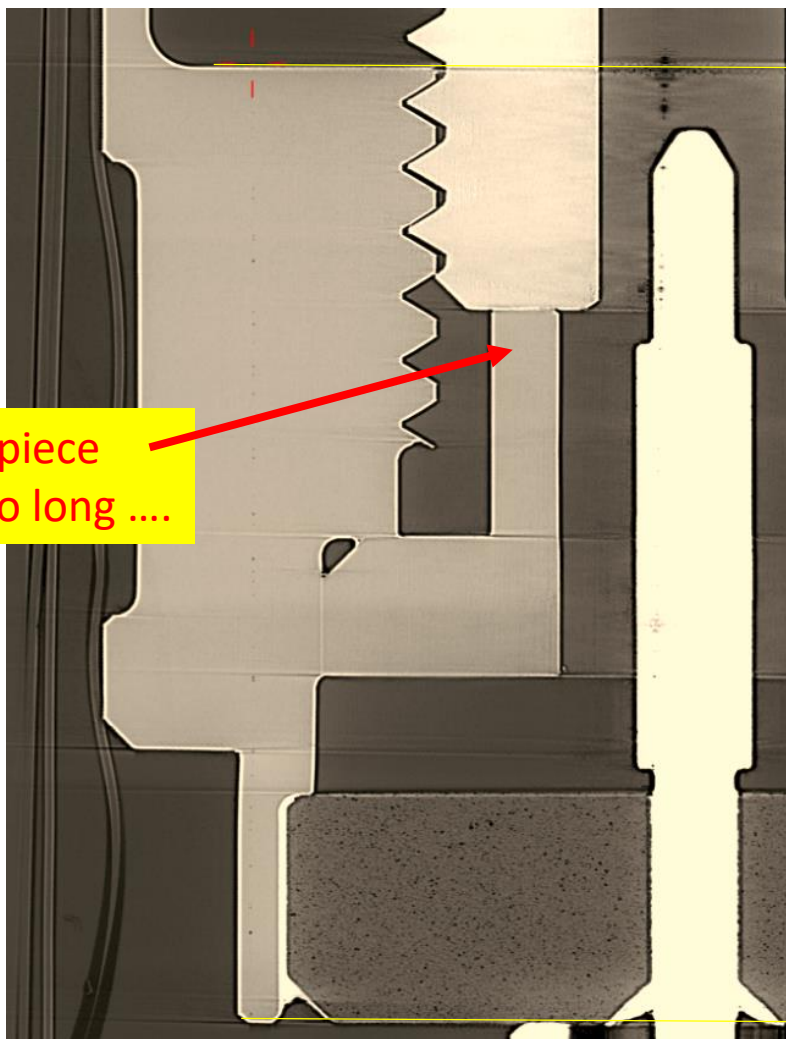
DLS unit



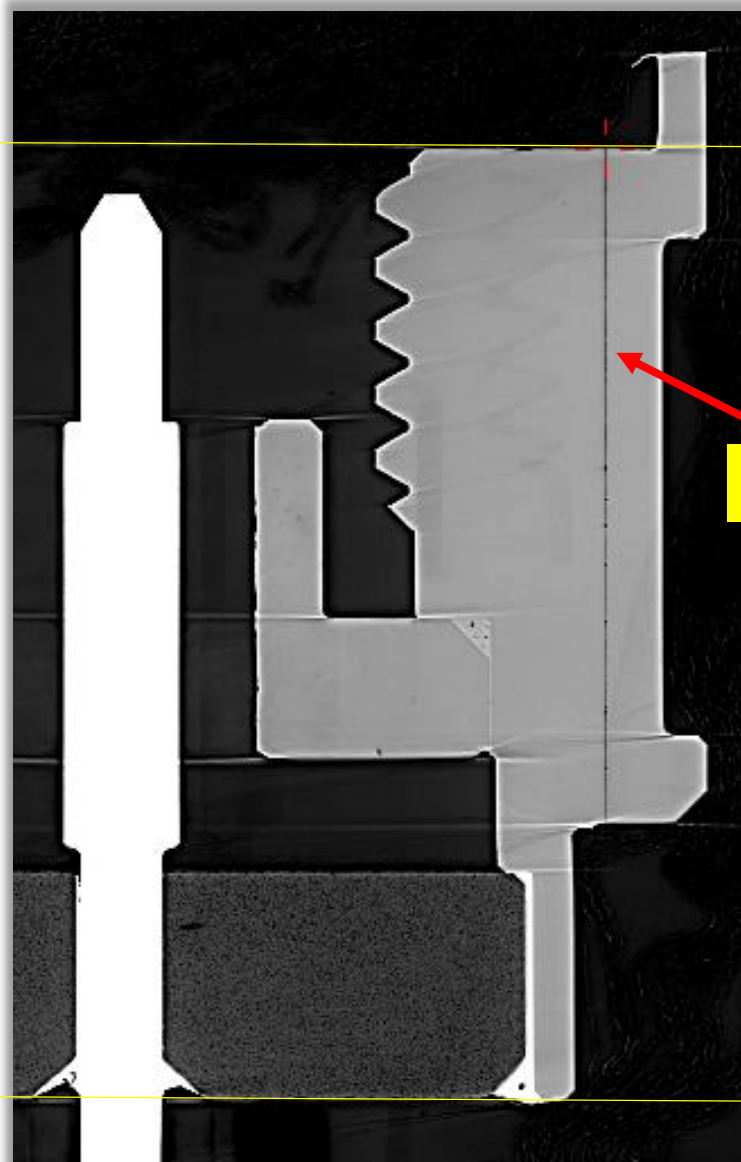
ESRF unit



DLS



ESRF





**experience with UHV-leaks on 1500 units of
BPM-buttons at the ESRF in 2016**



***Kees Scheidt, ESRF,
ASD, diagnostics group***

conclusions :

- 1) make sure the steel used is 100% compatible for UHV applications
understand steel certificates, or find someone who does ...
- 2) CT-scans are also useful for verifying many other aspects
to be considered for e.g. prototype inspections
- 3) specific leak-test, down to $1\text{E-}10$ (mbar litre / sec) are possible,
→ verify with manufacturer, insist on inclusion in FAT if possible

thank you for your attention, and thanks to the organizers !!

additional slides

also for use of illustrations etc. in
other discussions during the workshop

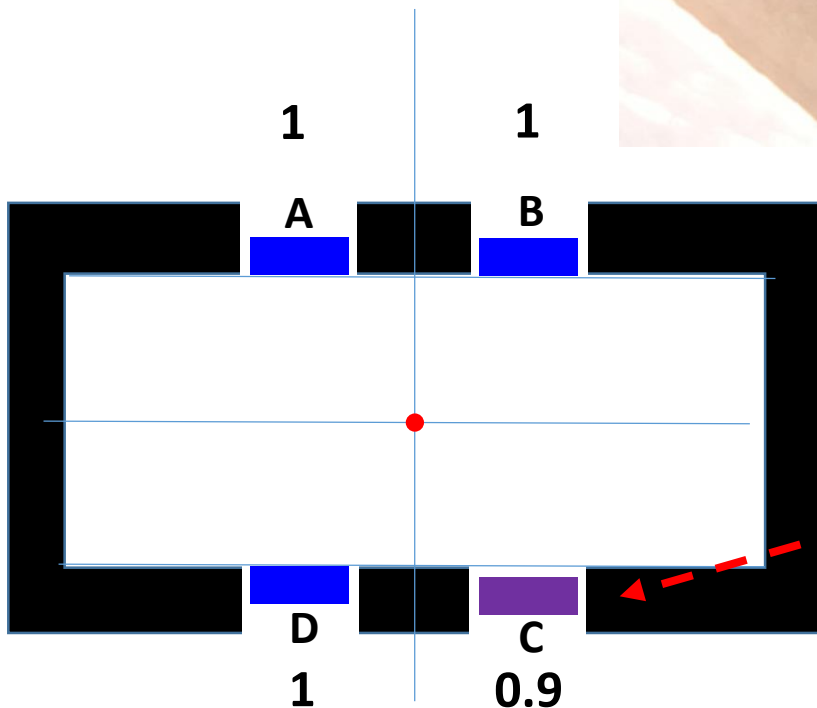
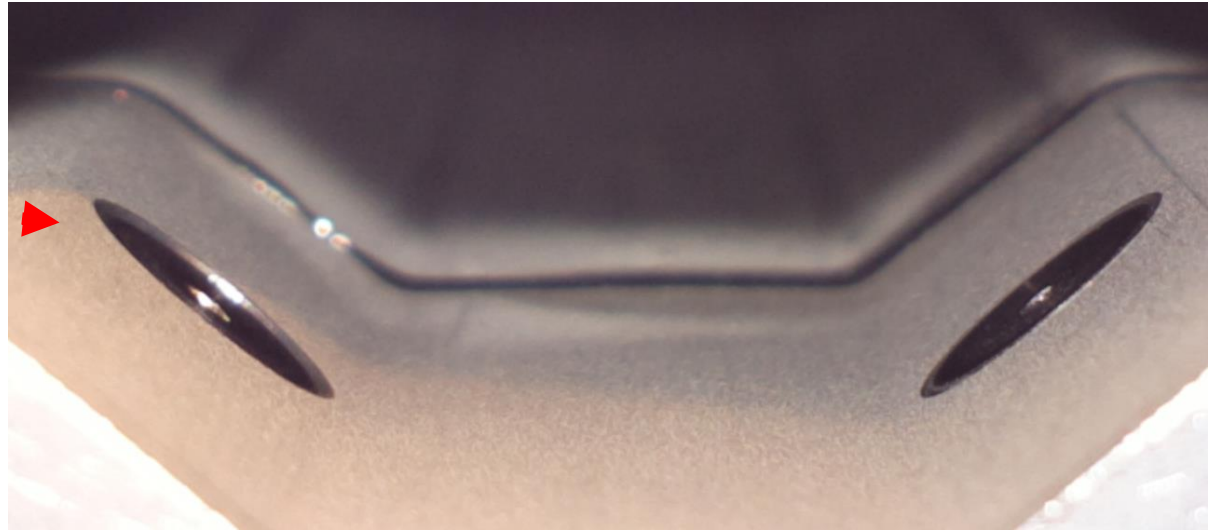
- 1) Calibration against relative differences
in sensitivity between the 4 buttons
- 2) Problems with “dust” inside the chambers ...
affecting (short-circuiting) the button ...
- 3) Calibration against relative differences
in transmission sensitivity between the 4 cables
- 4) Use of polynomials to better calculate
(next to H and V coordinates)
also the Sum and the Q (incoherence)

non-equal sensitivity of the 4 buttons

- this causes :
- an electric offset
 - a degraded linearity
 - coupling between the planes

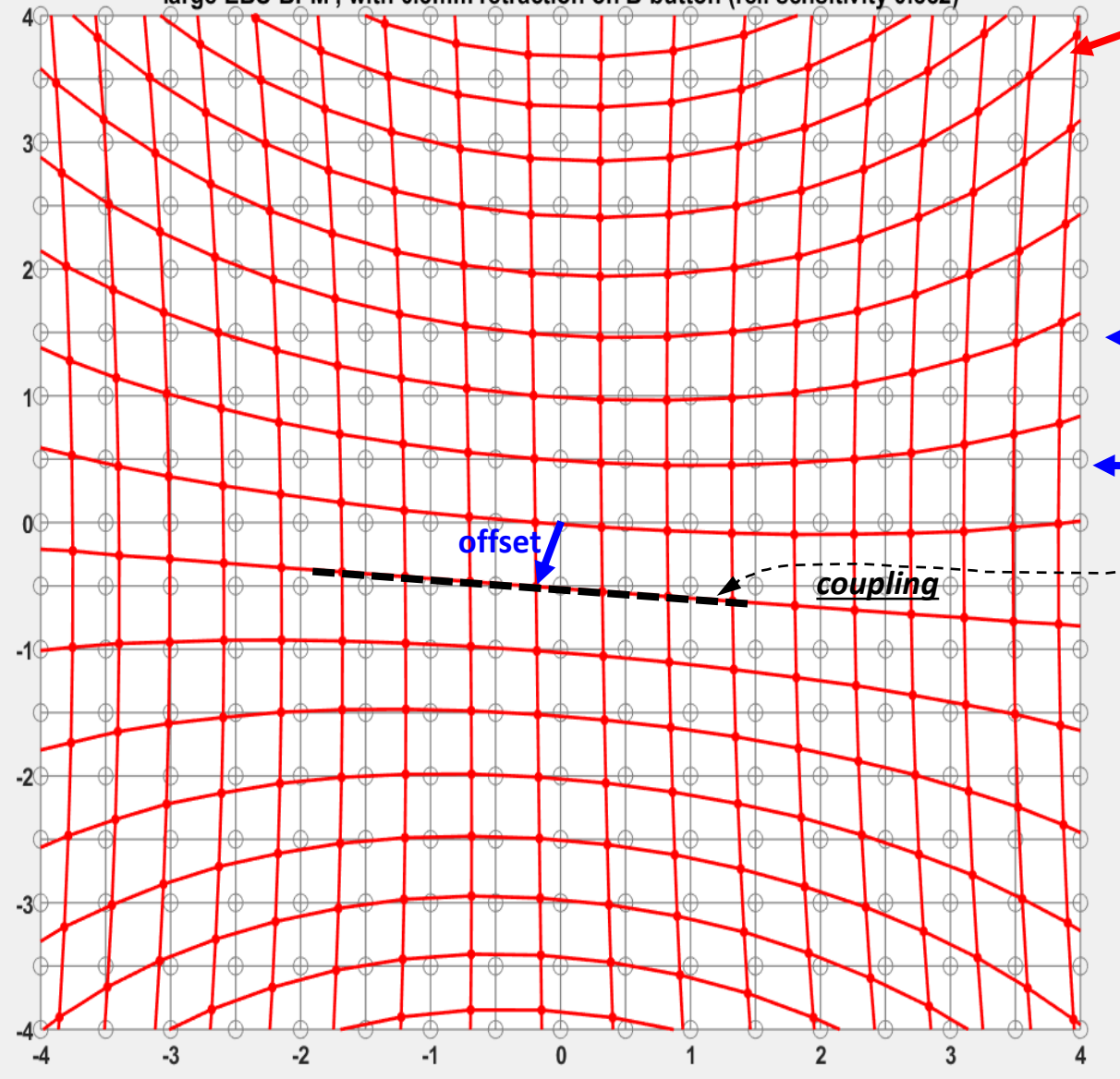
} this is all specific to each BPM-block
i.e. it is different for all 320 BPMs

