latest update on BPM requirements for the ESRF *EBS*
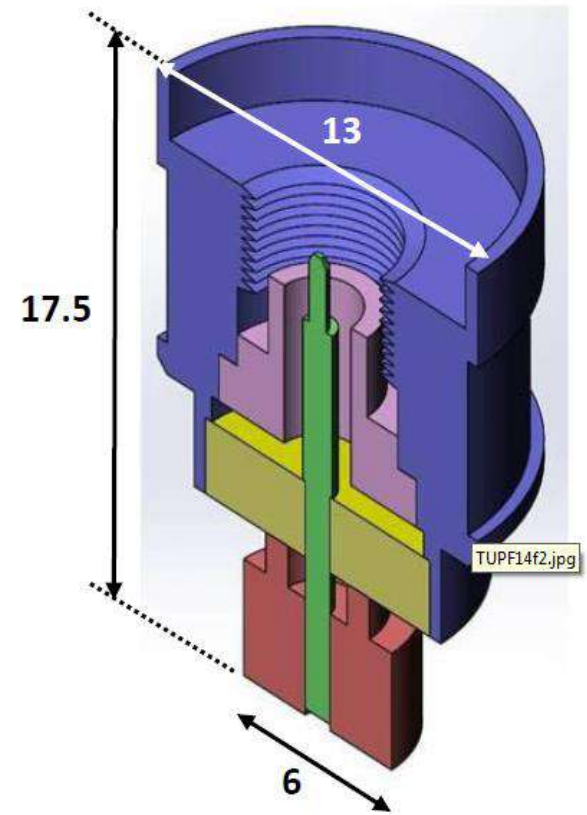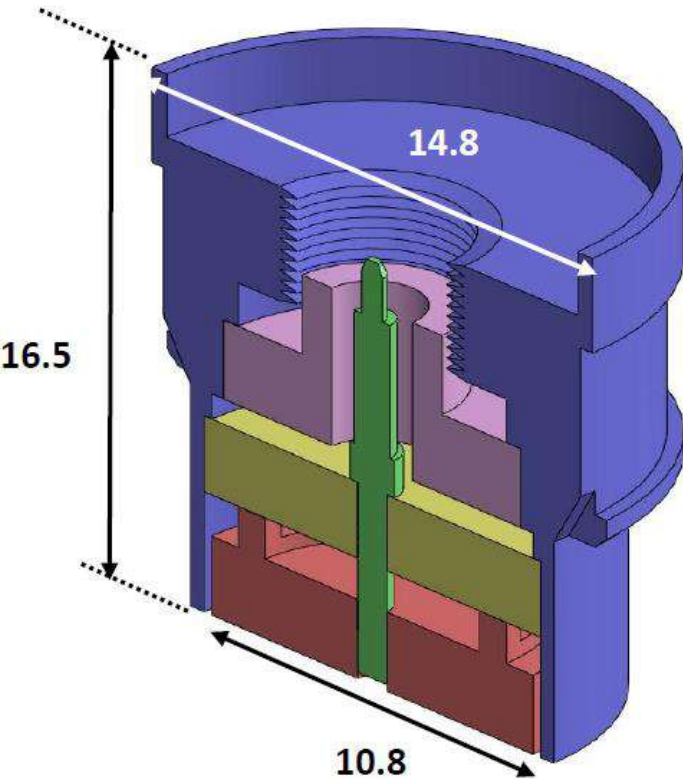
-1- UHV leakage problems with the new EBS-ESRF-BPM buttons

-2- continuation of characterization of the Spark-ERXR

-3- discovery, and the subsequent statistics records,
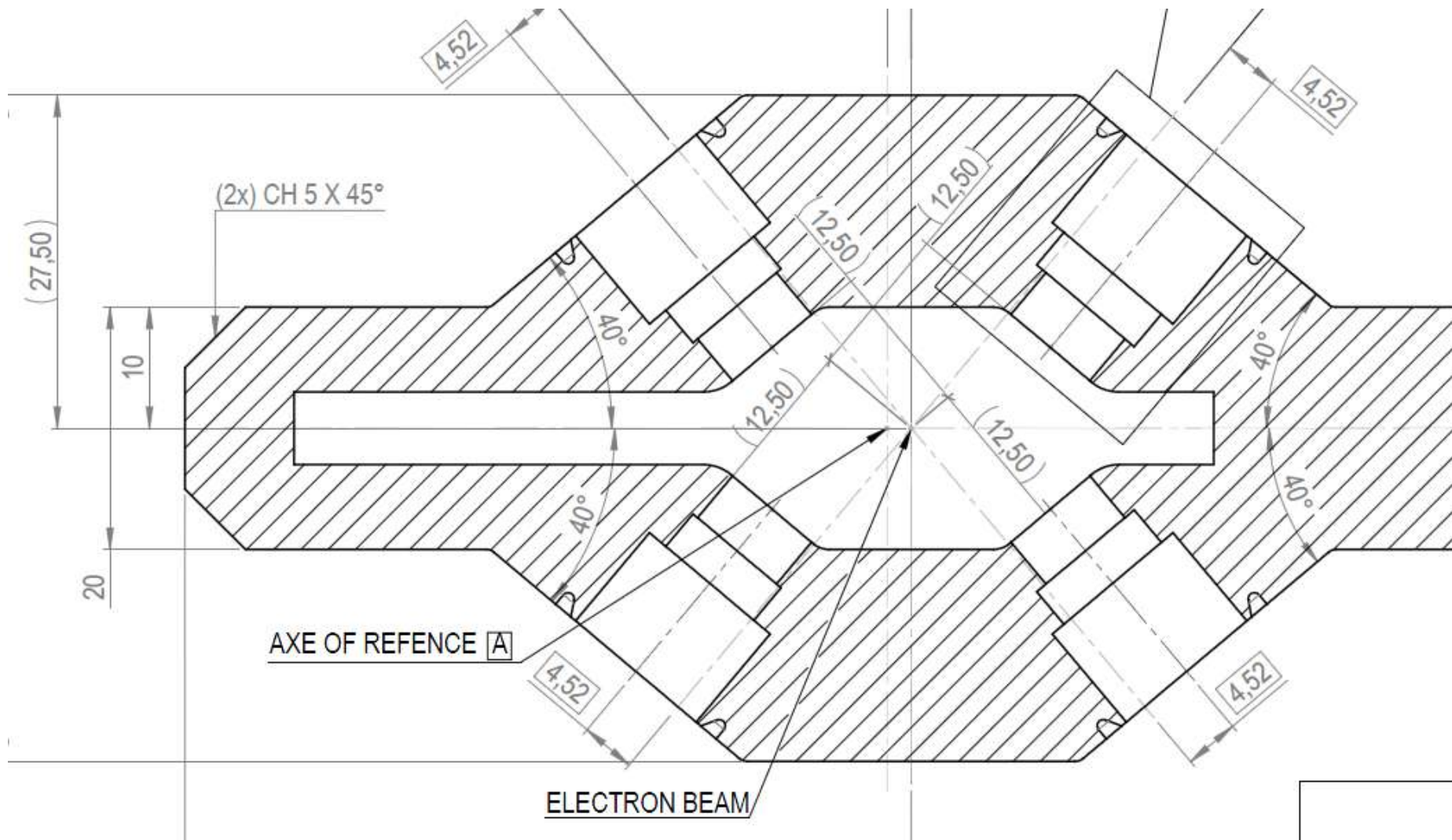   of the behavior of jumping amplitudes in Libera Brilliance

BPM-button vacuum leaks

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

delivery (1500 units *) : March 2016
total costs < 350 KEuros
* 600 with 6mm, 900 with 8mm button diameter

