SLAC workshop 7-10 July 2009
WP1: microwave-based accelerators

Progress towards a new standard X-band high-power flange

G. Riddone, 08.07.2009

(contribution from C. Garion)

Outline

- General requirements
- Recall of existing design from SLAC
- Presentation of the new design
- Program

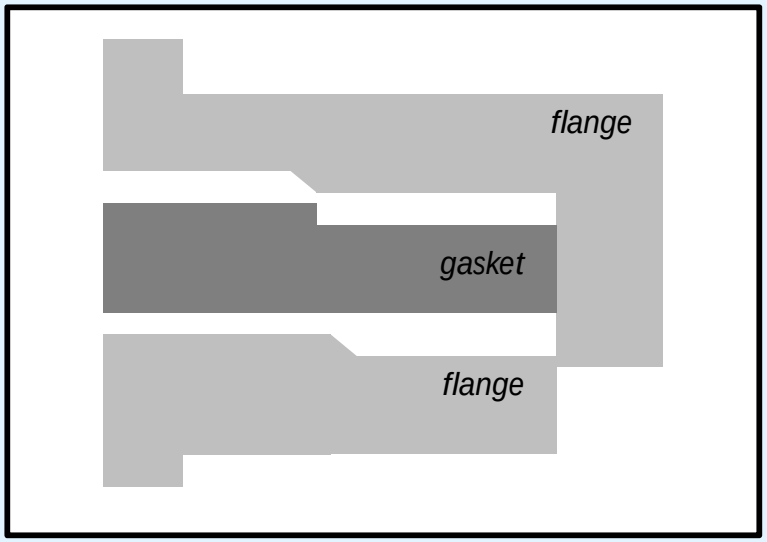
Requirements

- Reliable joint - high sealing performance
- Smooth flange-gasket-flange transition (RF performance)
- Simple shapes and preferably symmetrical joint
- Easy assembly
- Cheap production
- Needs
  - X-band test stands (few hundreds): needs for CERN and for several other test stands (eg. PSI. Elettra,..)
  - CLIC - about 500 000 units

SLAC design

Parts
-Two different flanges - 2 stainless steel WR90 flanges (AISI316LN)
-1 OFE copper gasket

<u>Observations:</u>
- Not symmetrical gasket cross-section
- Main sealing mechanism comes from shearing not compression
flanges clamped with 8 bolts