retracted
button
on chamber "0413"



electric offset BPM-block :
non-equal sensitivity of the 4 buttons
due to non-equal positioning

large EBS-BPM , with 0.3mm retraction on B-button (rel. sensitivity 0.882)



mapping shown (red) is for DoS

Large BPM

Kx= 6.7

Kz= 16.2

for one button = 0.3mm retracted with relative sensitivity of 0.882 i.e. -1.1dB

H-to-V=79mrad
V-to-H=13mrad

for 0.2mm retracted with relative sensitivity of 0.92 i.e. -0.72dB

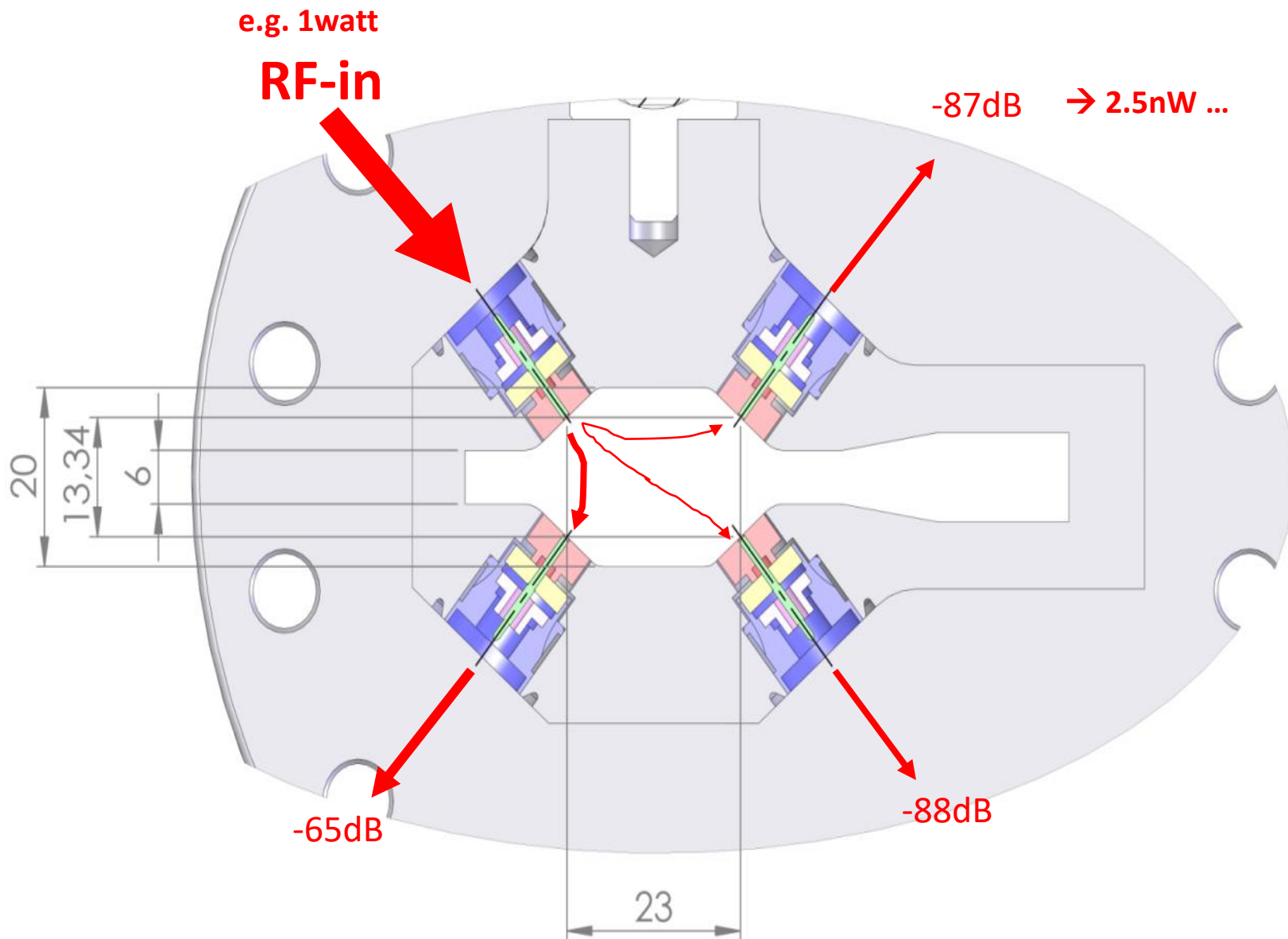
H-to-V=50.8mrad
V-to-H=8.8mrad

for 0.1mm retracted with relative sensitivity of 0.96 i.e. -0.35dB

H-to-V= 25.5mrad
V-to-H= 4.4mrad

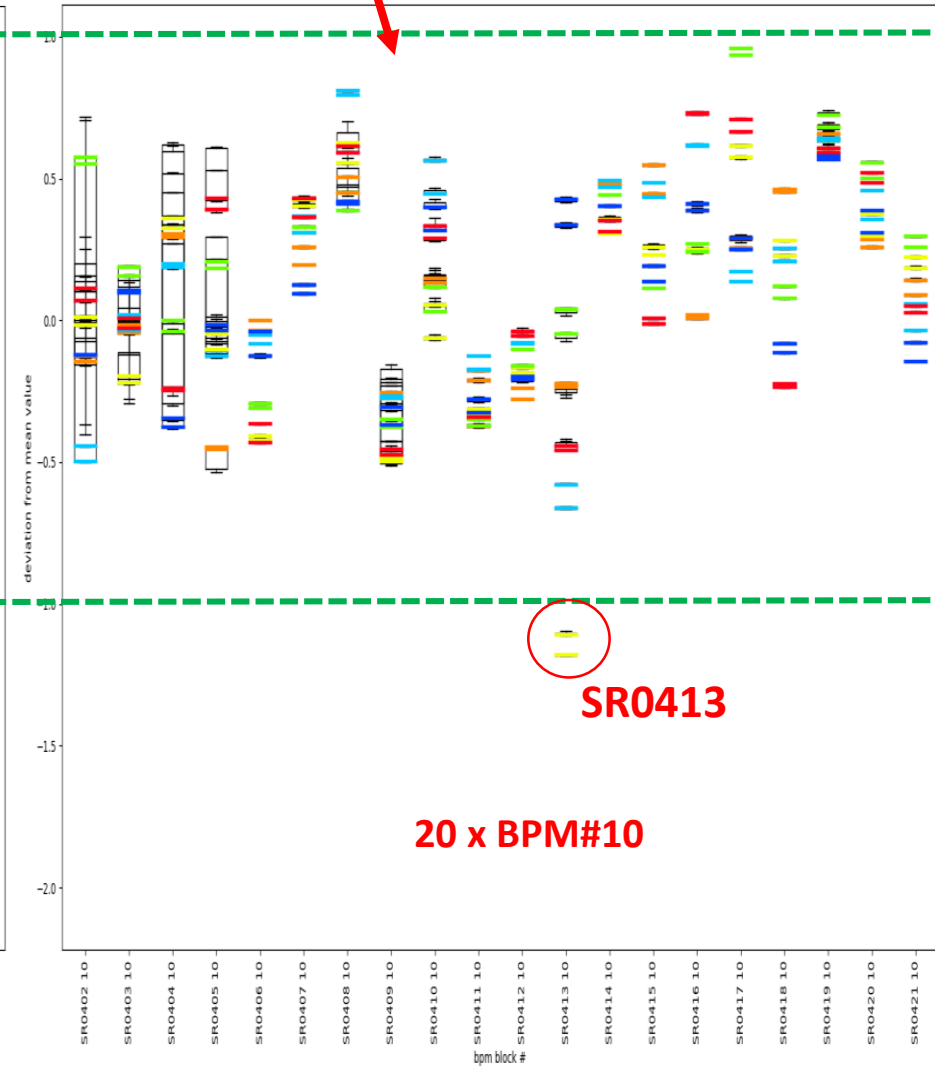
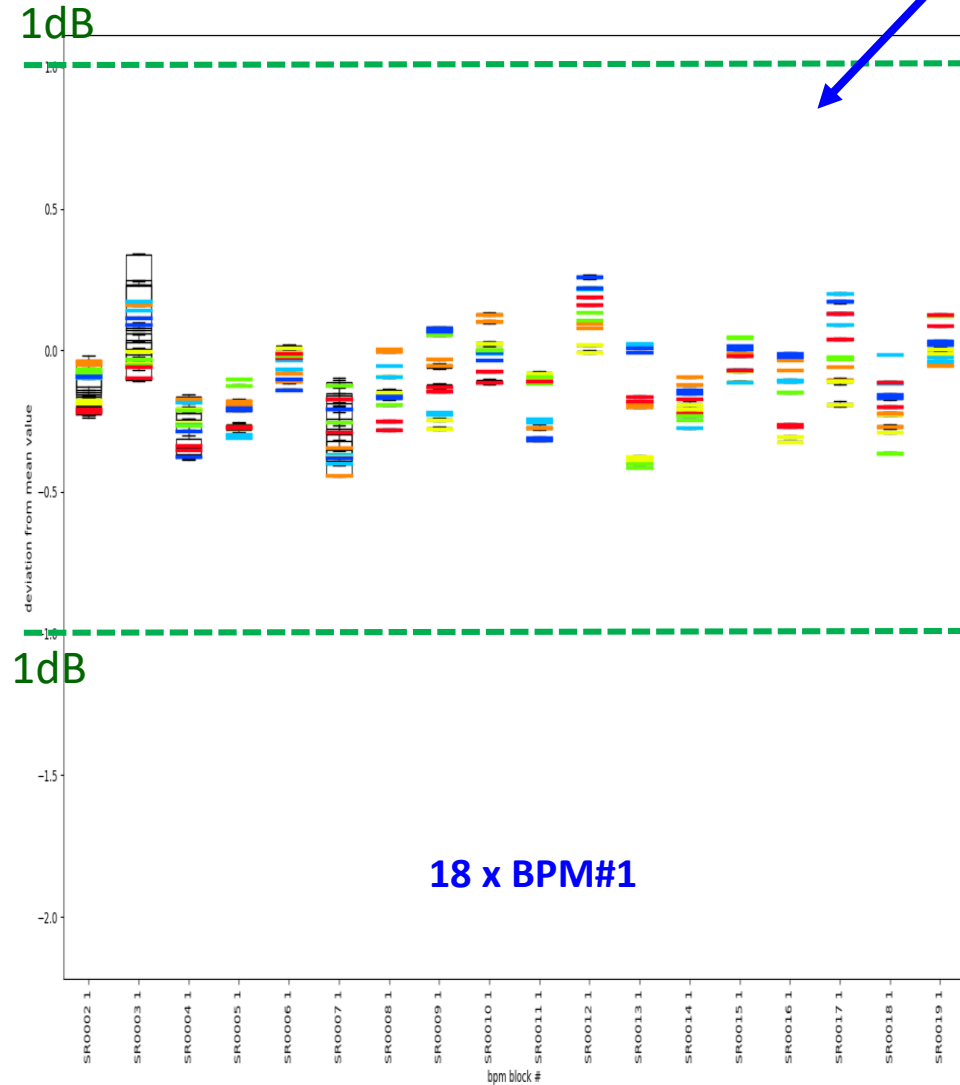
conclusion : the resulting **offset** is a minor, manageable effect (after beam-based alignment) but the **coupling** is much stronger affected, and can **not** be corrected (by beam-based alignment) but only (be reduced) by measuring it & compensating it

Measurements of “cross-RF-transmission” in BPM-blocks (“Lambertson method”)



4 x 3 measurements → sensitivity of each of the 4 buttons

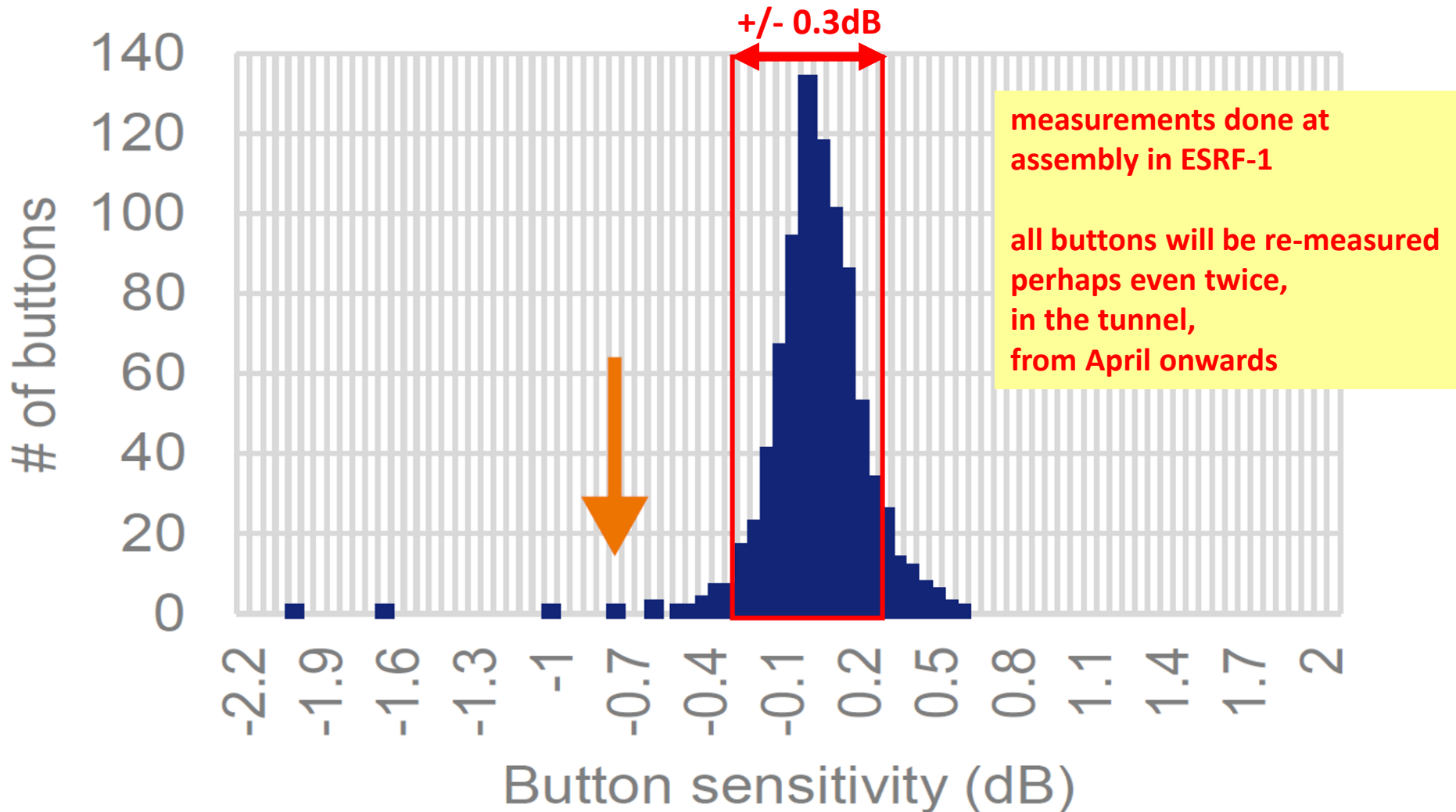
results of RF-cross-transmission measurements on numerous EBS-BPMs,
here below only of **BPM #1** and **BPM #10**