14.8

16.5

10.8

13

17.5

6

TUPF14f2.jpg

(2x) CH 5 X 45°

4,52

4,52

4,52

4,52

12,50

12,50

12,50

12,50

40°

40°

40°

40°

(27,50)

10

20

AXE OF REFENCE [A]

ELECTRON BEAM

1mm
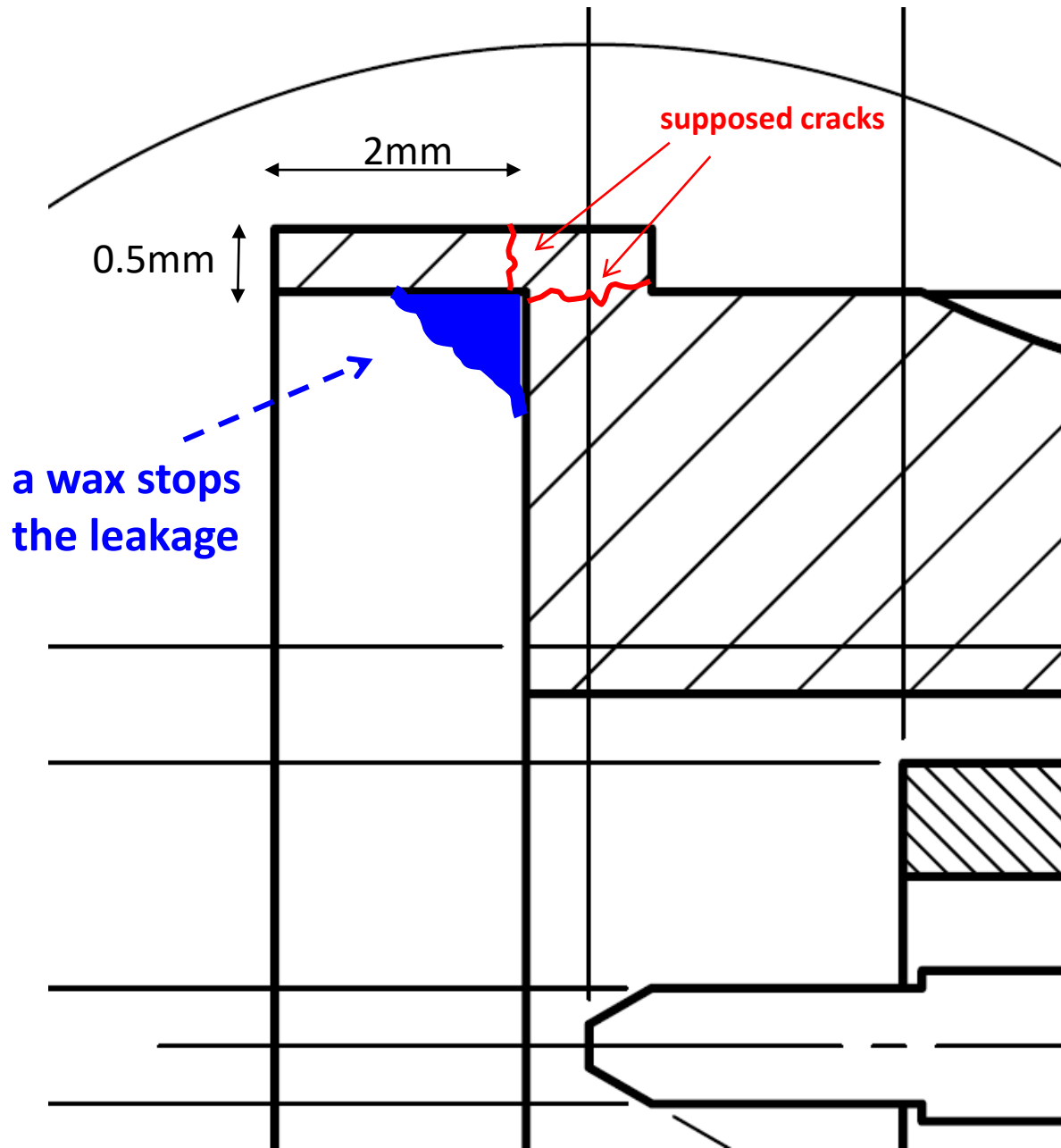
0.5mm

2mm

1.5mm
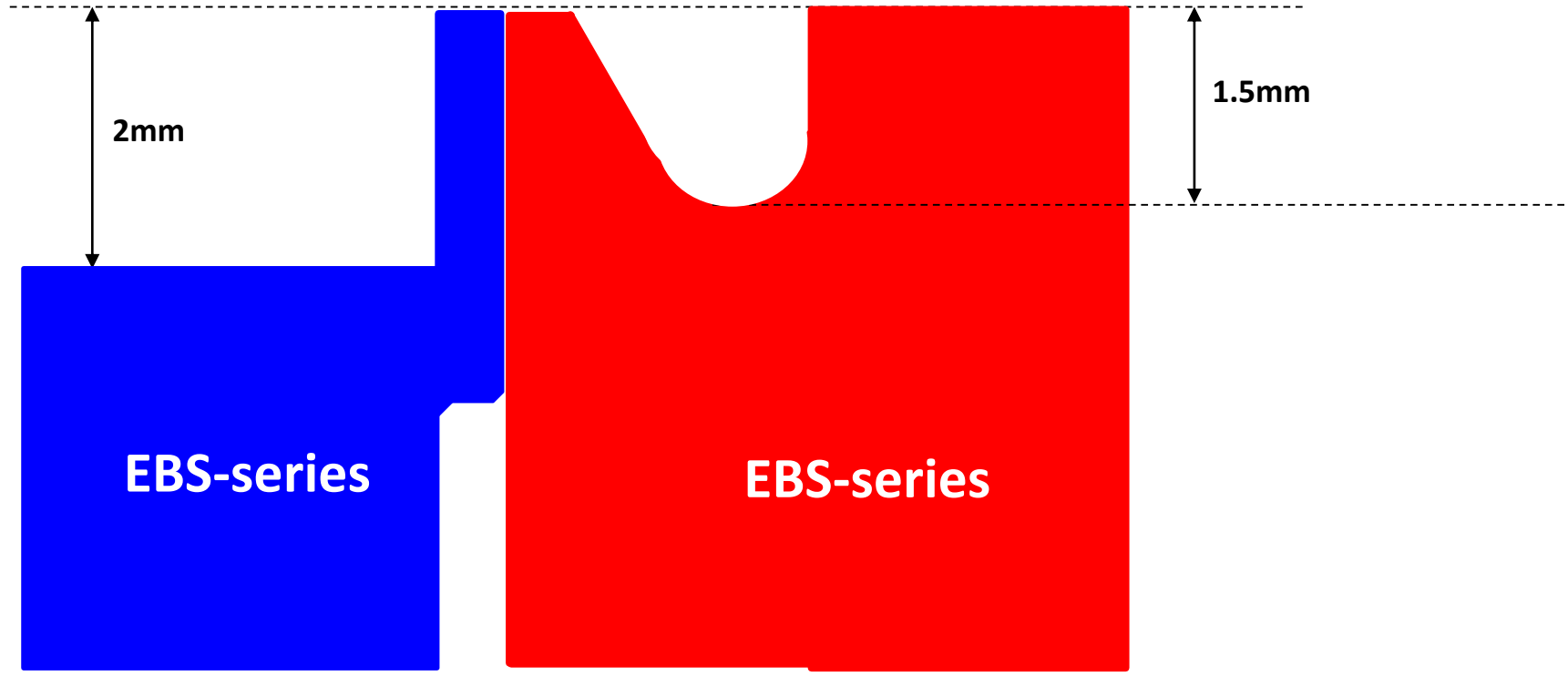
EBS-series

EBS-series