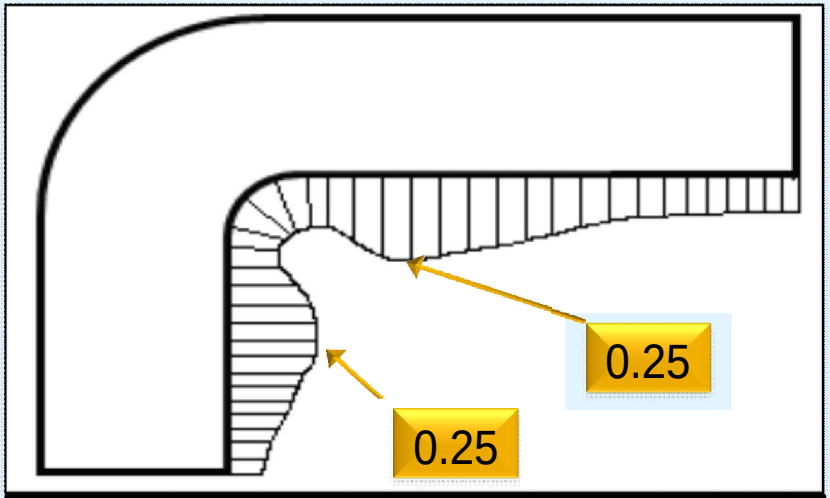


Flanges

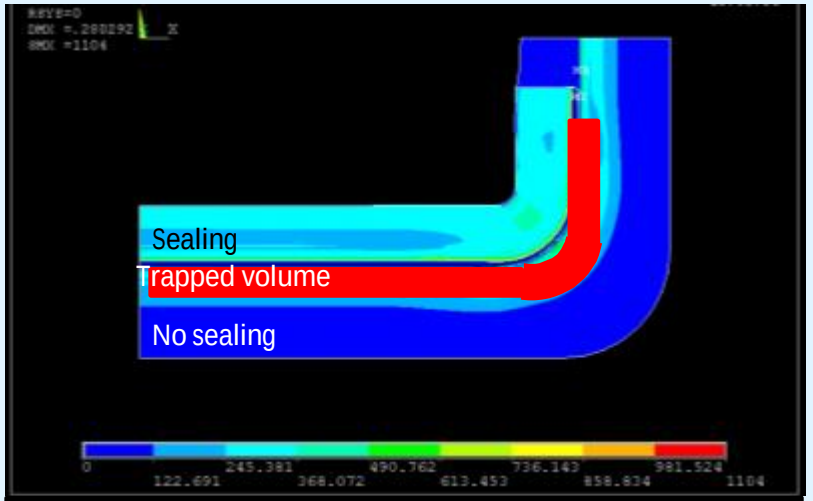
Gasket

Some remarks on SLAC design

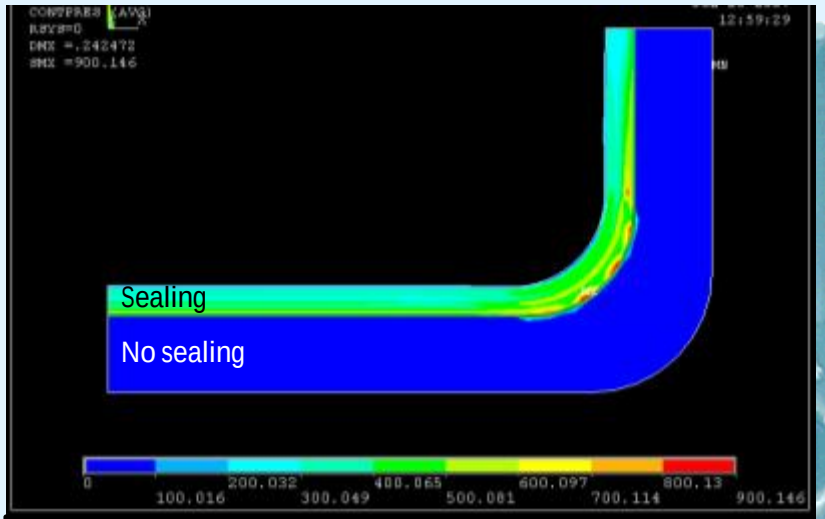
- Large and non constant displacements into gasket aperture