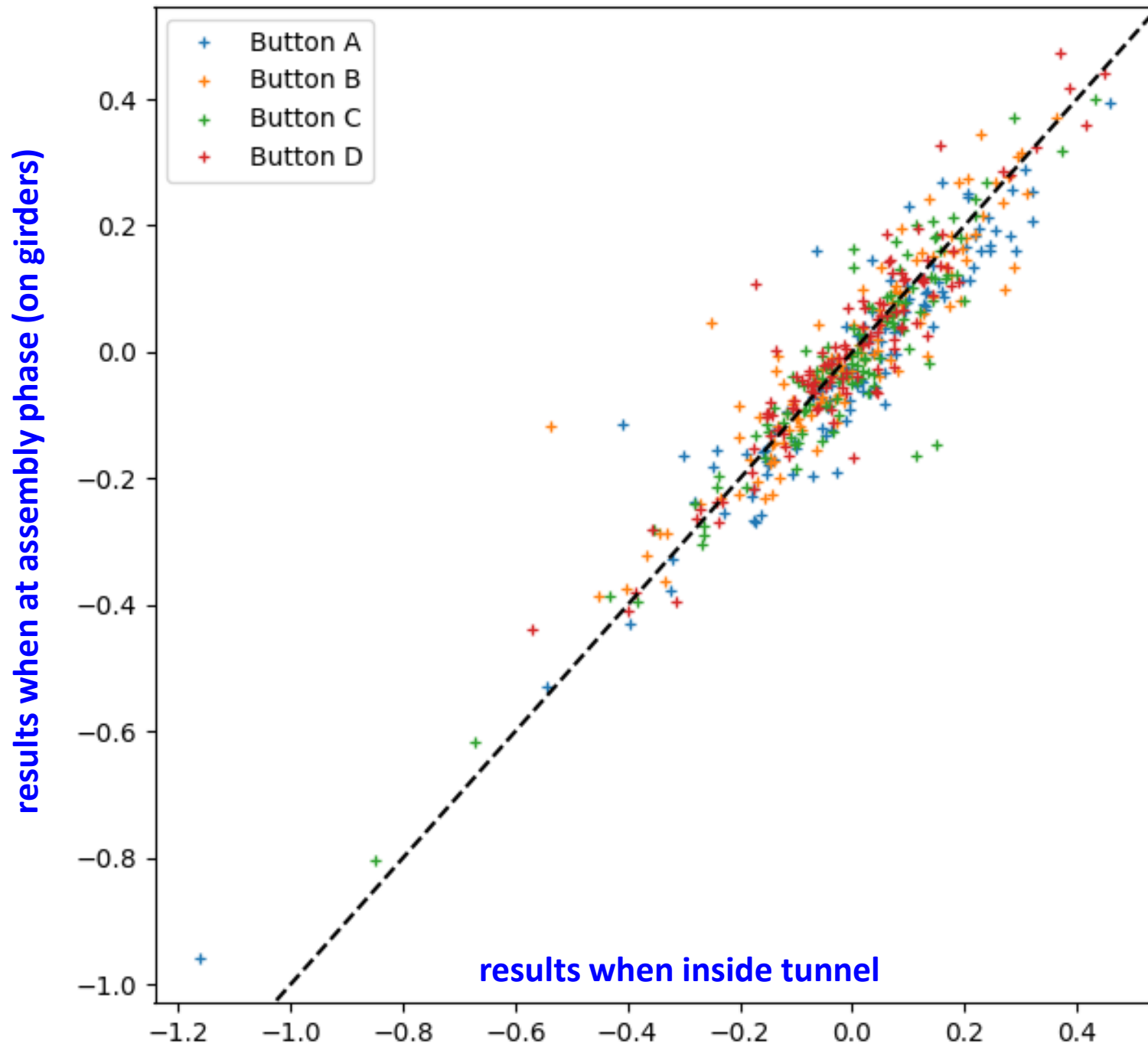
manufacturer : FMB Berlin,
Ch#1=BPM#1

manufacturer : PINK Germany,
Ch#14=BPM#10

Histogram of buttons' sensitivity

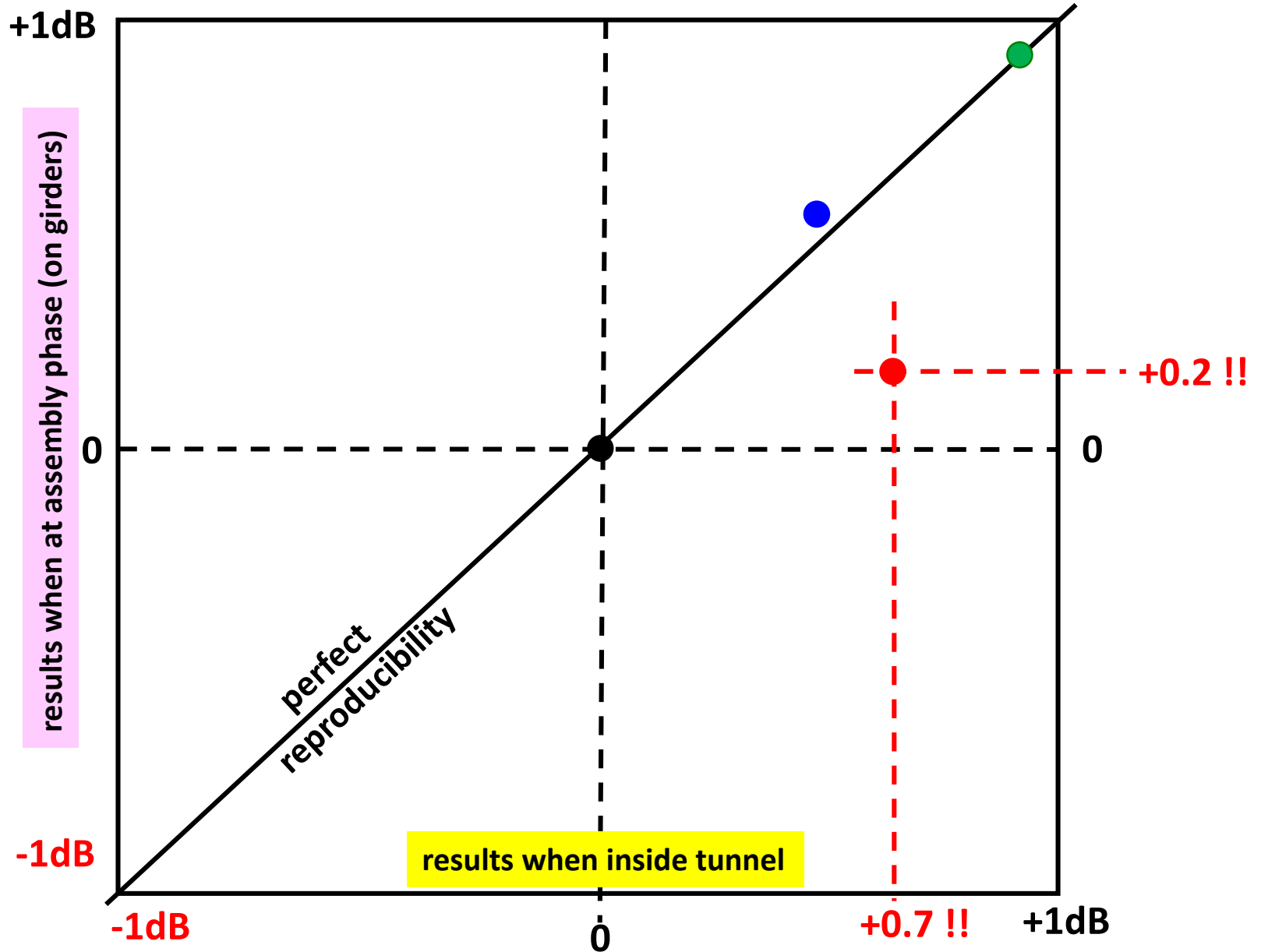


Buttons' sensitivities (dB)



2 separate measurements → useful to assess :

- the extent of the variations of sensitivities
- the reproducibility of these measurements

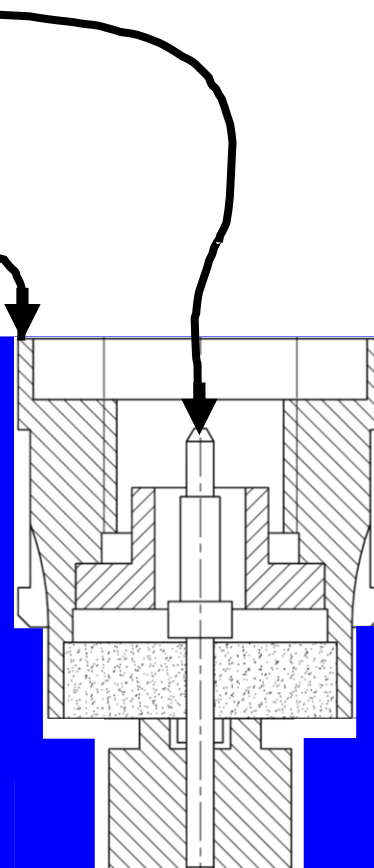


problems of dust, particles, slivers, foils ? ... INSIDE the vacuum chamber
causing NON Hi-Z impedance of the button ...
unpredictable & unexplainable occurrences in our new chambers
both on *upper-side* and on *lower-side* Buttons

simple
ohm-meter

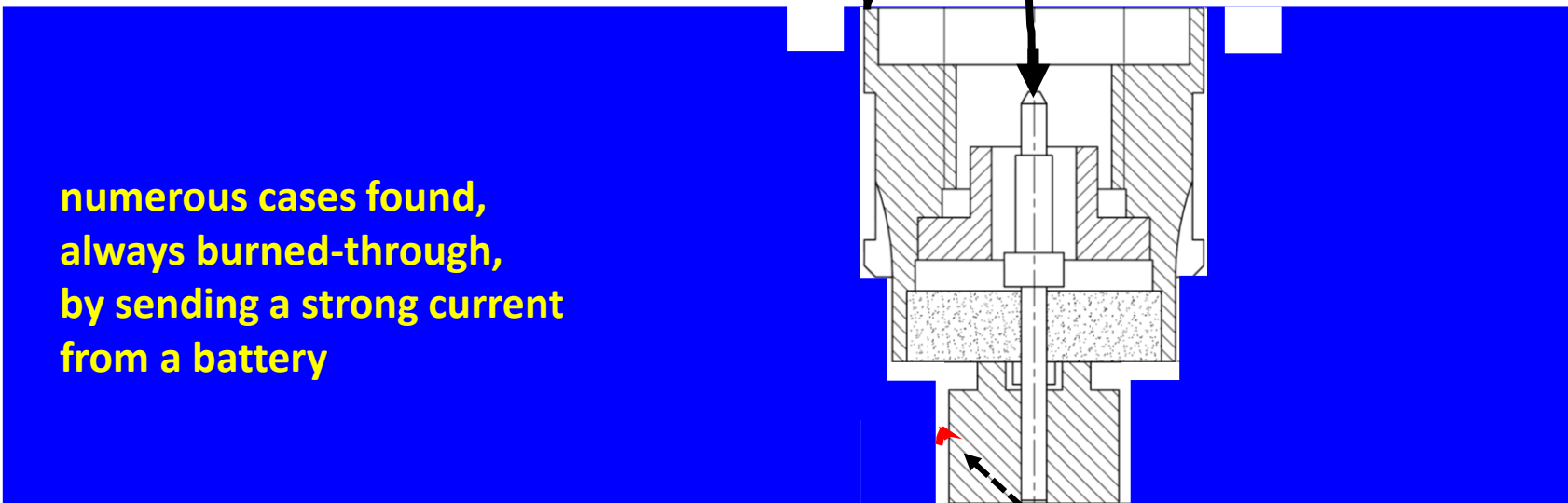
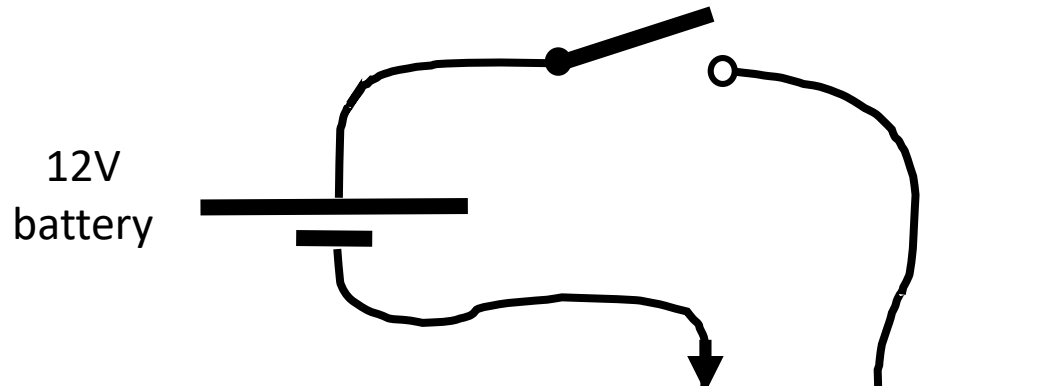
Hi-Z or
not ??