FMB experience (December) : 4 failures out of 16 buttons welded → 25% failure-rate
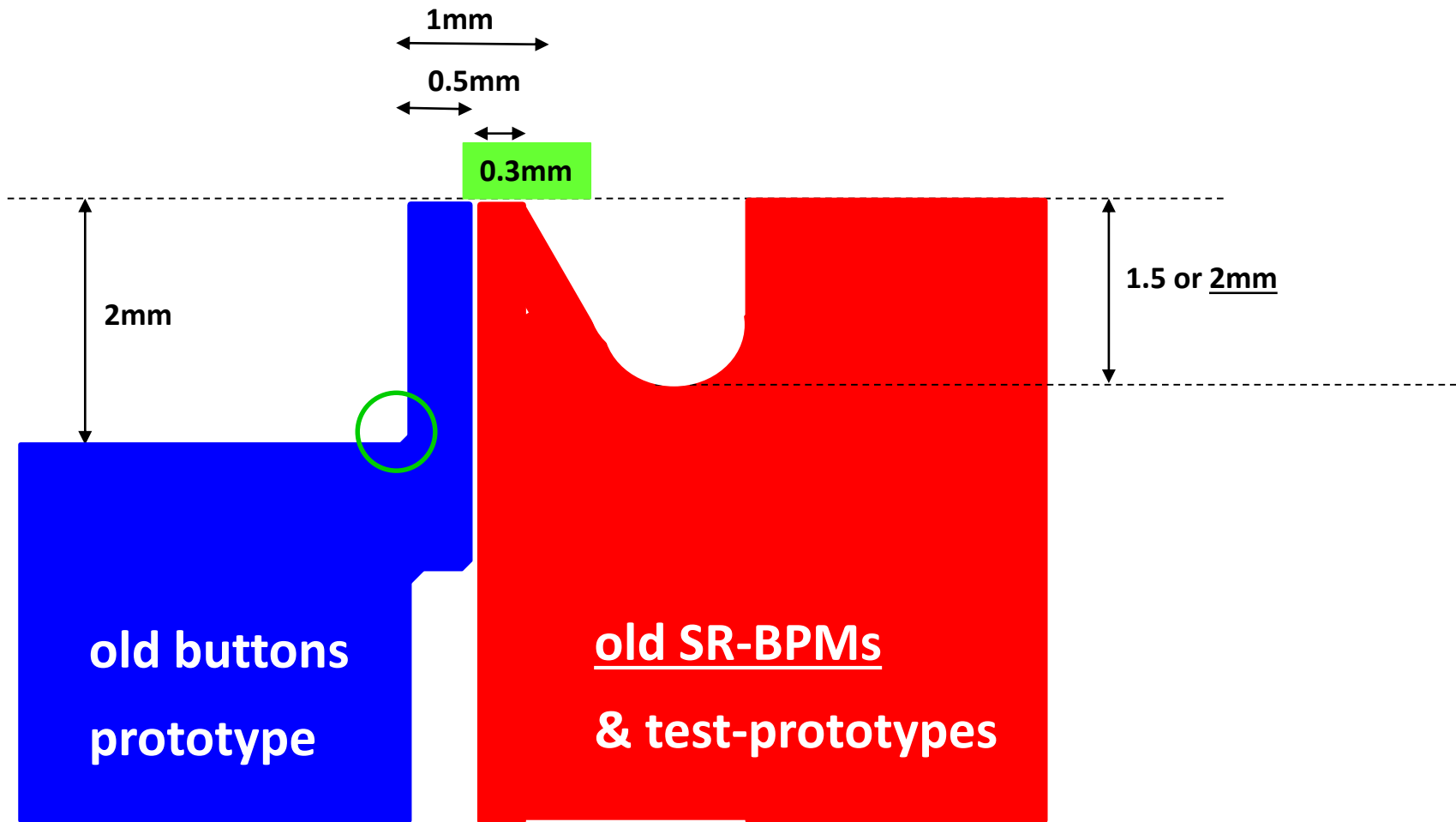
vacuum wax applied : the leak is stopped !

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

2mm

0.5mm

supposed cracks

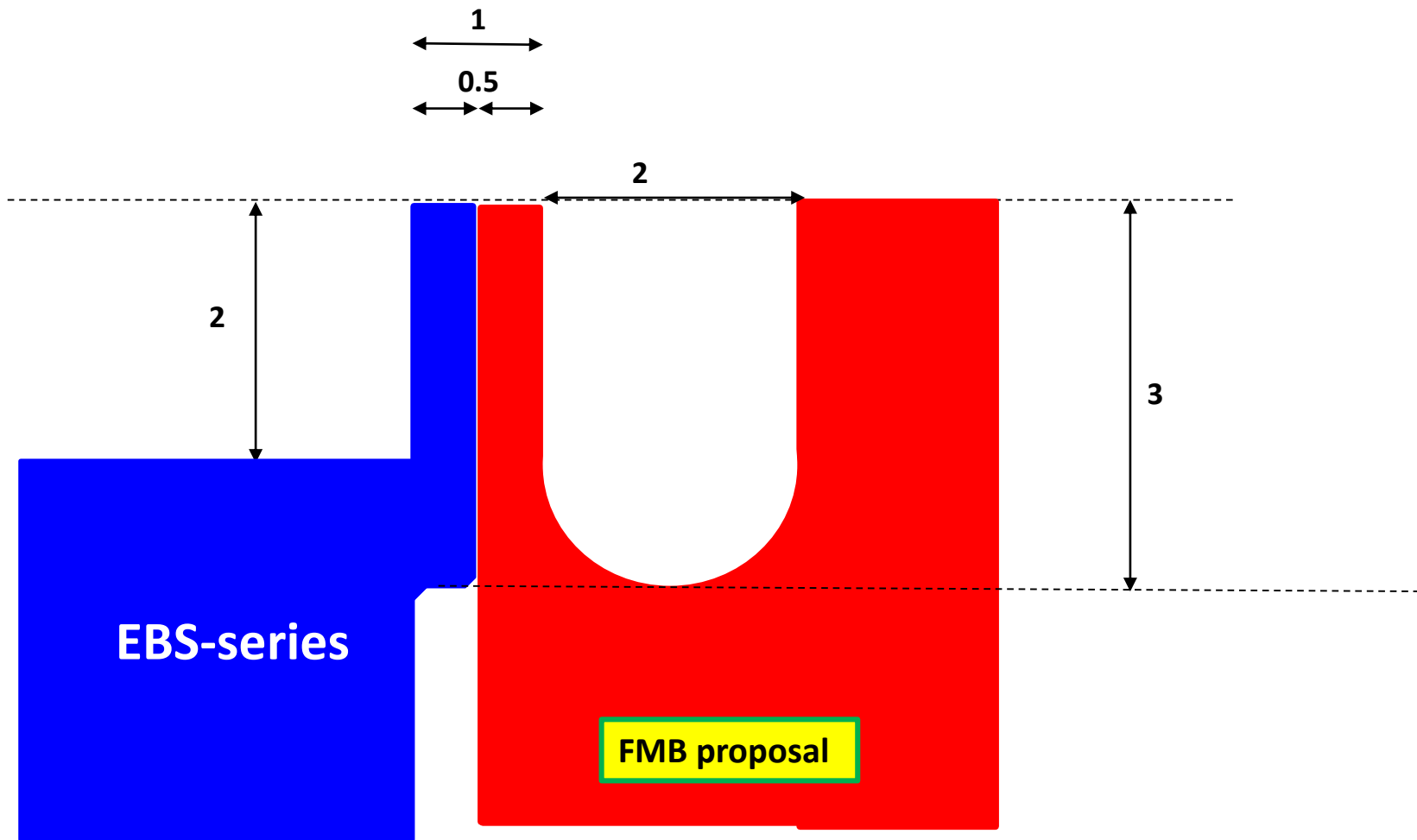a wax stops the leakage

FMB experience now : roughly 10% failure-rate … !

