Vacuum Technology Laboratory

Center for the Advancement of Natural Discoveries using Light Emission

Ultrafast Beams and Applications
Armenia

17-23 June 2024, CANDLE, Armenia

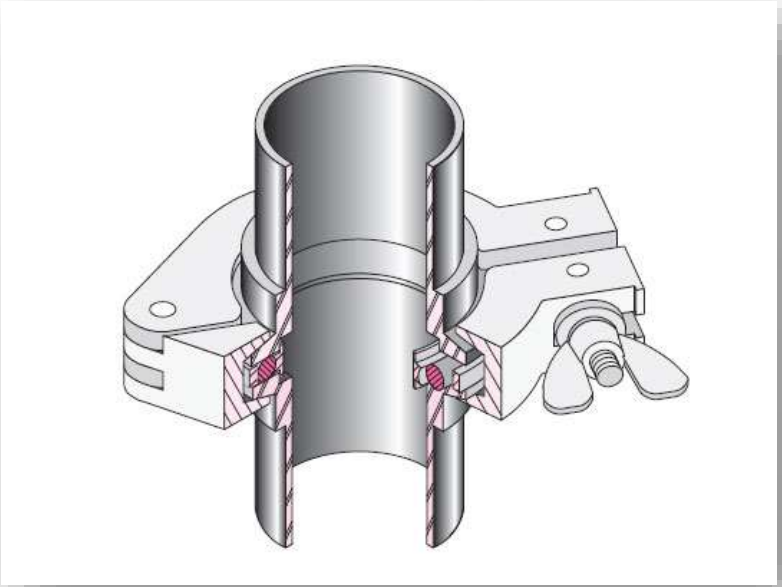
Simulation and Experimental Analysis of the ConFlat-type Flange Joints Under High-Temperature Gradients

The research was supported by the Higher Education and Science Committee of MESCS RA MESCS RA (Research project № 23AA-2D019)