we do a simple quick check
if the impedance is Hi-Z

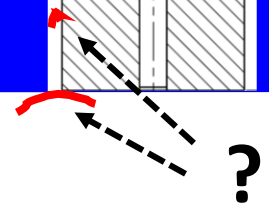


?

problems of dust, particles, slivers, foils ? ... INSIDE the vacuum chamber causing NON Hi-Z impedance of the button ...



numerous cases found,
always burned-through,
by sending a strong current
from a battery



problems of dust, particles, slivers, foils ?
... INSIDE the vacuum chamber

simple
ohm-meter

Hi-Z or
not ??

we do a simple quick check
if the impedance is Hi-Z

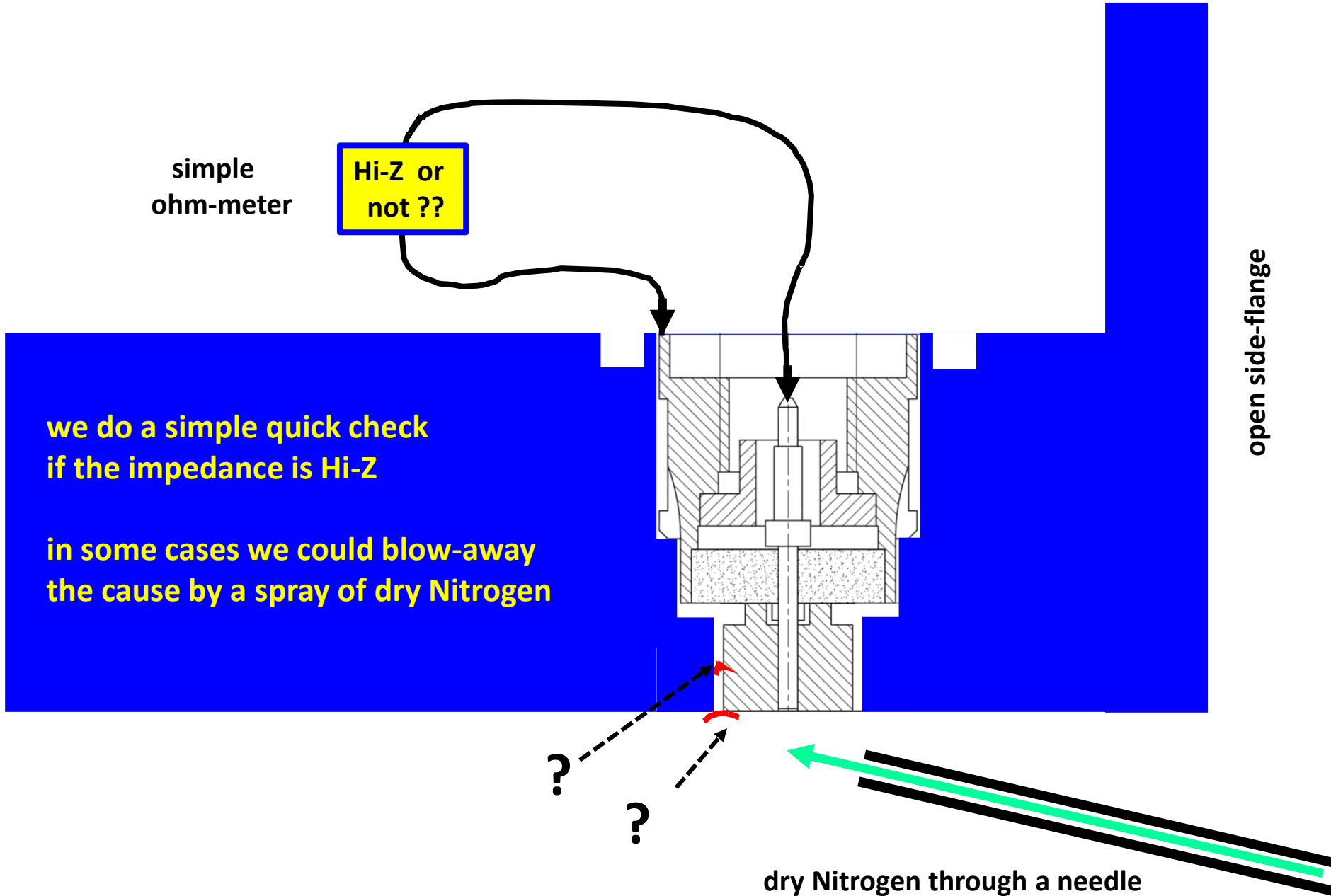
in some cases we could blow-away
the cause by a spray of dry Nitrogen

open side-flange

?

?

dry Nitrogen through a needle



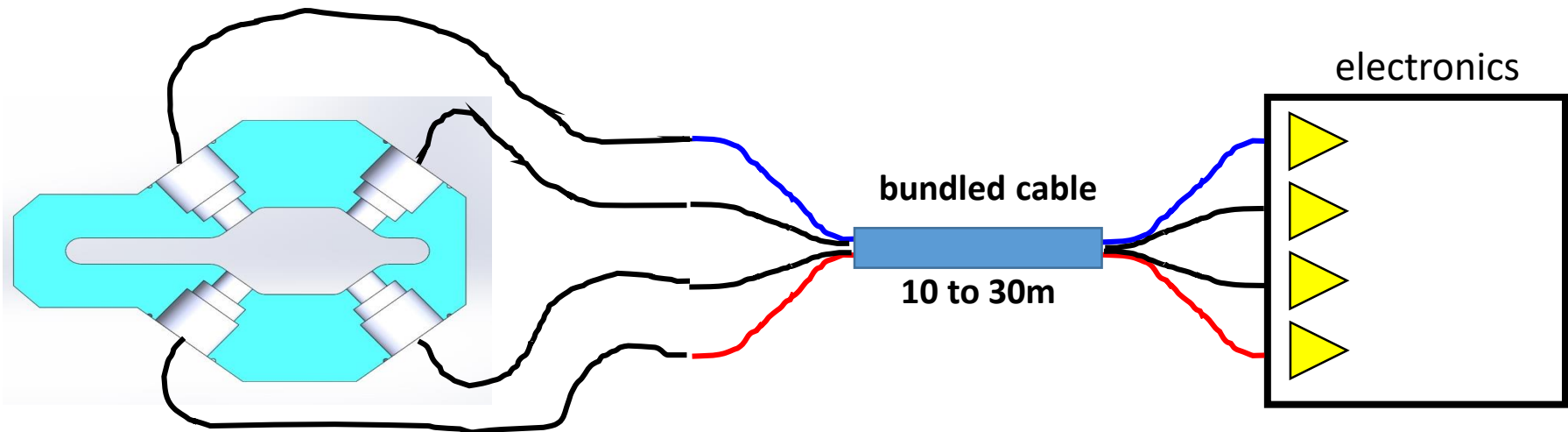
typical recordings (movies) of endoscopic inspections done by manufacturer



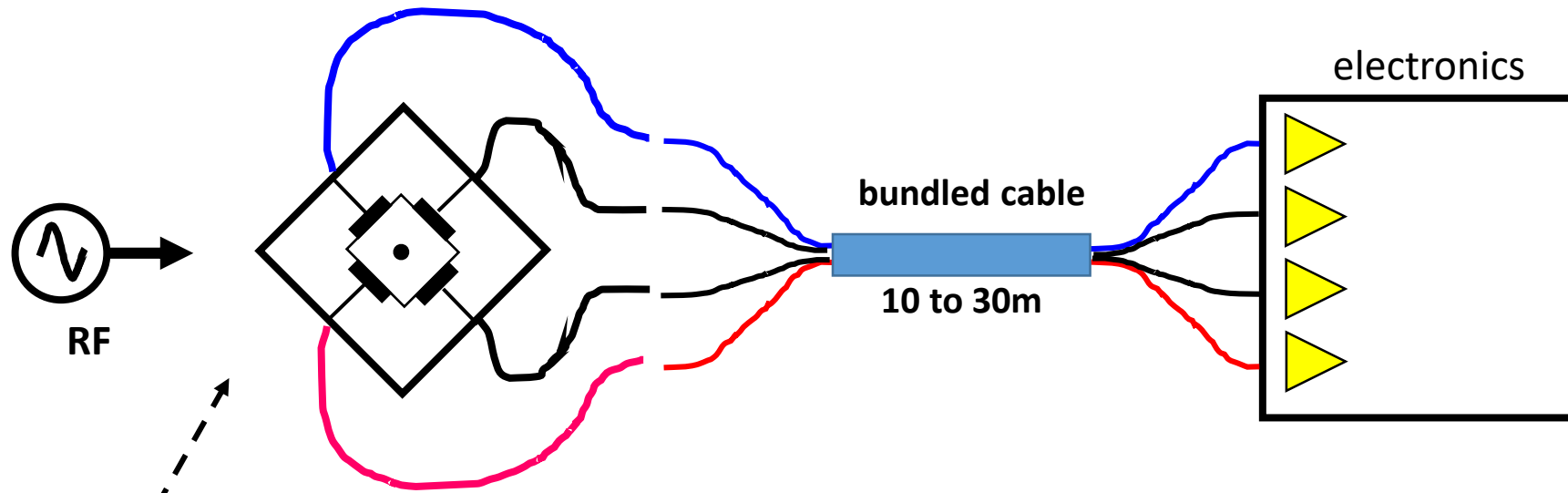
dealing with difference in RF signal transmission in the 4 cables

reflections, standing-waves impacting the 4 signal transmissions due to :

- none-perfect $50\ \Omega$ matching at electronics input
- perfect reflector at button side
- cable attenuation very low (few dB)
- different phases between the 4 cables

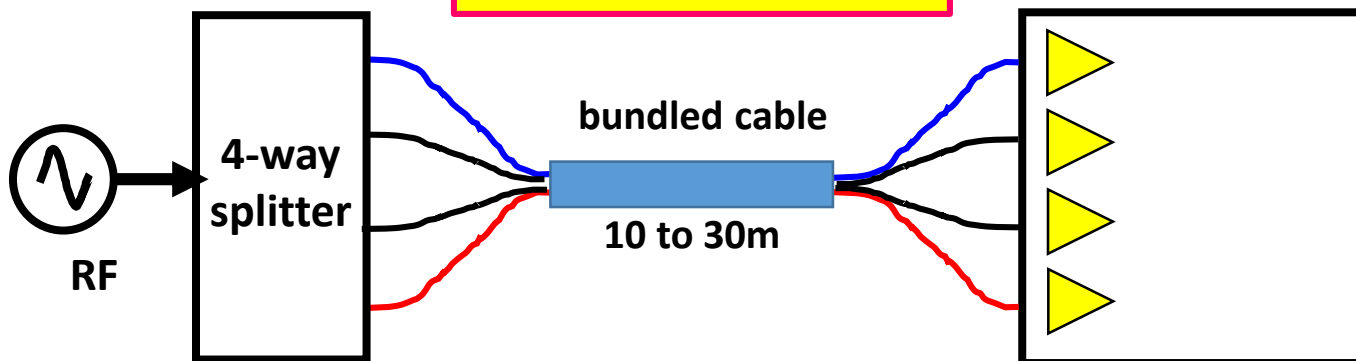


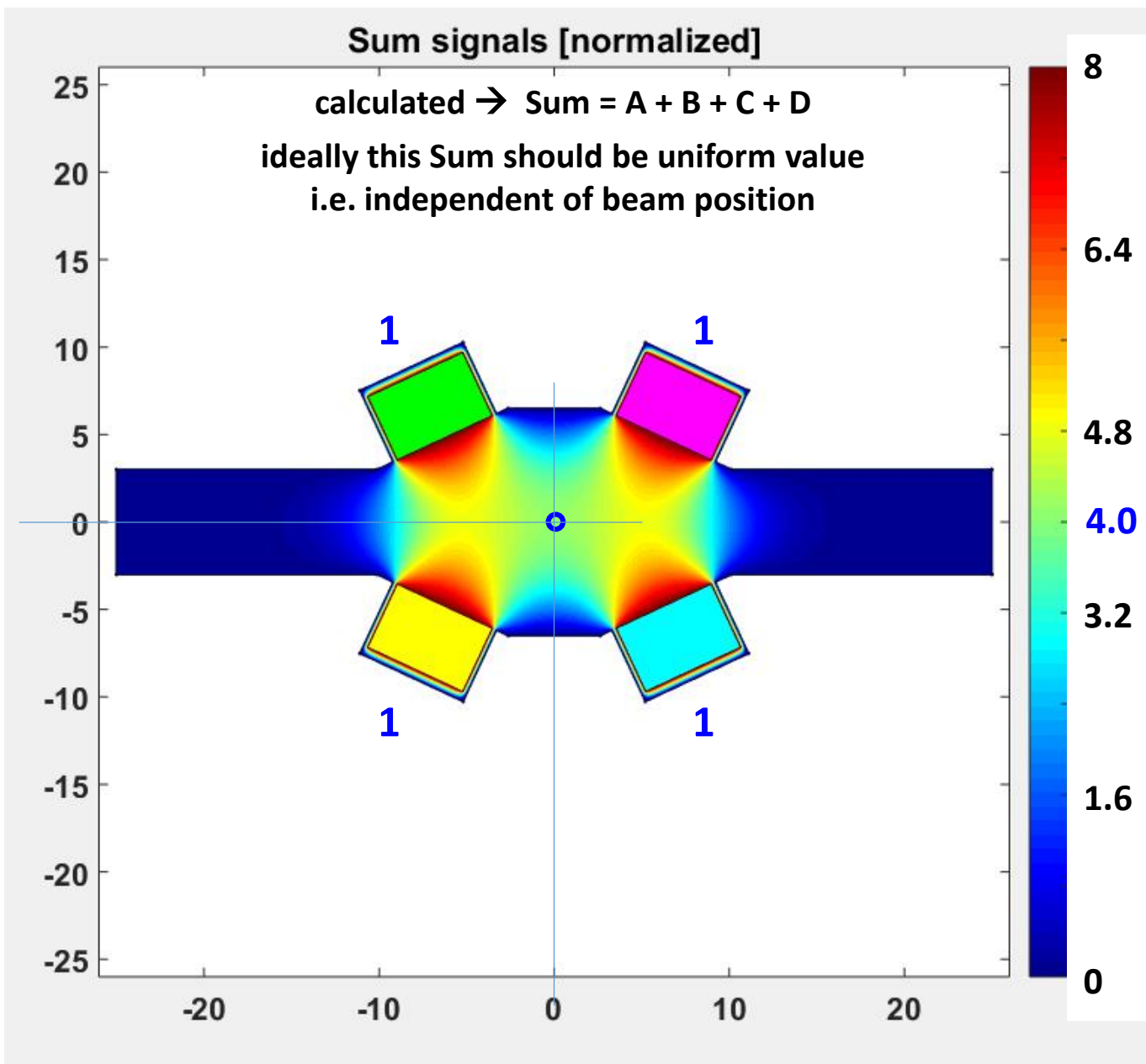
dealing with difference in RF signal transmission in the 4 cables