1mm

0.5mm

0.3mm

2mm

1.5 or 2mm

old buttons prototype

old SR-BPMs & test-prototypes

old buttons / BPMs : never any leaks (SR- & SY- >1300)
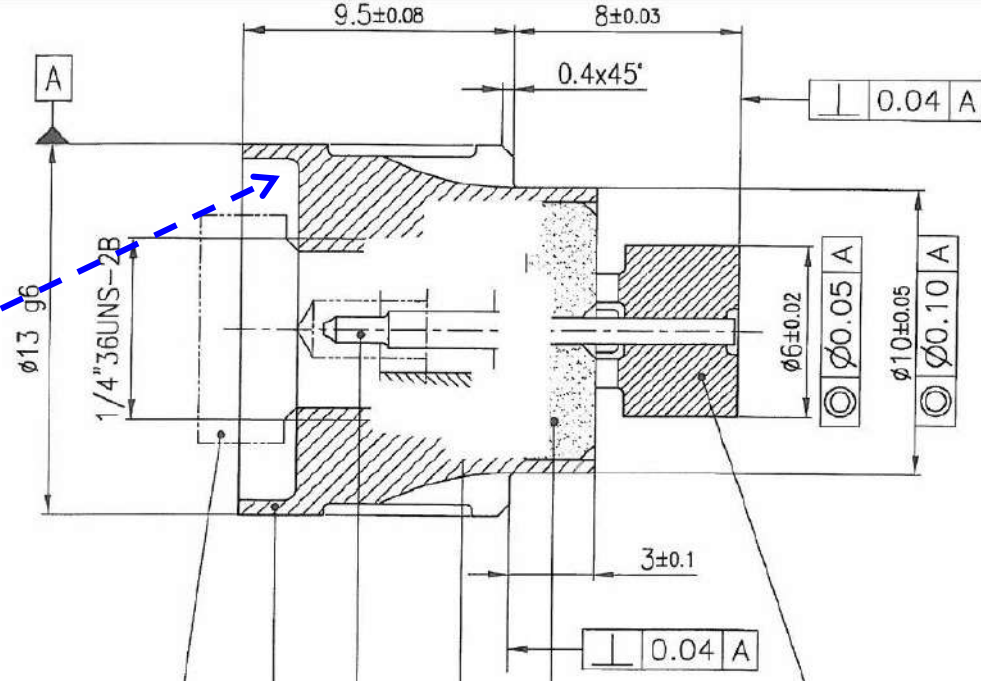
the 12 protos : no leaks

EBS-series

FMB proposal

FMB experience (Jan-April) : 2 failures out of 24 …

more rigourous test (May) : 5 failures out of 60 …

DLS

rounded corners

9.5±0.08 8±0.03

0.4x45°

0.04 A

1/4"36UNS-2B

Ø13 g6

Ø6±0.02 Ø0.05 A Ø10±0.05 Ø0.10 A

3±0.1

0.04 A

ESRF

sharp corners

2.50

9.50 ±0.08 0.04 A

(17.50)

1/4-36UNS-2B Ø4.50 30°

Ø0.92 ±0.02

3

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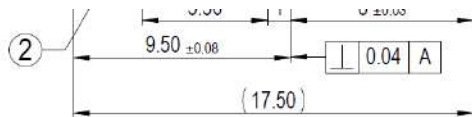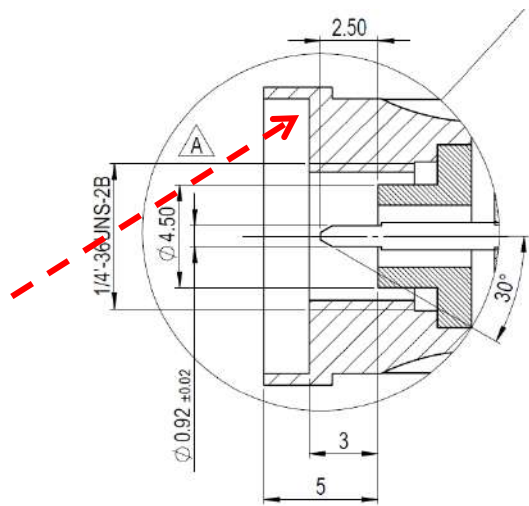
5	1	ELECTRODE	304L
4	1	CERAMIC	Al2O3
3	1	PIN	MOLYBDENUM
2	1	SLEEVE	304L
1	1	FLANGE	304L
ITEM	QTY	DESCRIPTION / REMARKS	MATERIAL

DESCRIPTION / REMARKS	MATERIAL	TREATMENT

SCALE: 5/1

0mm ————————————— 20

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

GEN. TOL. :

GEN. SURFACE FINISH :

SR, BEAM DIAGNOSTICS
BPM PROJECT
BUTTON BPM Ø8

VALID FOR MANUFAC...
21 Dec 15

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

ASSY.

88.50.0002

A3

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

angle of view
micro-scope

proto

series

2mm **1mm**

0.5mm

impossible to use failure rate much too high !

today

improvement ?
on today's version ?

Ideal ... but will cost us 300KEuros extra !

ideal new buttons ...

Technically NOT possible !