Lateral profile of the maximum inner displacements



Contact pressure between upper gasket surface and flange

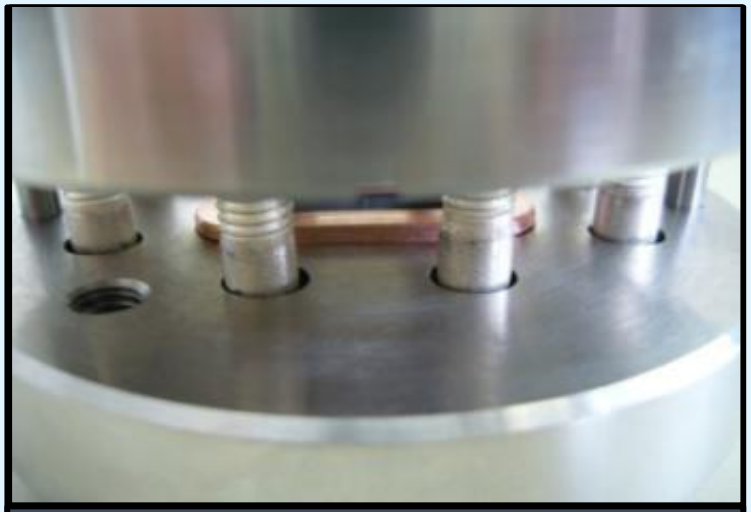


Contact pressure between lower gasket surface and flange

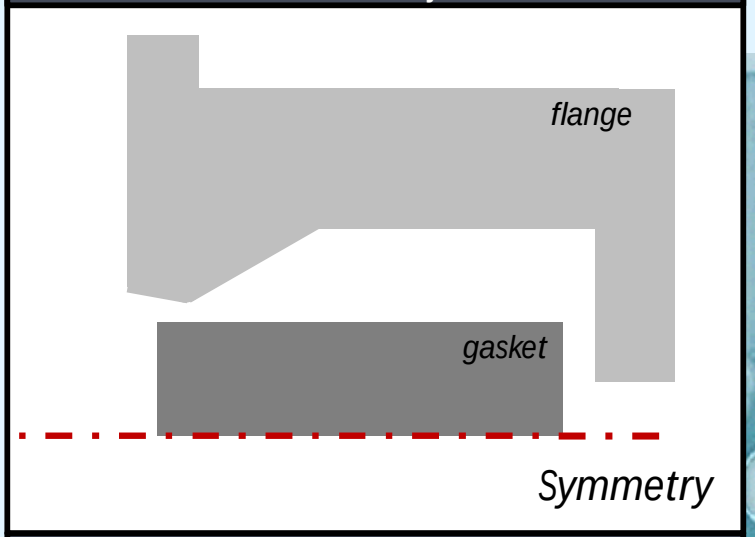
- Different contact pressure distribution for upper and lower surface of the gasket
- Trapped volume

CERN design proposal

- Same flanges
- Rectangular cross section OFS copper gasket
- Symmetrical, "knife" based design
- Initial gasket position away from flange/flange plane
- AISI316LN flanges with 6 bolts and 2 centering pins