calibrator tool :
4 equal RF signals with
source impedance like real buttons

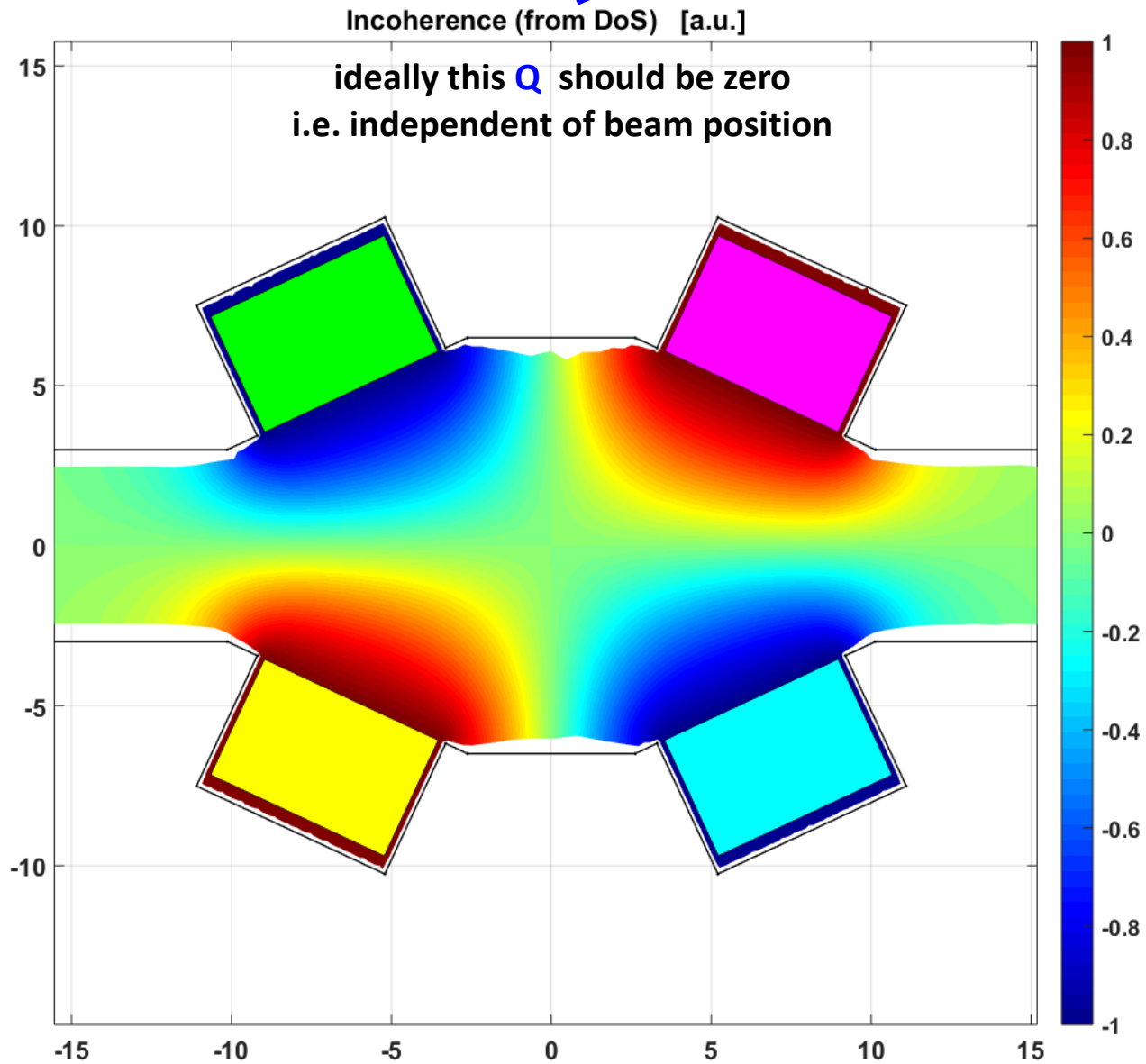
NOT good enough ...





this will also be dealt with by Bpmlab_v_ESRF

$$Q = \frac{A+C-B-D}{A+B+C+D}$$

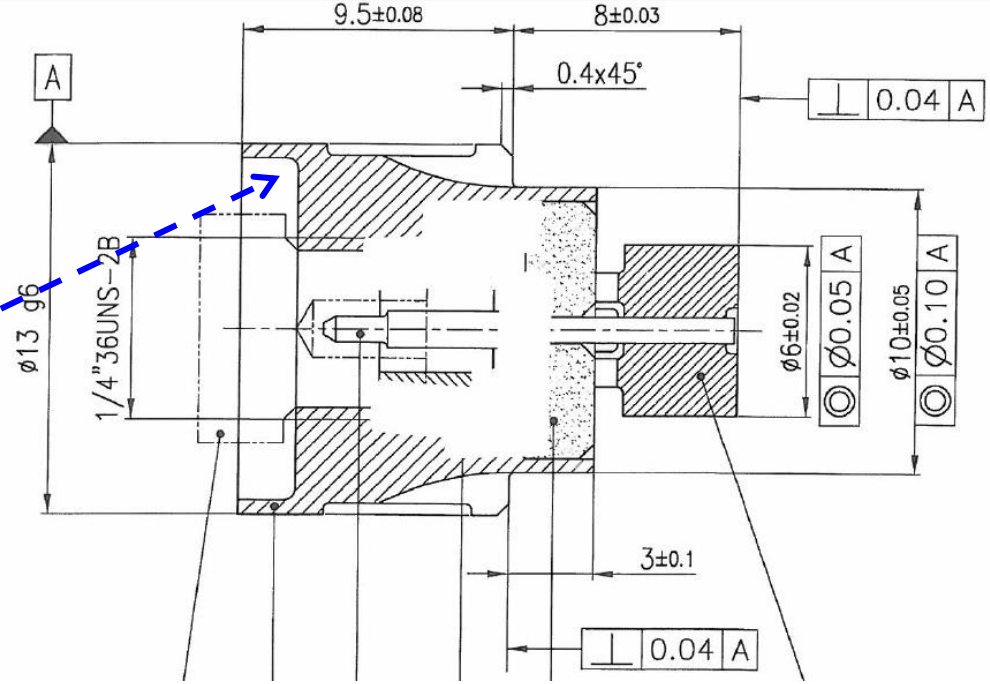


this will also be dealt with by Bpmlab_v_ESRF

further slides & illustrations

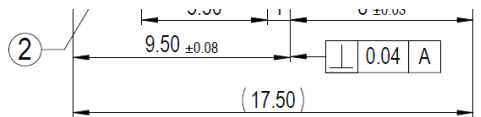
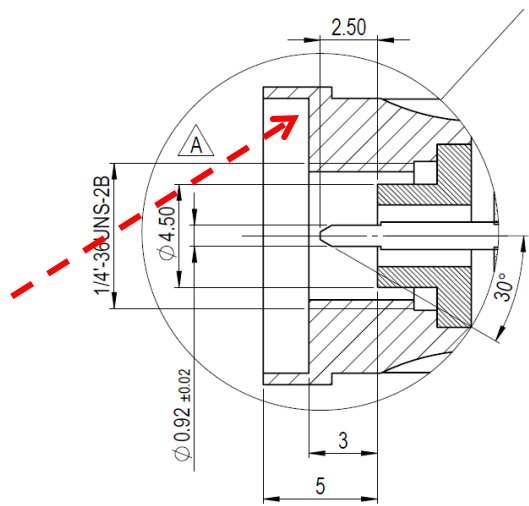
DLS

rounded corners



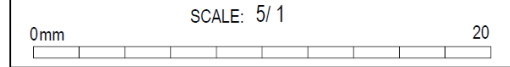
ESRF

sharp corners



5	1	ELECTRODE	304L
4	1	CERAMIC	Al2O3
3	1	PIN	MOLYBDENUM
2	1	SLEEVE	304L
1	1	FLANGE	304L
ITEM QTY DESCRIPTION / REMARKS			MATERIAL

DESCRIPTION / REMARKS	MATERIAL	TREATMENT
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SR, BEAM DIAGNOSTICS
BPM PROJECT
BUTTON BPM Ø8

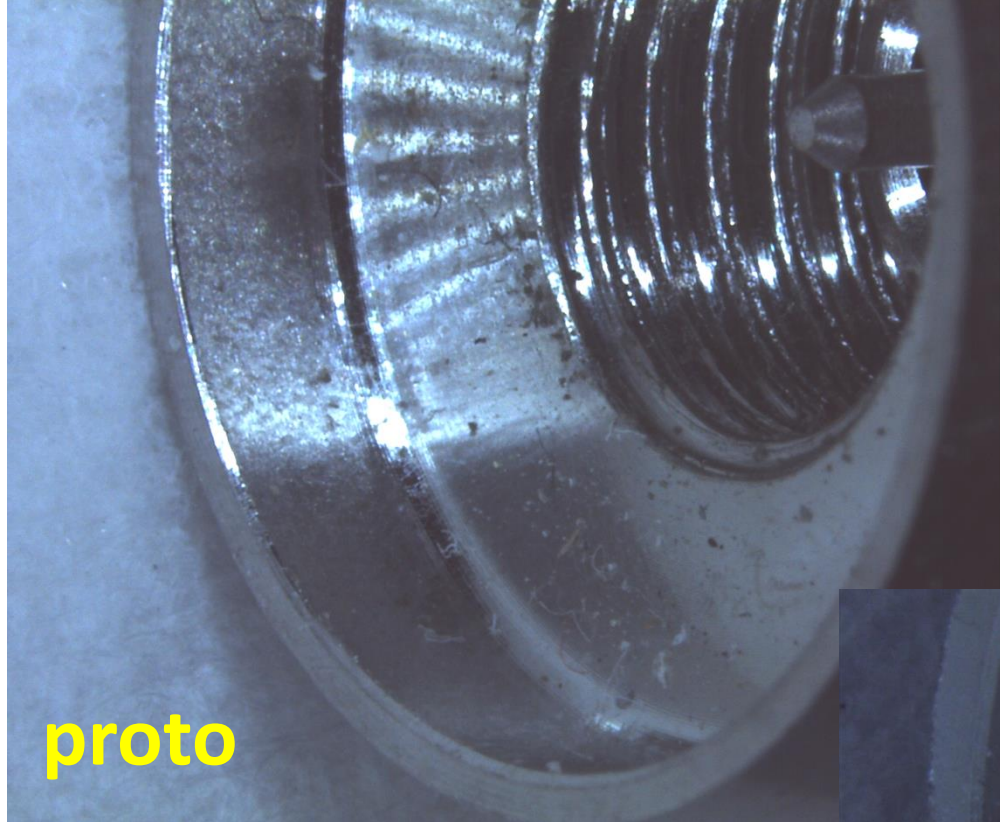
NAME		
DRN.	N.BENOIST	(
CKD.	K.SCHEIDT	2
APPD.	L.GOIRAND	2

GEN. TOL. :
GEN. SURFACE FINISH :
VALID FOR MANUFAC
21 Dec 15

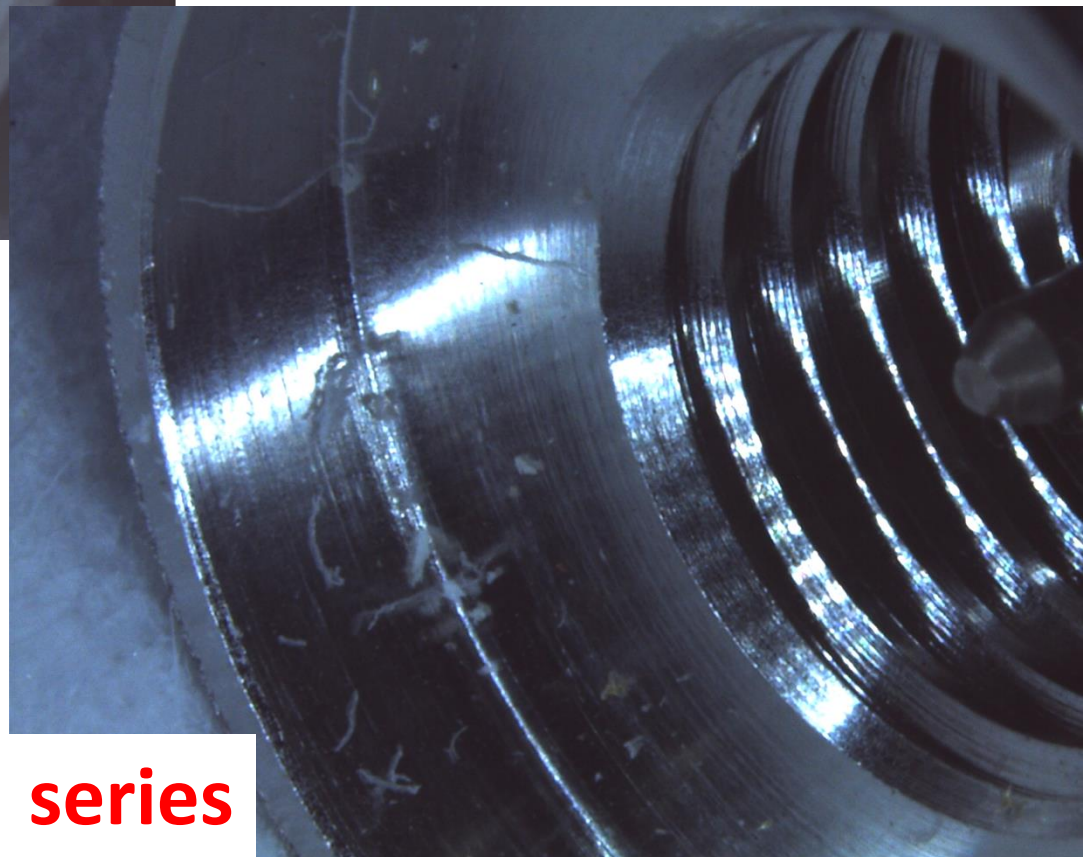
AND	ELECTRODE 304L in stead of MOLYBDENUM
AND	
D.	DESCRIPTION