improvement ?
on today's version ?
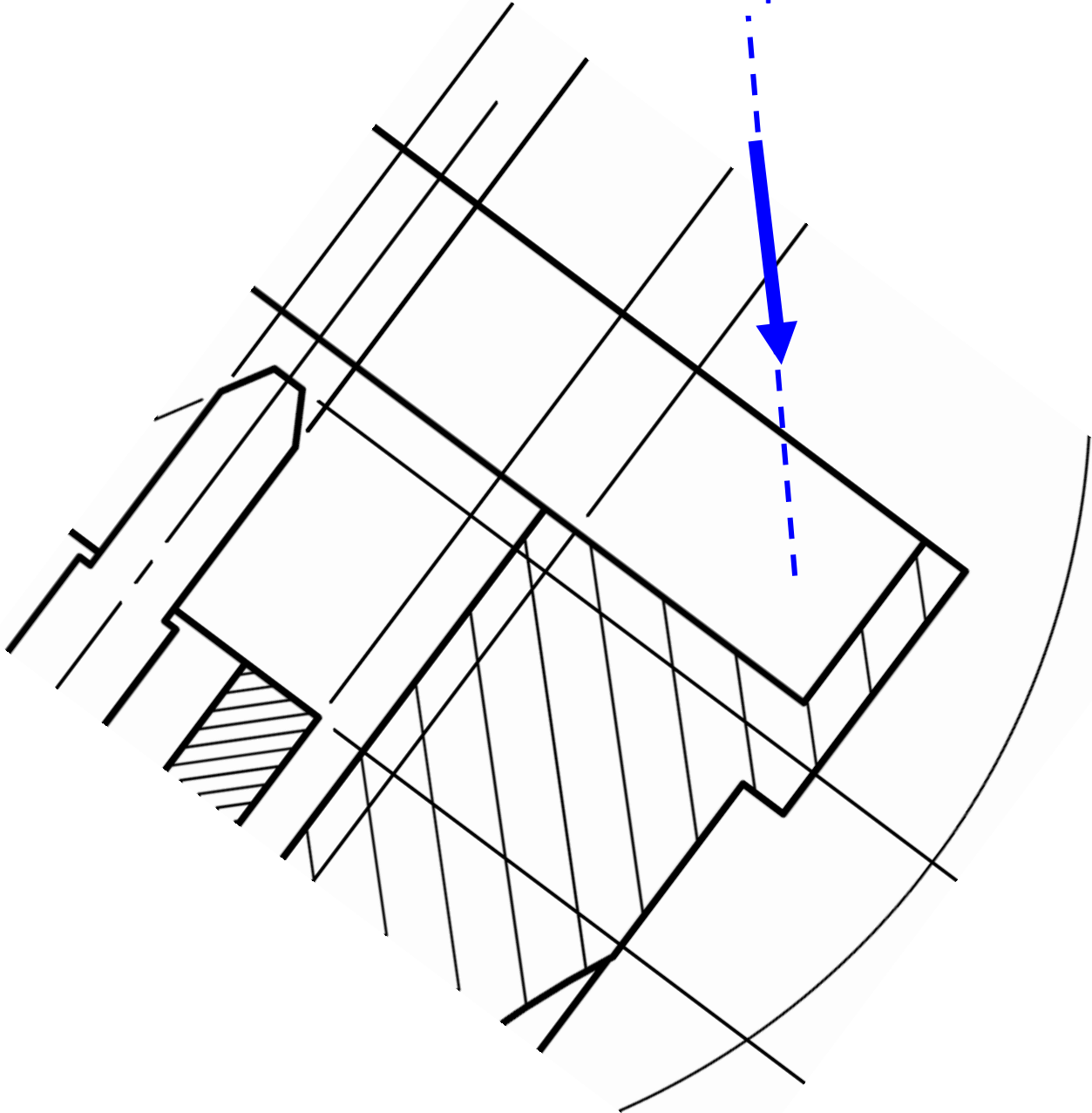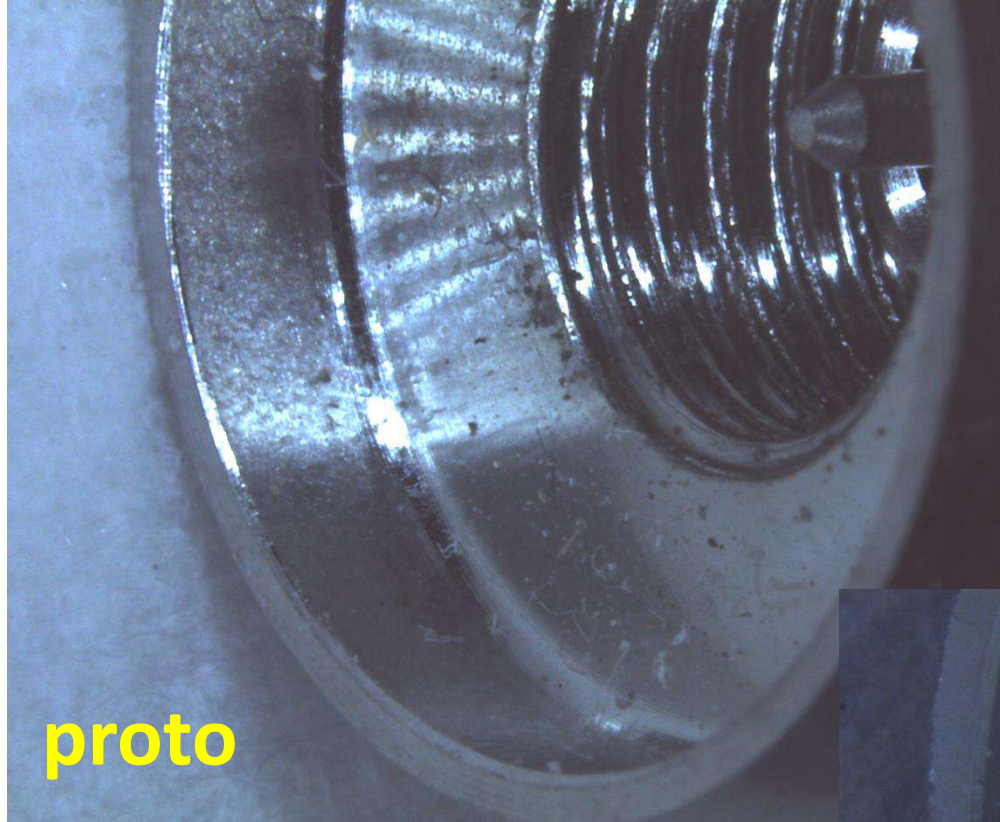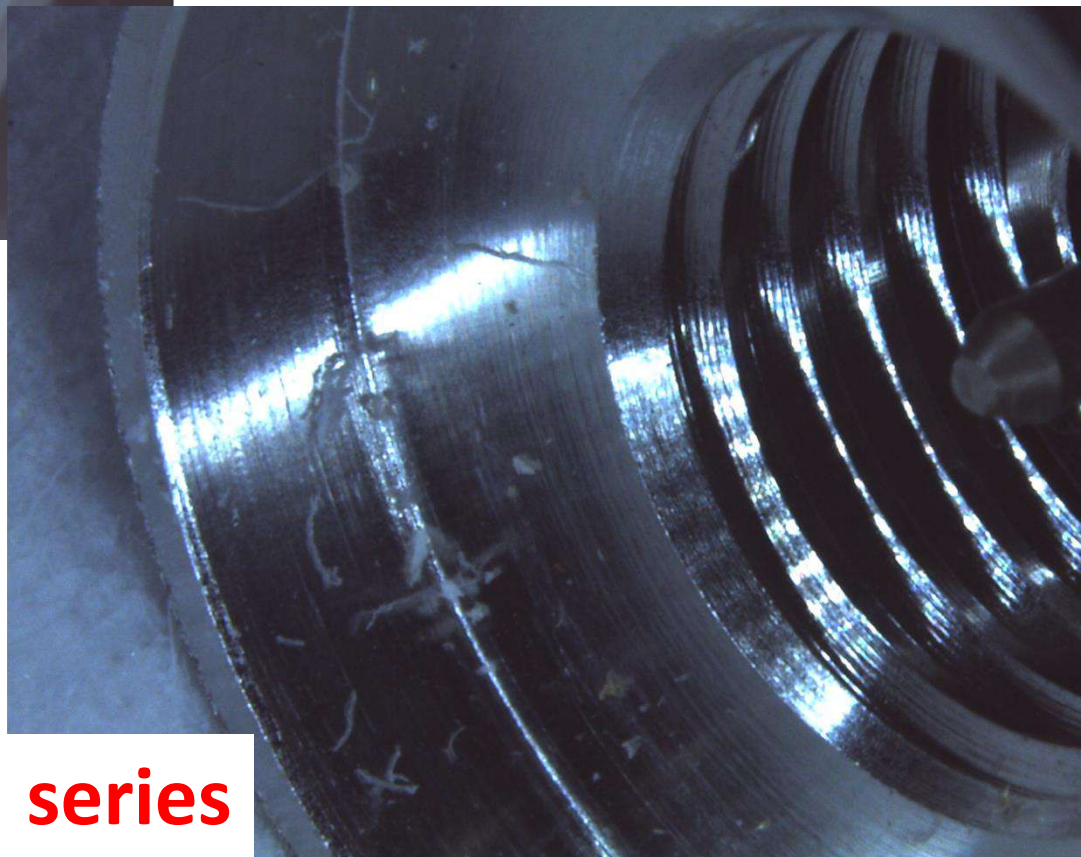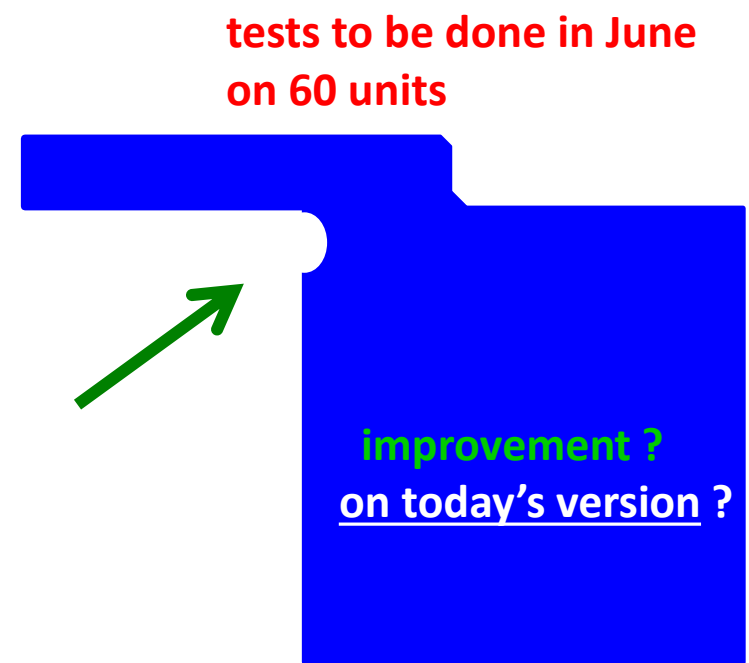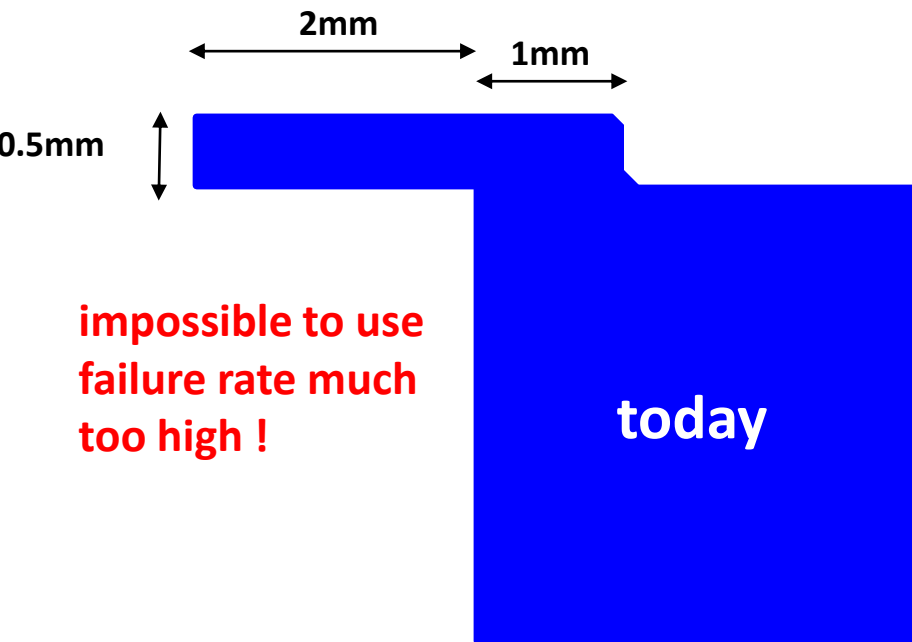
min : 450