Assembled joint

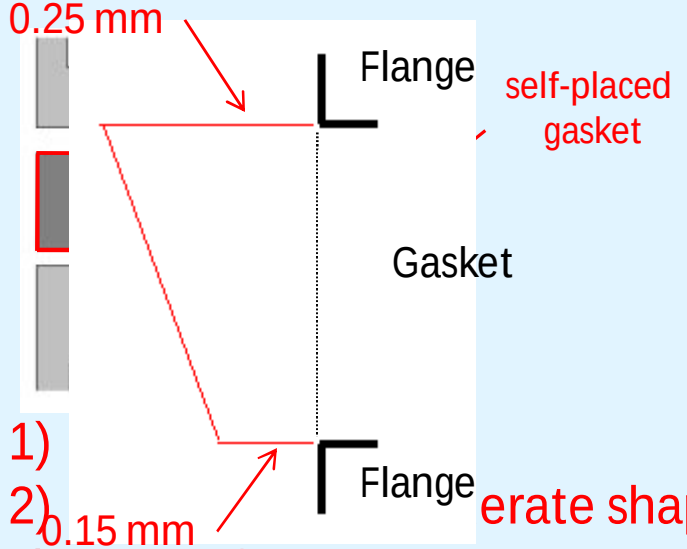


New CLIC design concept

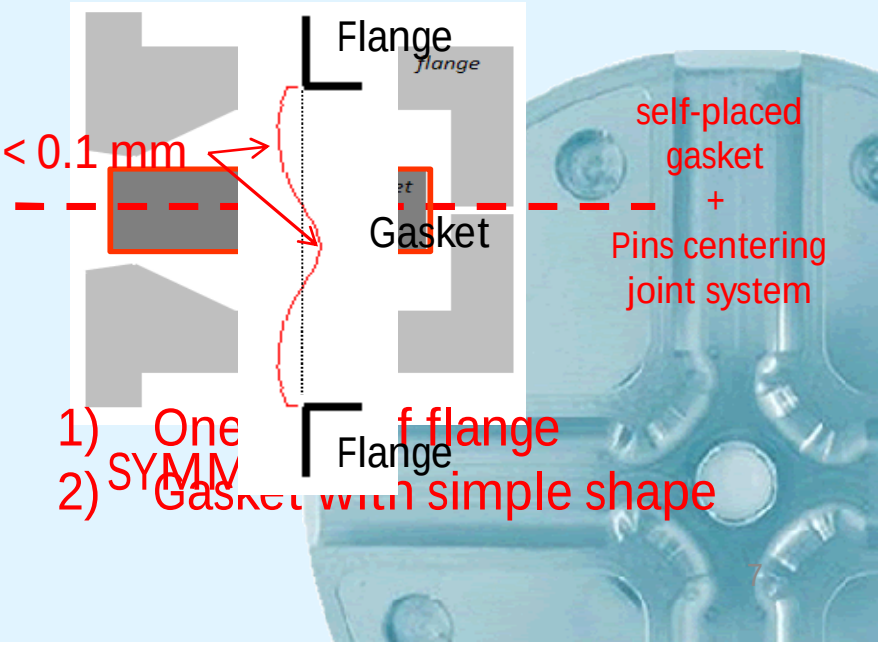
Some advantages on CERN design proposal

- Homogeneous contact pressure –*symmetric type joint*
- Cheaper production – *simple and easy to machine gasket shape and one type of flange only*
- Easier assembly – *symmetric, self-placed gasket with additional pins centering joint system*
- Better properties – smooth flange-gasket-flange transition

SLAC design



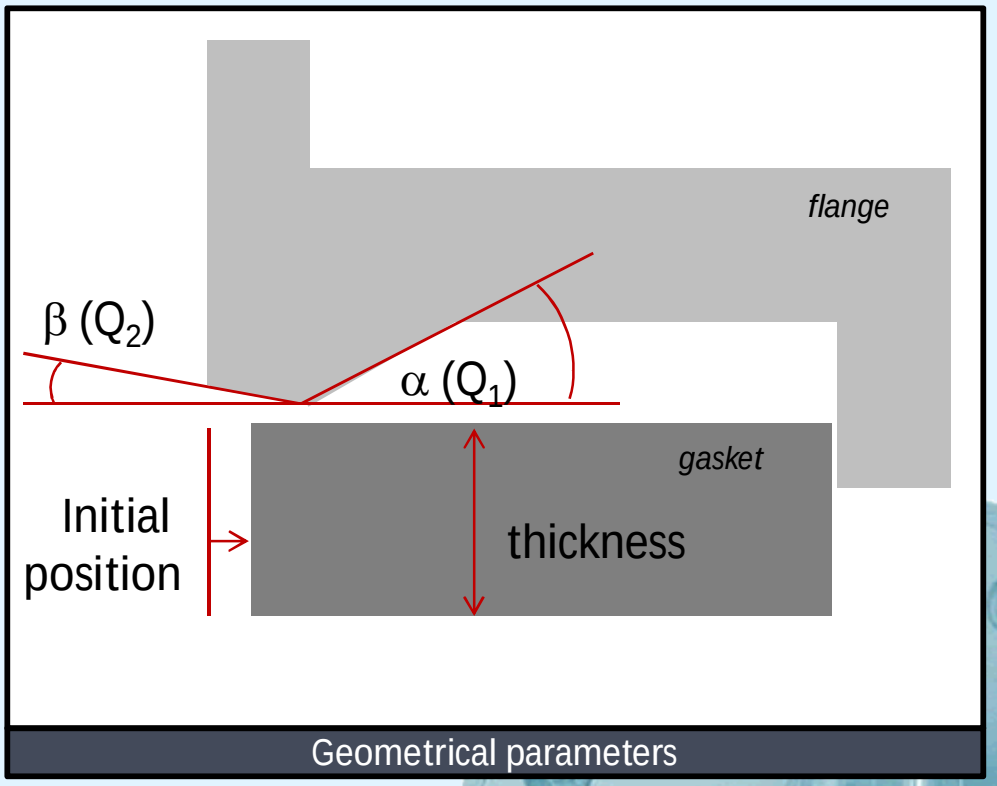
New proposal



CERN design optimization

Optimization of the joint geometrical parameters based on FE models:

- Flange: knife (α,β), thickness, diameter, type and number of bolts
- Gasket: thickness, width
- Interface: imprint depth, initial position



Criteria:

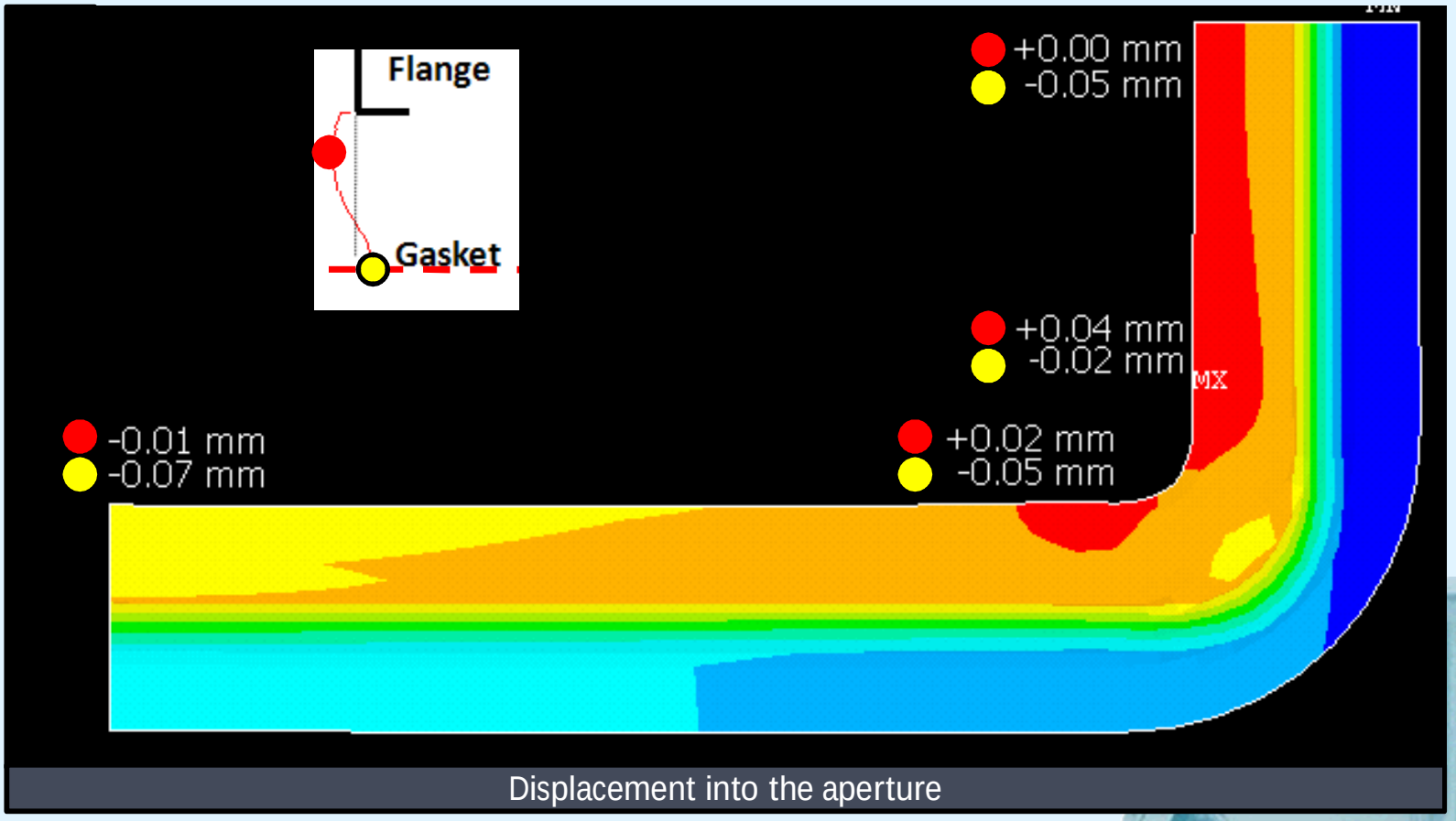
- Leak rate (<10^{-12} mbar·l/s)

$$Q = 3400\frac{A^2}{w}\exp\left(-0.306\frac{P}{R}\right)$$

P = contact pressure, w= contact width, A, R = parameters as a function of roughness