EUROPEAN SYNCHROTRON
RADIATION FACILITY
CS 40220 - 38043 Grenoble Cedex 9
TEL. 04-76-88-20-00 WWW.ESRF.FR

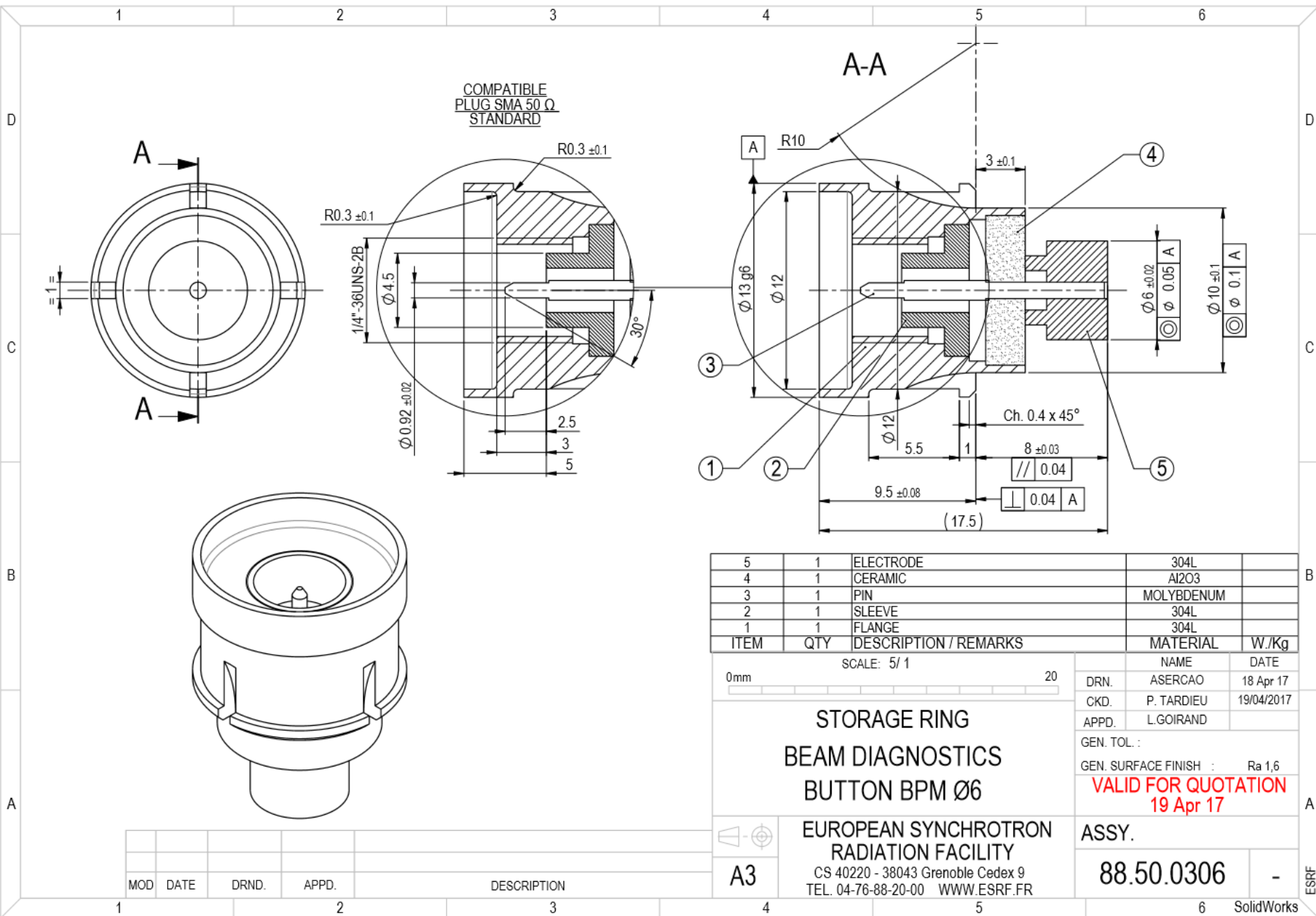
ASSY.
88.50.0002



proto



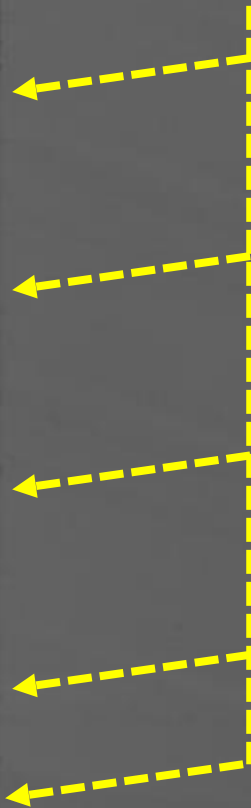
series



new design April 2017 : rounded angles/corners

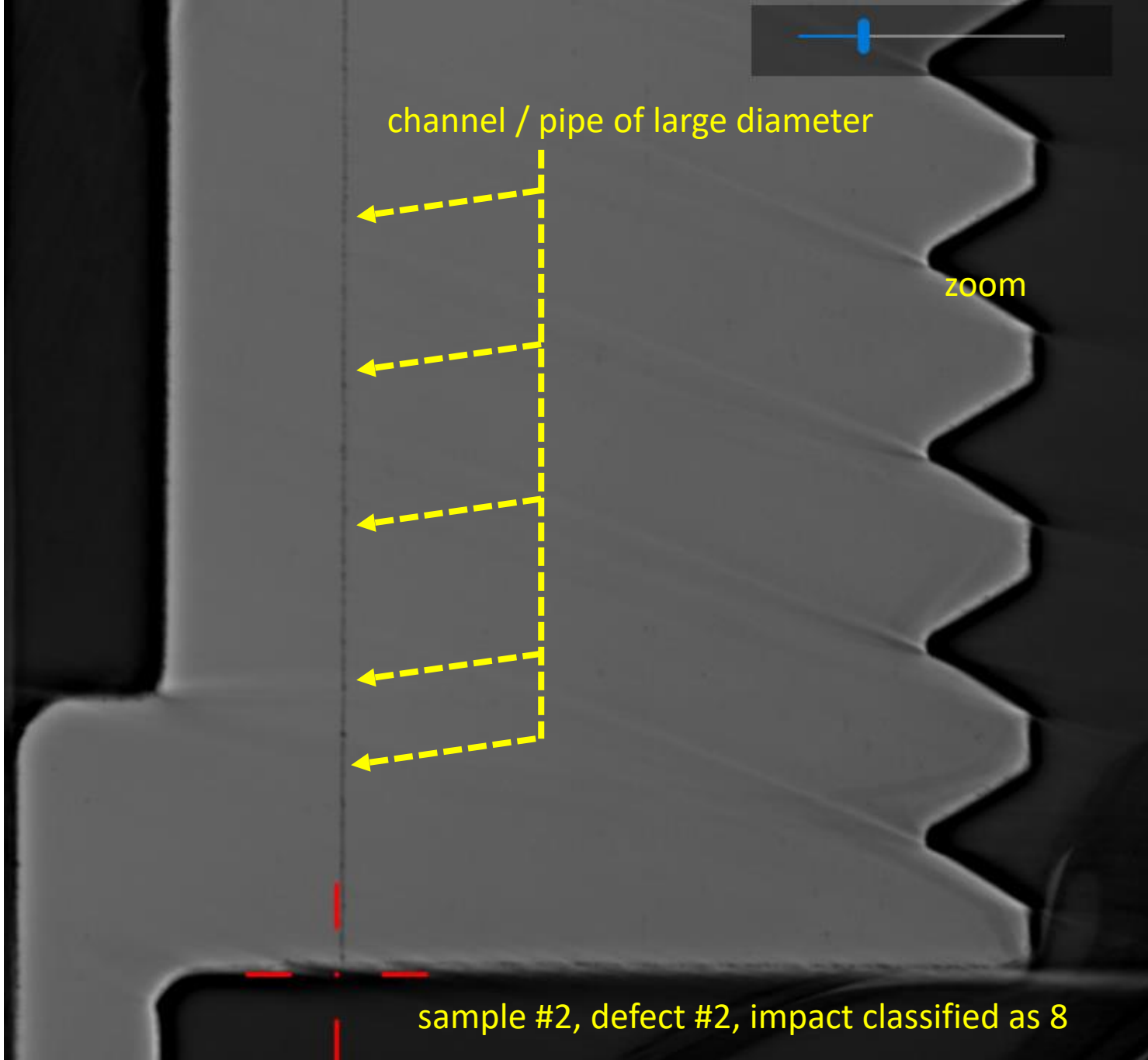


channel / pipe of large diameter

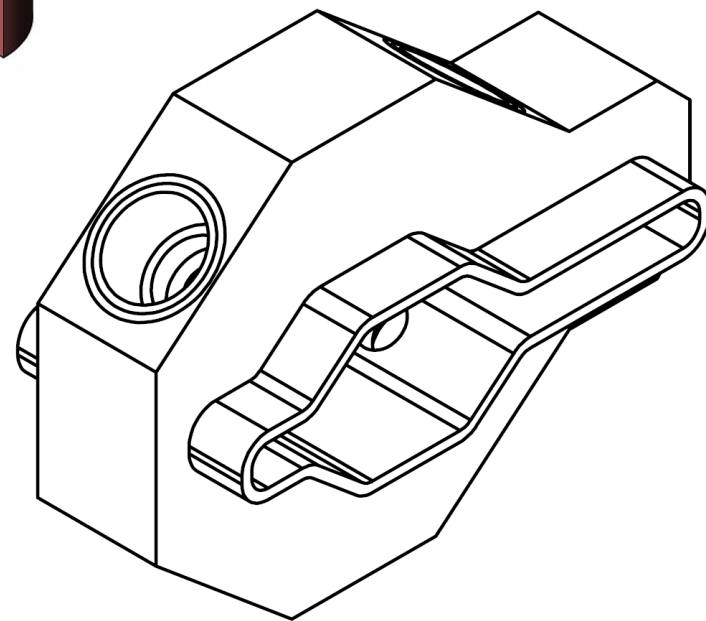
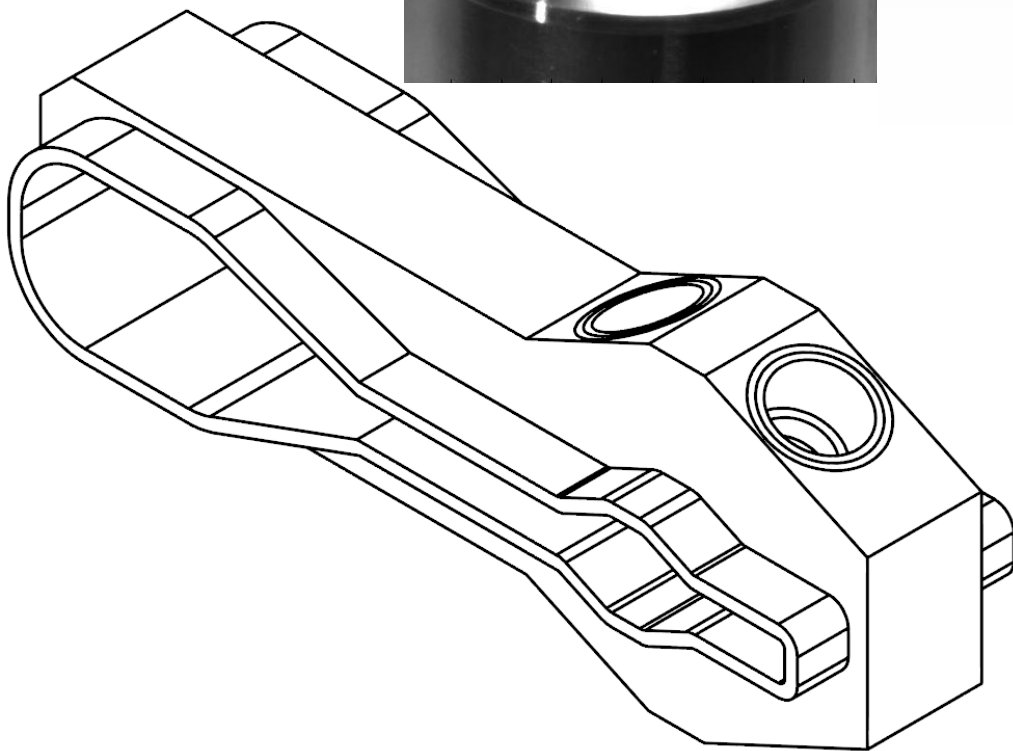
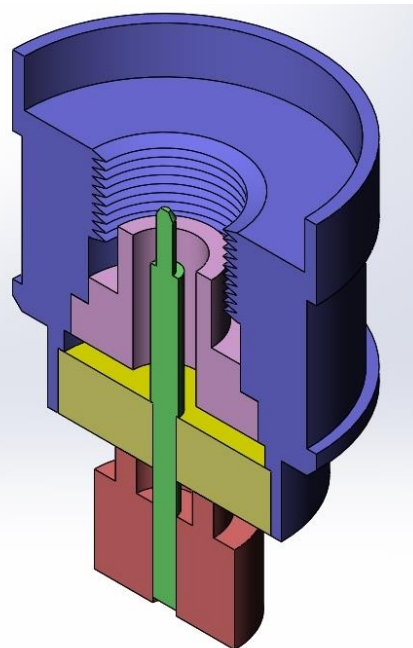