max : **50**
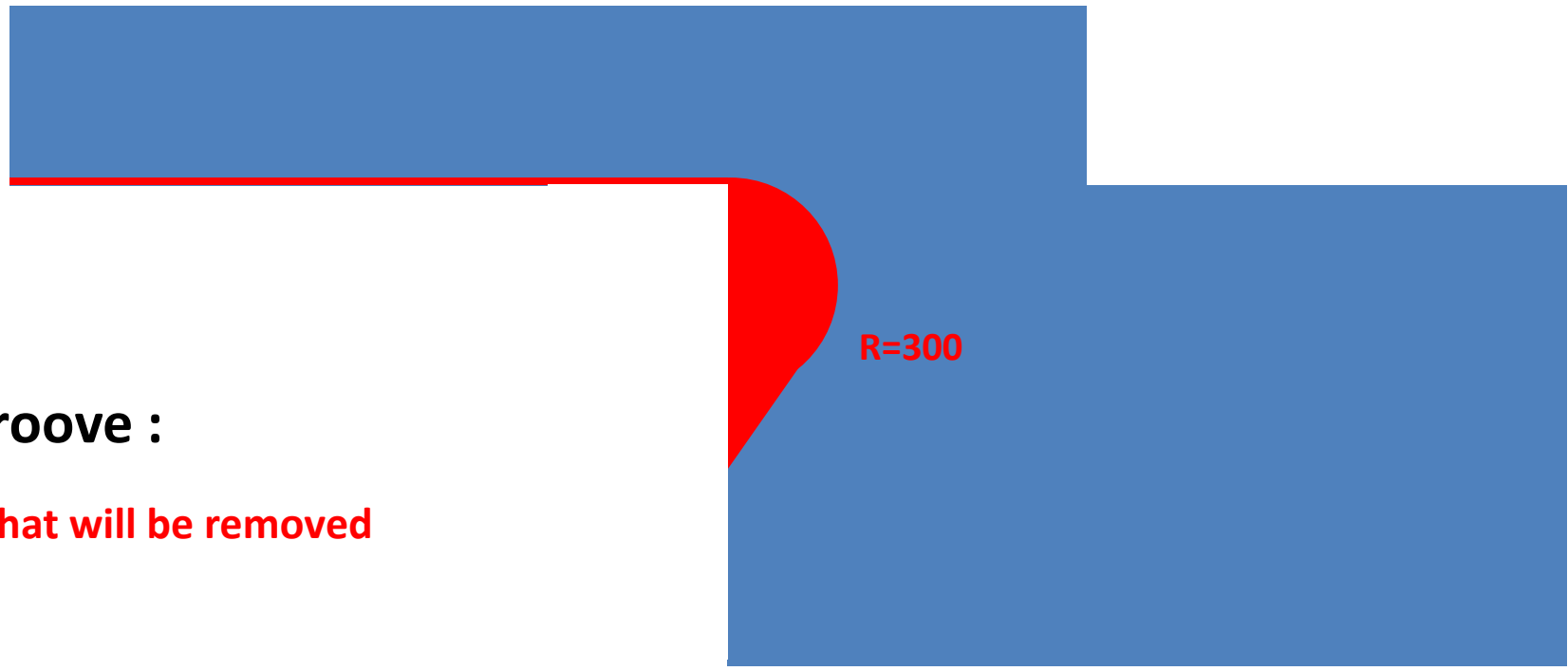
with groove :

in red what will be removed

R=300

2000 | 1000

500

now :

continuation of characterization of the Spark-ERXR

first version of Spark-ERXR was tested to satisfaction (nearly 2 years ago)
i.e. compatible with ESRF requirements of :
- position stability (few um drift over hours, or with 50% current change)
- High peak input signals (single bunch fillings)

However, this version was using different Analogue components (amplifiers & SAW filter)
then the final version that the ESRF envisages to procure (140-150 units) this year
for the extra BPMs in the *EBS*.

Also, the platform (chassis) is upgraded (still PoE)
and the interface software (no longer SCPI, but Tango for the ESRF)

The SAW filters were doubled and RF circuit improved, yielding higher resolution.

But the final version (including the new SAW filters) was received only 2 weeks ago,
and ESRF tests on this have not been done yet.
Is an ESRF priority in the next weeks/months.

That final version will also include the possibility to (software) select the sensitivity
of the ADCs. This yields an extra 6 dB gain-switch on top of the 31dB of the RF-attenuators.
Will be appreciated during the early (difficult) commissioning of EBS with low currents etc.