- Plastic strain in the flanges
- Cost

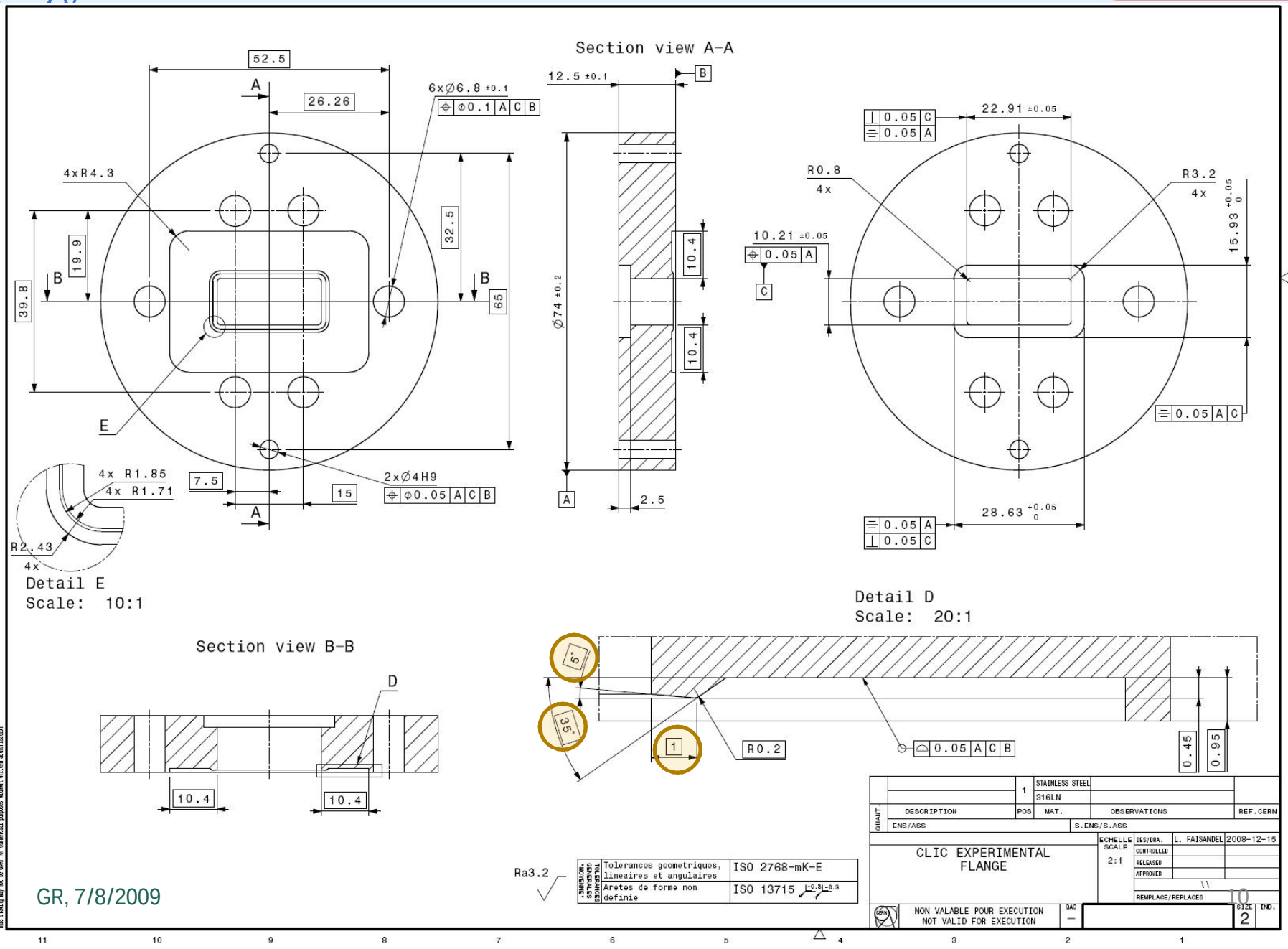
CERN design optimization



Displacement into the aperture

The displacement into aperture is an input for future RF calculations

CERN Proposal Flange Drawing



GR, 7/8/2009

Program

- Circular gasket design: leak rate measurements
- Final design: 5 full units (CINEL) available at CERN as well as gaskets
  - Dimensional control ➔ conform
  - Leak-rate measurement as a function of torque (promising results)
  - Realization of the tooling for centering the gasket (done)
  - Displacement as a function of torque
  - Low-power RF tests at CERN
  - Preparation for high-power testing at SLAC of two units: Sept 09