zoom

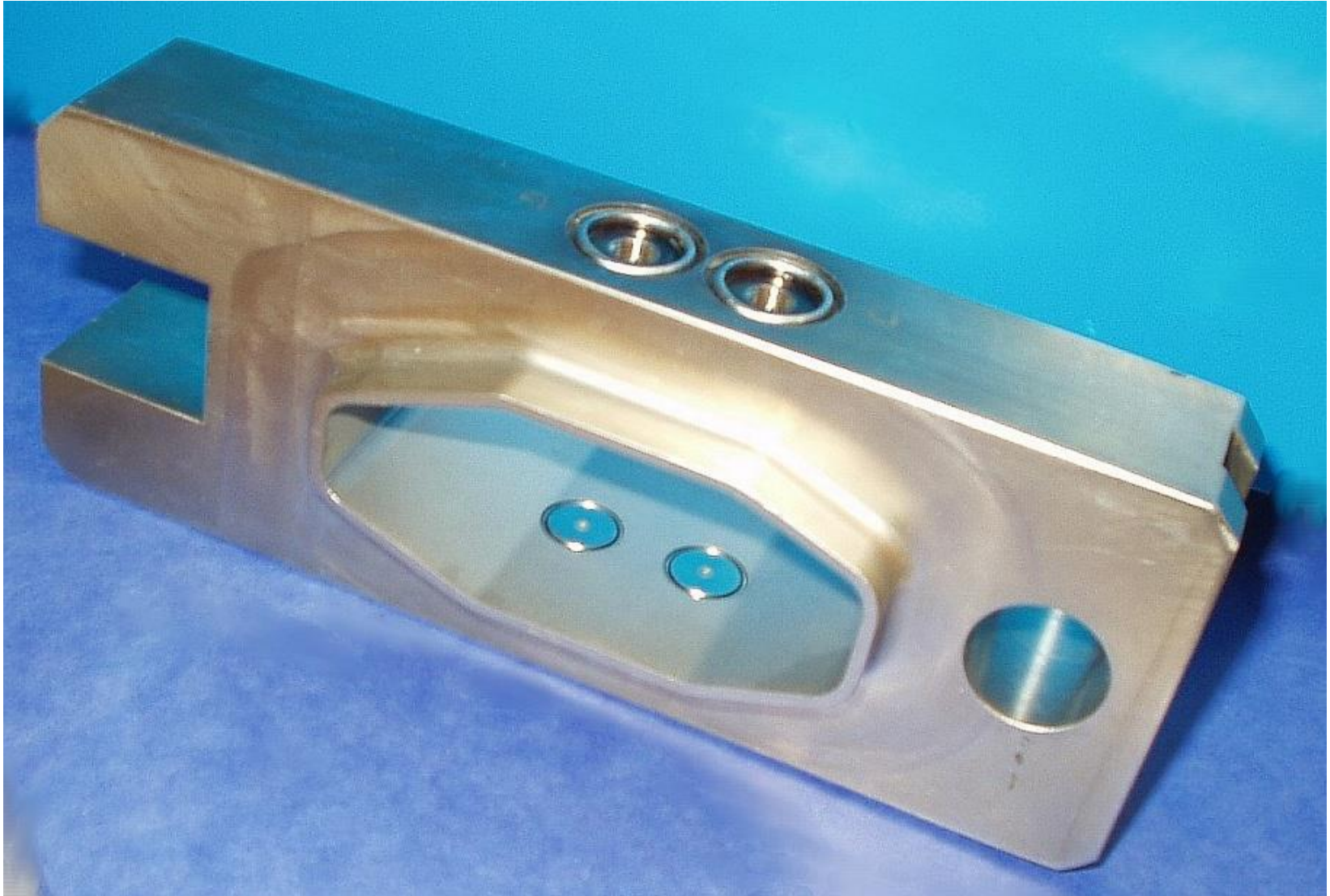
sample #2, defect #2, impact classified as 8

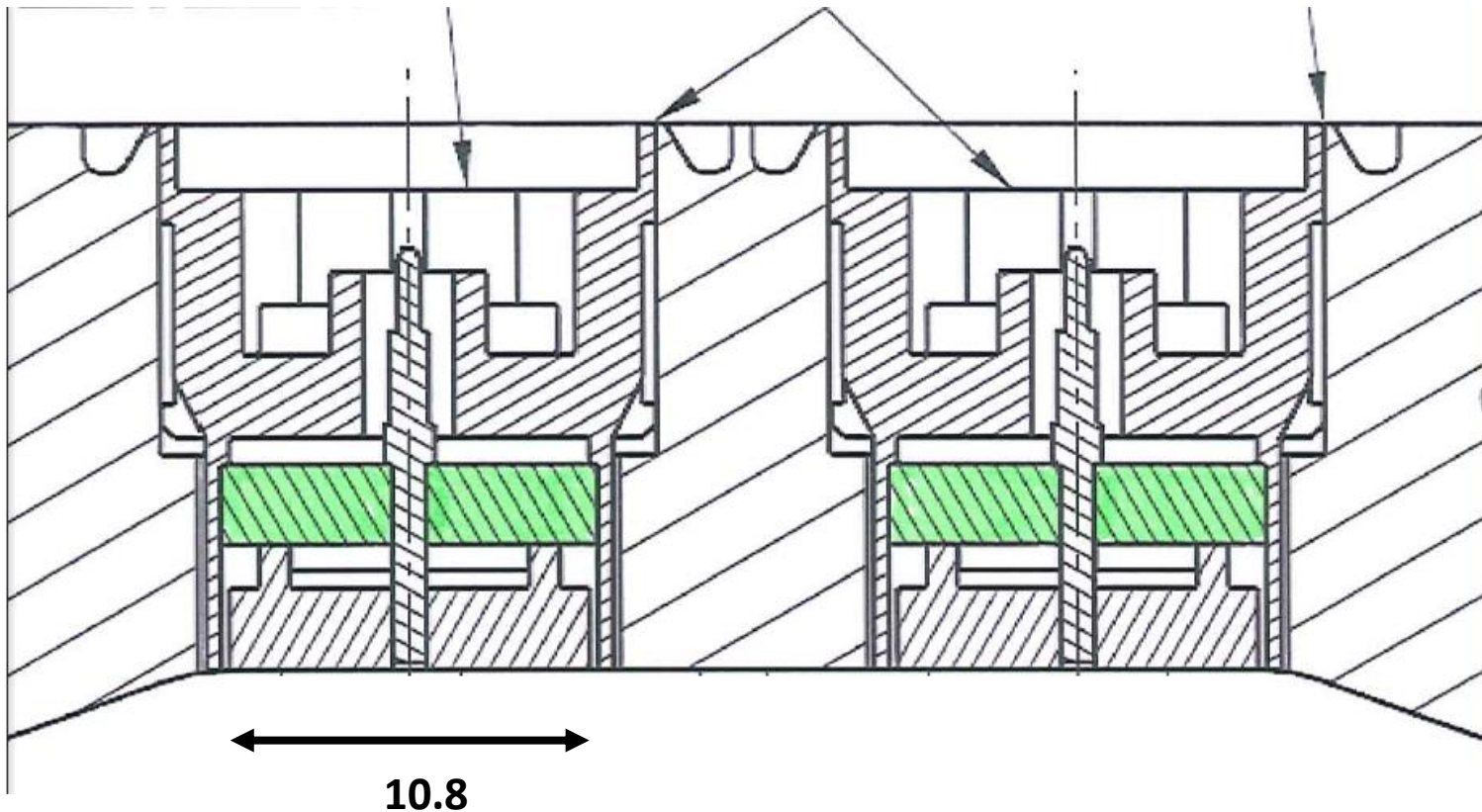


development of a new BPM Button feedthrough for the future LE-Ring



In our present Ring : Steel : BPM-Block
Steel : BPM- Feedthrough
Ceramic (Al₂O₃) : Isolator inside