**discovery, and the subsequent statistics records,
of the behavior of jumping amplitudes in Libera Brilliance**

Recall :   - presently we operate 224 **Libera-Brilliances**

- *EBS* needs total of 320 BPMs :

- 192 will re-use **Libera-Brilliances** ⟶ **is obsolete, so we create extra (32) spares**

- 128 will be equipped with Spark-ERXR

so we keep a vigilant eye on our park of **Libera-Brilliance** since
orbit measurement and stability depend on it in the future

discovery of "**jumping amplitudes**" :

The **RF-multiplexing concept** in the Liberas provides an active & permanent
compensation of any relative gain **drifts** (slow) between the 4 channels
It is a key element in providing the **stability** of beam-position measurement.

This RF multiplexing is typically done around 13KHz, this is above the FA frequency (10KHz)
and with dedicated notch filters etc. in the FA chain this 13KHz interference is removed.

It can not be removed from higher bandwidth outputs (buffers) like the T-b-T (>100KHz),
But spikes and steps (in T-b-T data) that this RF-switching causes are minimized by applying the
DSC coefficients that the Libera calculates itself permanently.
DSC coefficients are 4 values of amplitudes and 4 of phases, and concern these 4 RF-channels.
They are calculated and (if needed, i.e. drift) re-applied at 12 sec period.

i.e. a Libera unit may have amplitude coefficients like : **1.03 0.99 0.99 0.99**
They may drift, but it will not affect the stability of the BPM data.

At the ESRF we are (since January 2017) storing these 4 coeffs. at 10sec interval.
We observe that among our 224 units a certain number produce **sudden jumps** of these values.

discovery of "**jumping amplitudes**" :

Monitoring these 4 DSC coefficients (and their jumps) is the easiest way of taking note
of this problem,
but at the ESRF we got first track of this behavior by : our FOC switching-off …
(done automatically if it has to make a too abrupt correction)

This FOC going-off was (at some period last December) often caused by the same unit,
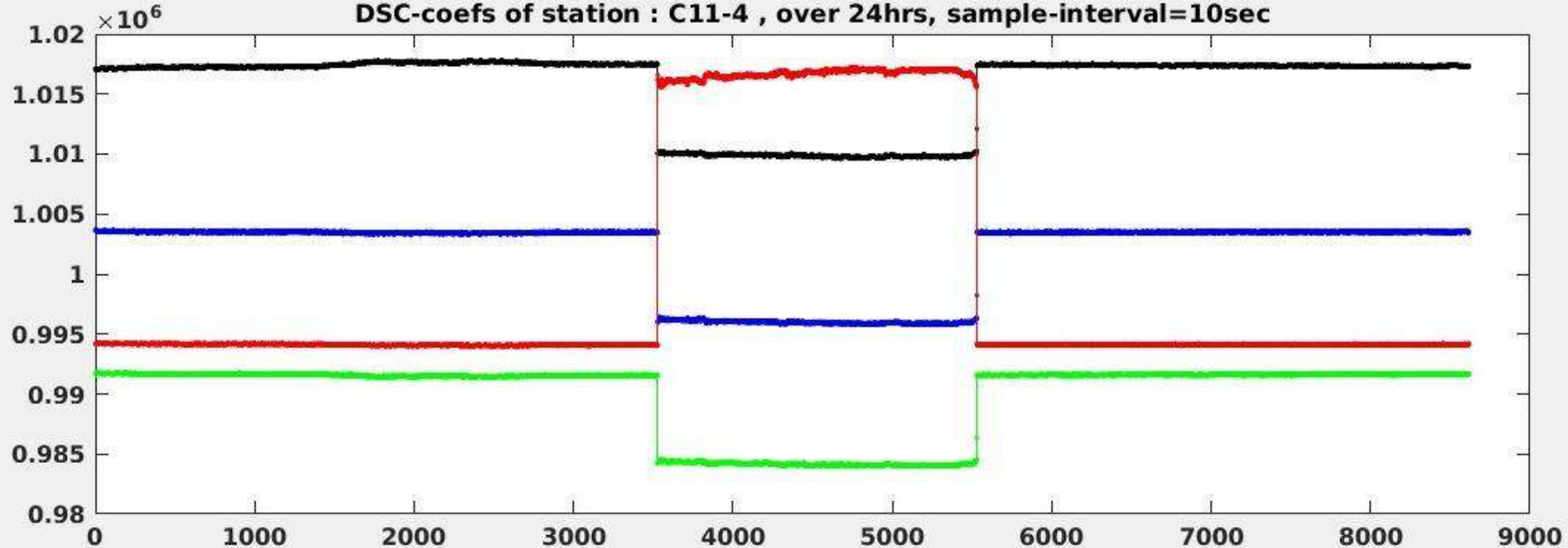so we focused on that unit :
- analyzing the FDA data,
- triggering the PM-buffer (at the moment of FOC going off) → analyzing the PM T-b-T data
- operating it with the DSC deamon OFF