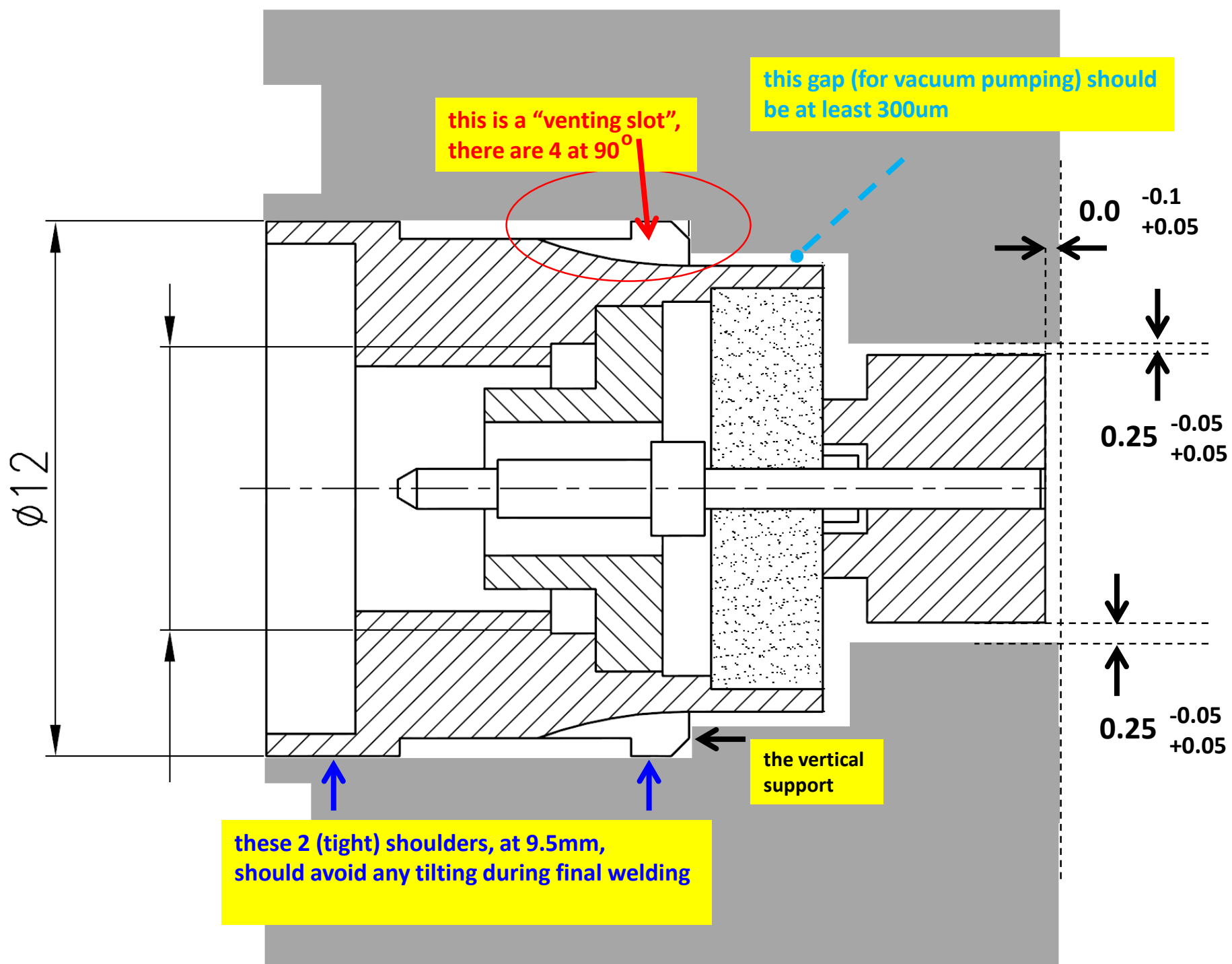


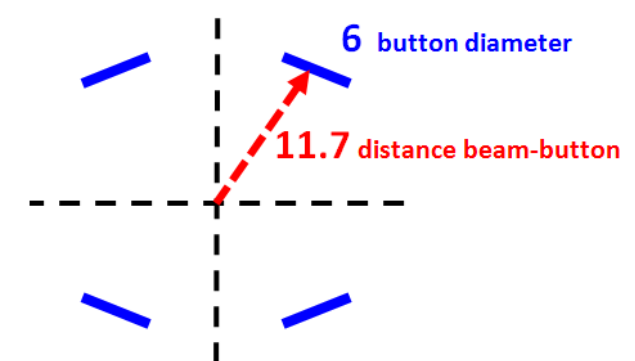
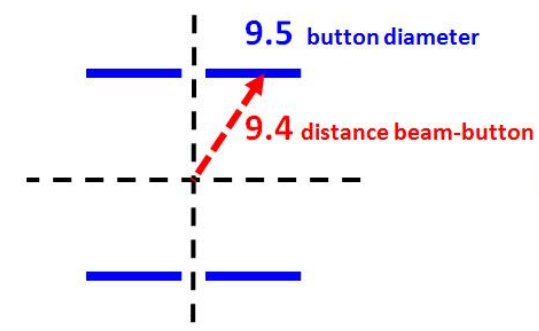
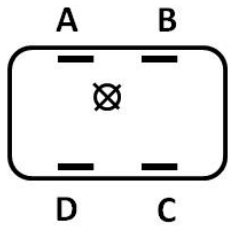
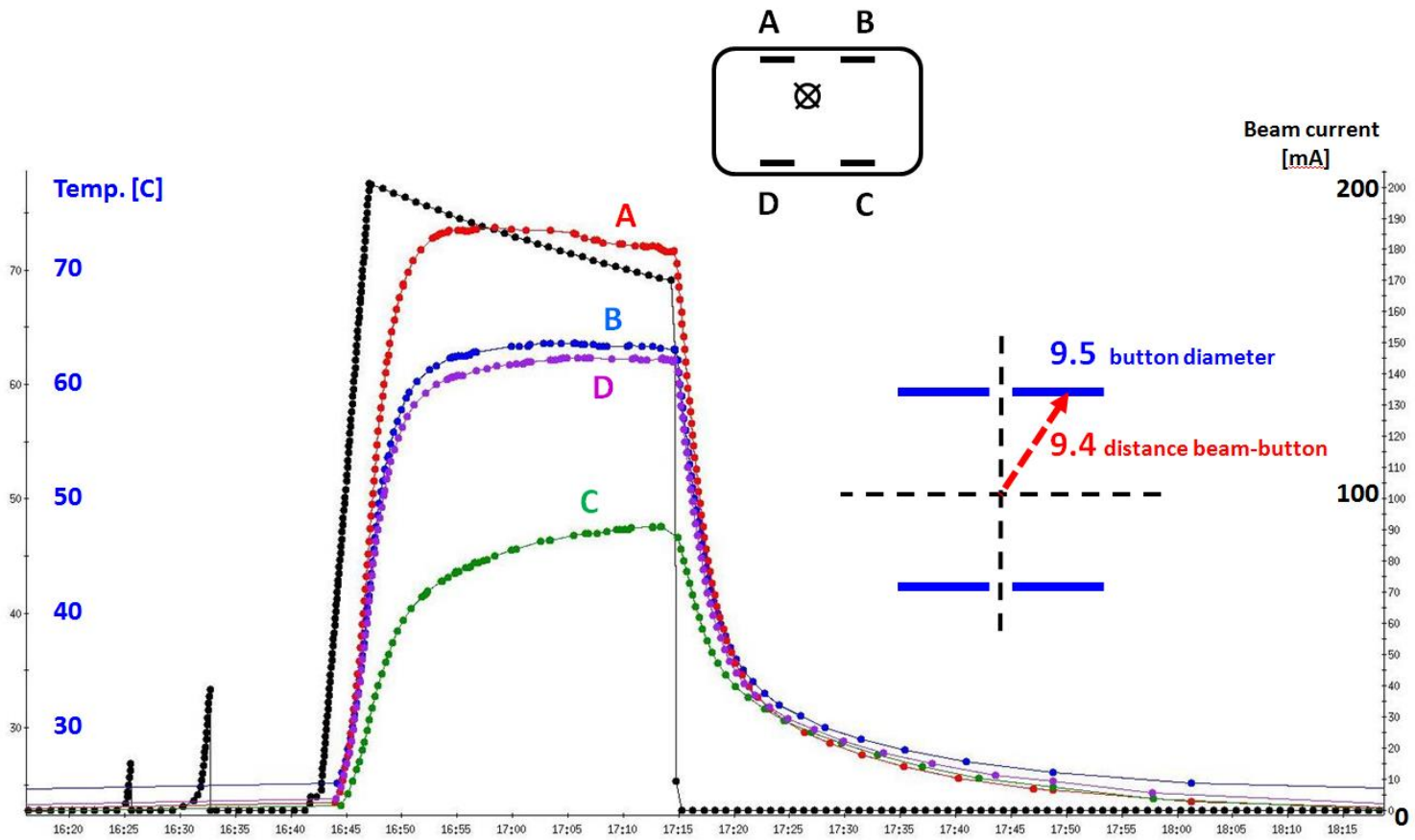
BPM Button feedthrough made by Meta-Ceram (now **PMB-ALCEN**) in **1990**

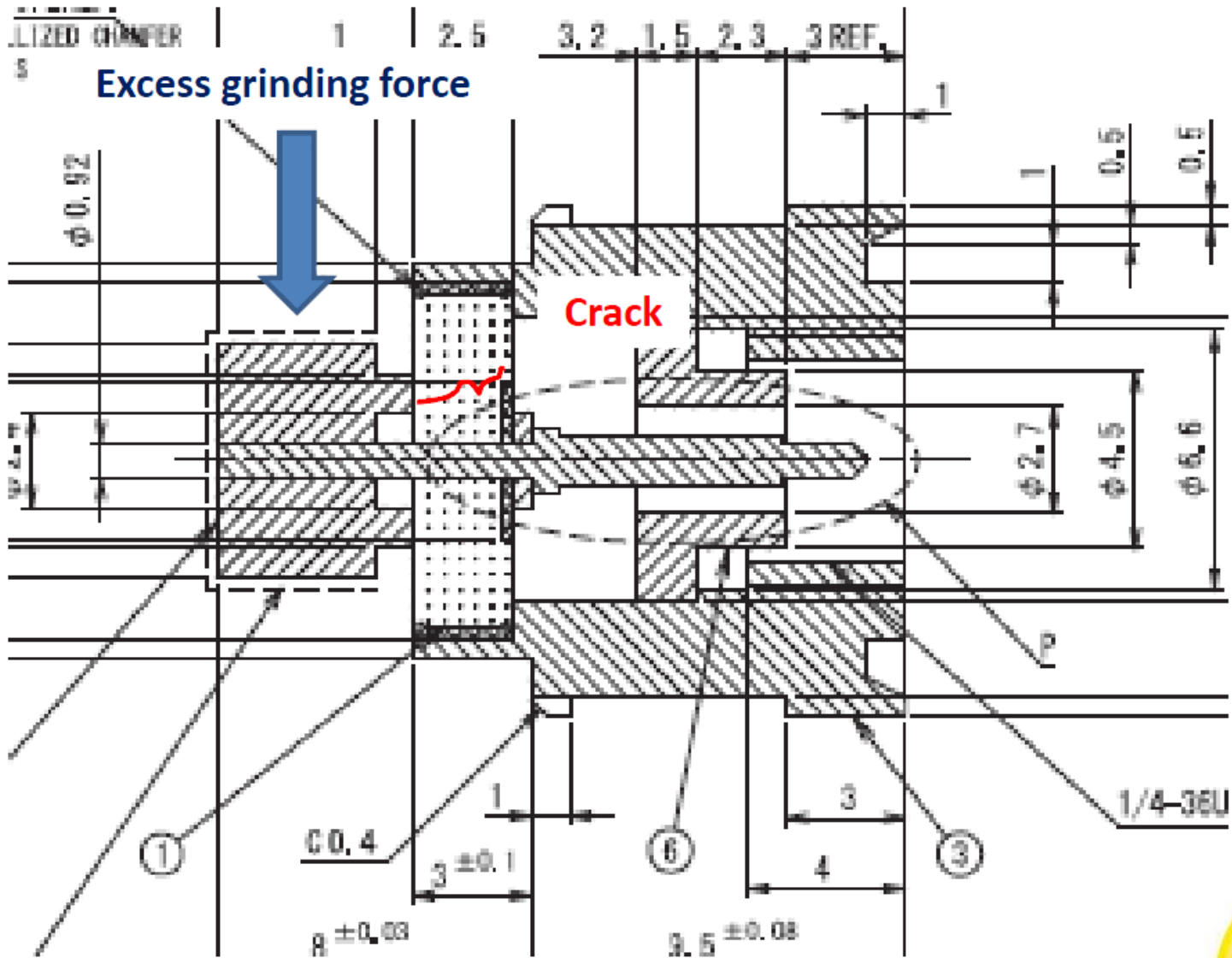
Characteristics : button diameter= 10.8 mm
with skirt (and a gap of 250 um)
center-pin is Molybdenum
male-SMA connector

also made buttons for :
SLS , DLS , ...
Elettra (?) , Delta (?)

but not for :
Soleil , Alba , Max4 , ...





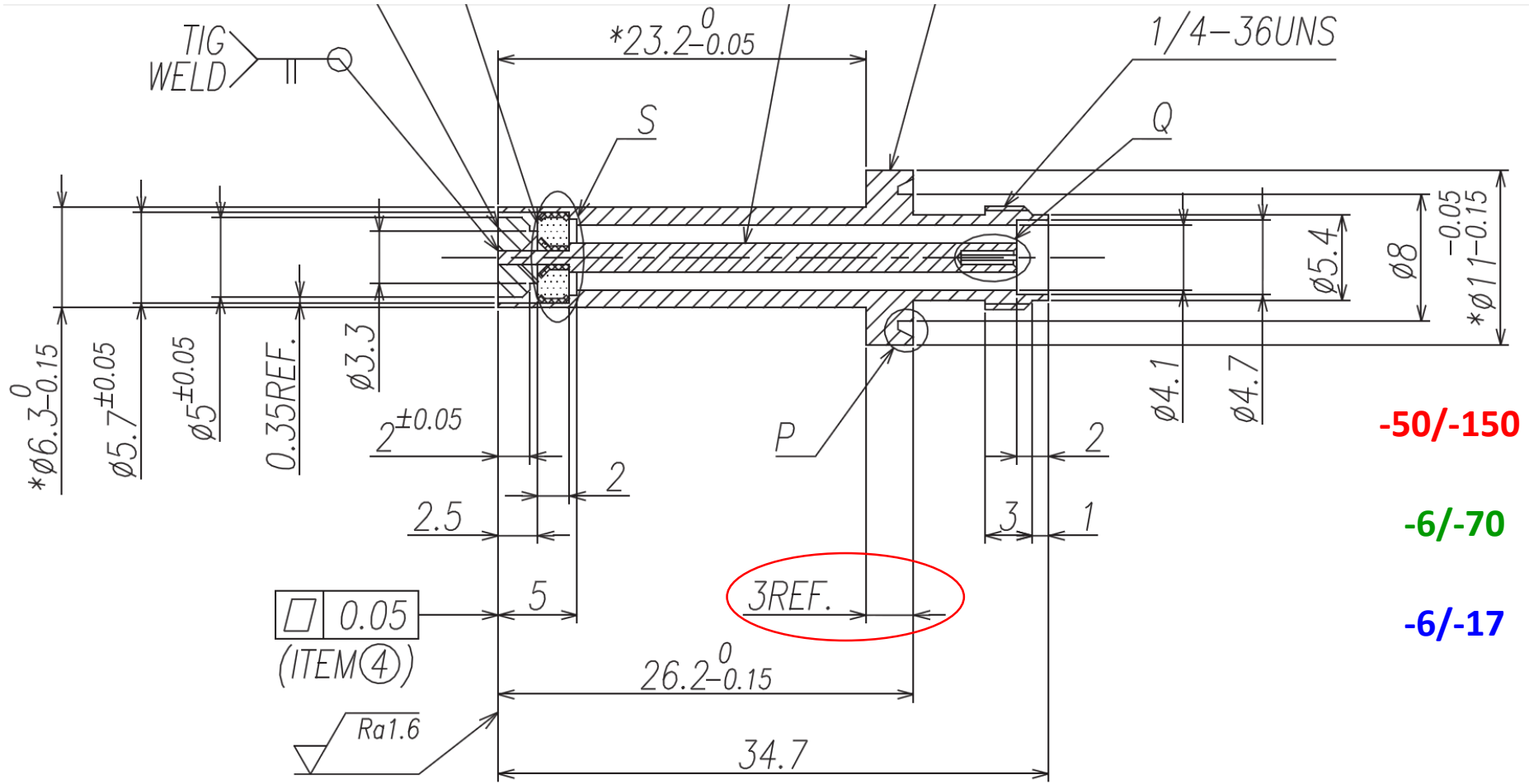


the next 6 (Steel) BPM-buttons from Kyocera have a problem ...
 (info Friday May 9)



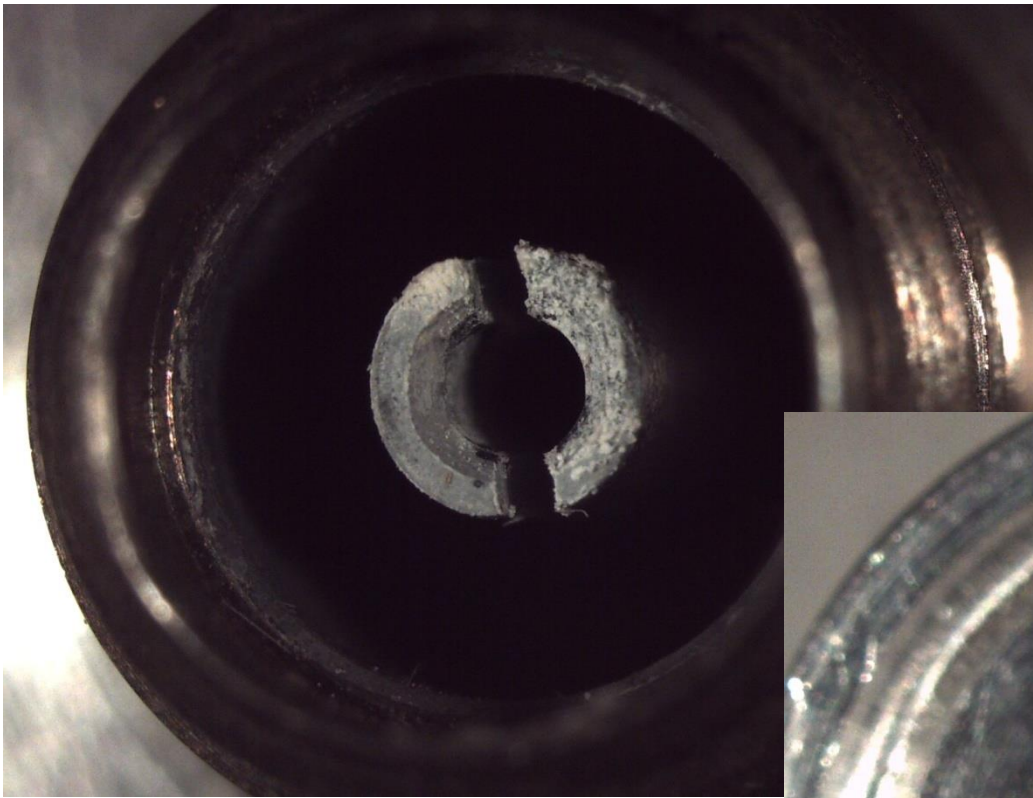
development of a new BPM Button feedthrough for the future LE-Ring





BPM button made for MAX-4 by Kyocera,

**Large dimensional tolerances : e.g. -50/-150um
 no tolerances of concentricity (less important with encapsulated button)**



Titanium does not look
like a suitable material,

- Radiation damage to surface
- Poor elasticity