This lead to the conclusion that the DSC itself works properly, i.e. it does what it has to do.
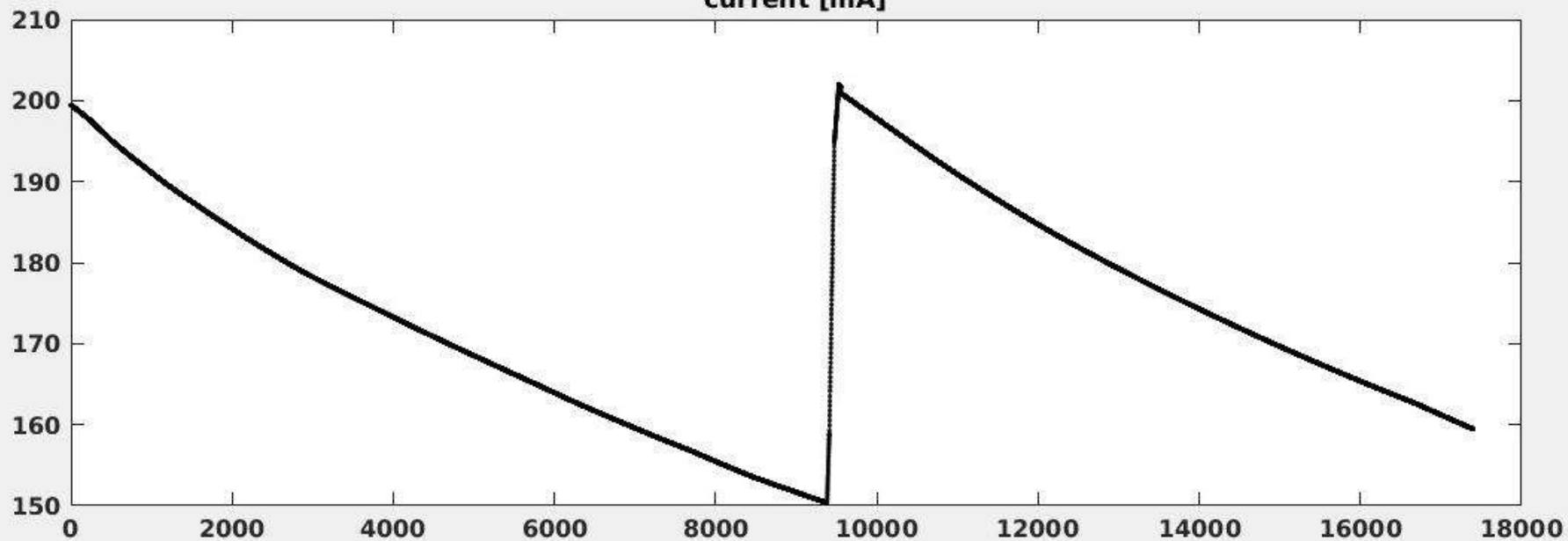But : the jump (of the DSC coeffs.) comes from a real sudden jump in the amplitude of a channel
as if the gain of such channel suddenly changed by typical 2 to 20% (+ or -)
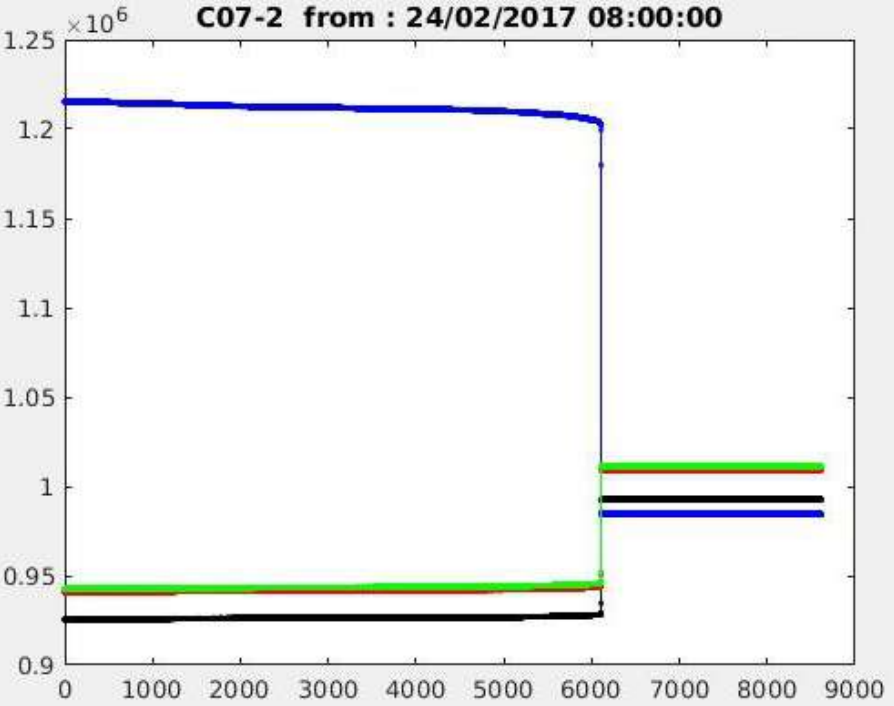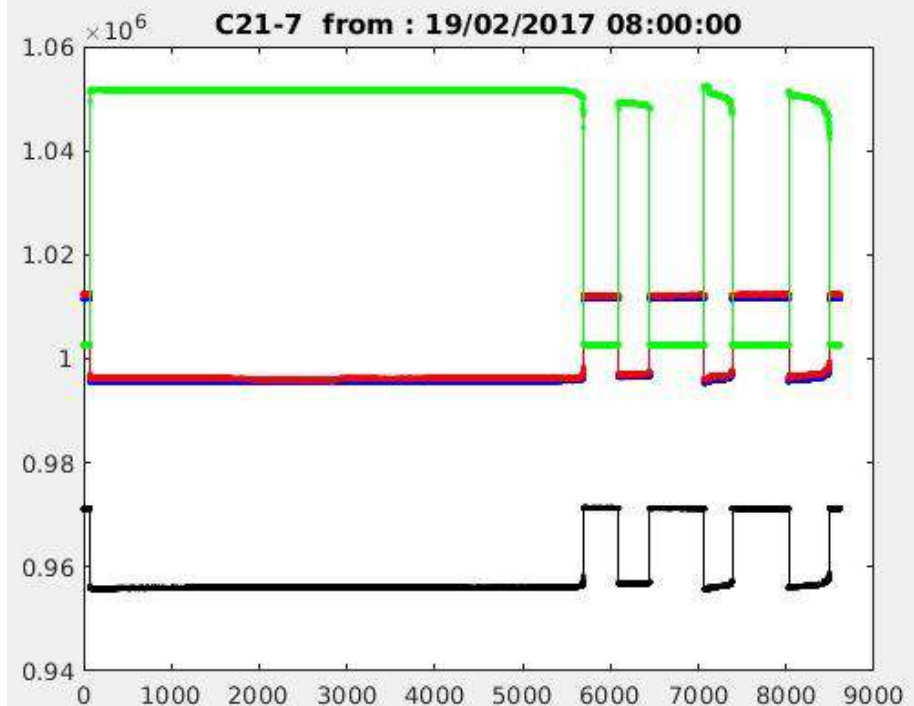(stress : input signals from BPM-buttons are NOT at cause)

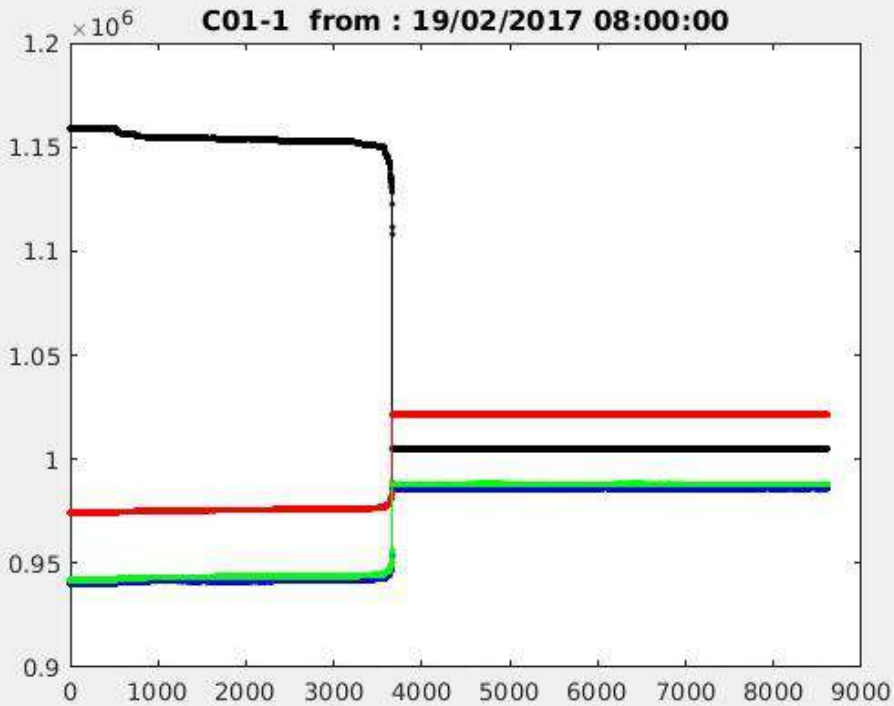illustrations :

DSC-coefs of station : C11-4 , over 24hrs, sample-interval=10sec

current [mA]

C01-1 from : 19/02/2017 08:00:00

C21-7 from : 19/02/2017 08:00:00

C07-2 from : 24/02/2017 08:00:00

3 examples, recording=24hrs, 10 sec interval

about 10% of our park (224) is (more or less) affected

but not all in the same way :
- some have regular jumps, some only 1 per week …
- the amplitude is also very different <1%   >20%
- which channel

 also : a power-off-on can cure (for a while) this behavior

what we worry about : is it an ageing effect and will it grow ?

- affecting progressively more units ?
- jumps getting more frequent and stronger in amplitude ?

what is the consequence for the BPM data ? (when running FOC with FA data)
SA-data : virtually none
FA-data : a **short spike**, followed by **oscillations** <u>for max. 12 sec</u>

**too short to leak into
your orbit, but may
switch-off the FOC**

**at freq. values defined by
your Libera decimation, etc.
can be in your FOC bandwidth,
thus leaking into your orbit …**

actions underway :

ESRF : **follow-up this behavior, and build-up statistics :**
asses if it grows (or not)

I-Tech : **2 worst stations under analysis,**
to find the real (hardware) cause of a jump

other Libera users :

can you store the 4 DSC (amplitude) coefficients (at 10sec interval) ?
and check if you see "jumps" ?