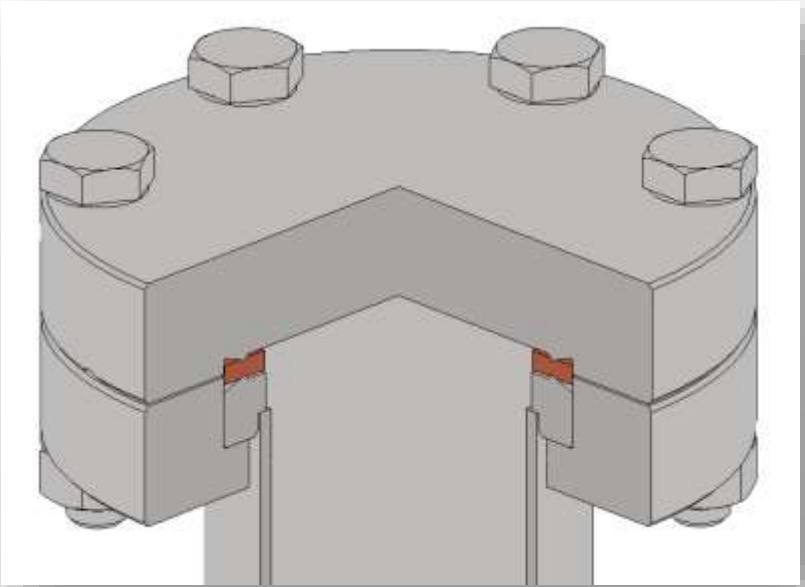
Ph.D. Student, Albert Davtyan

Flanges in Accelerator Technology

https://www.ftipv.com/kf-vacuum-components/

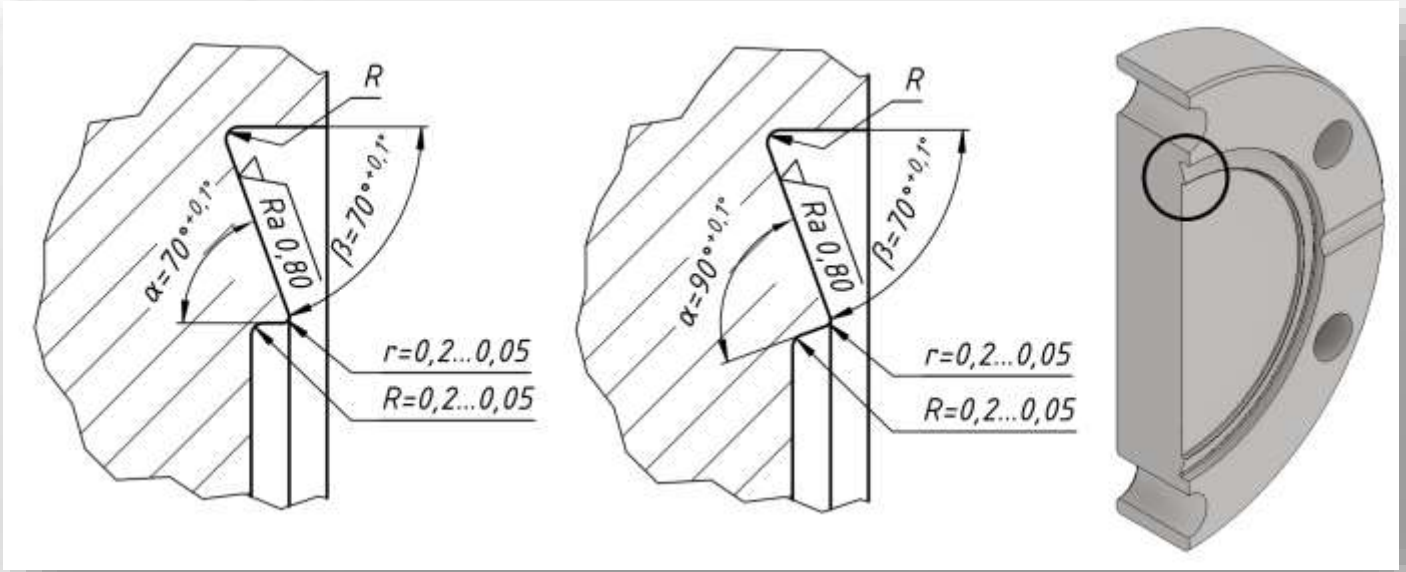


KF (QF) Flange



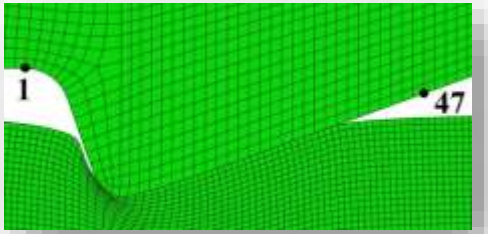
ConFlat-type (CF) Flange

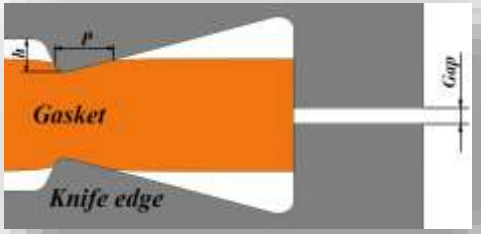
UHV ConFlat-type Flanges

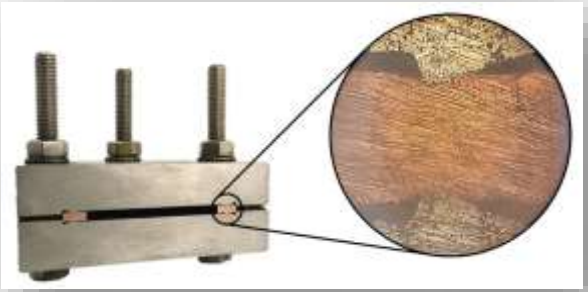


Wheeler's model CERN's model

Two Widely Used Models



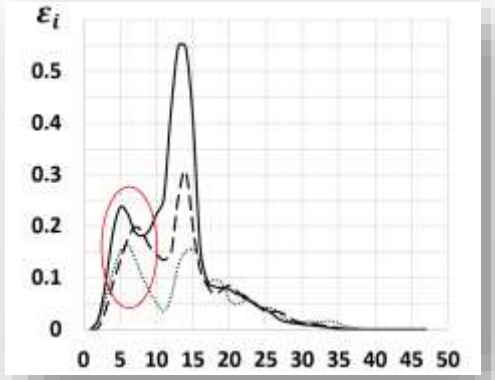


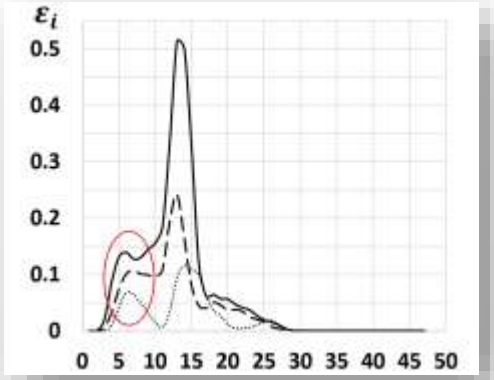


Knife edge tip radiuses:

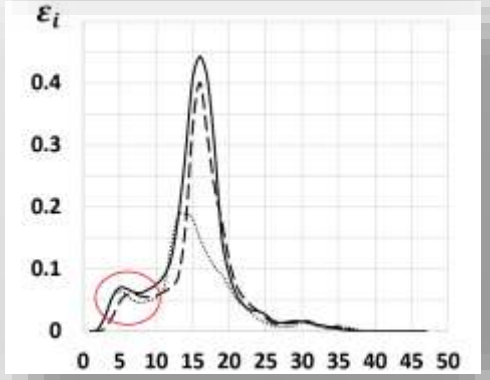
0,05 *mm* 0,1 *mm* 0,2 *mm*

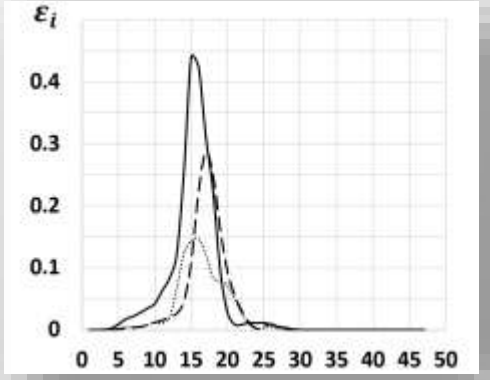
Wheeler's model





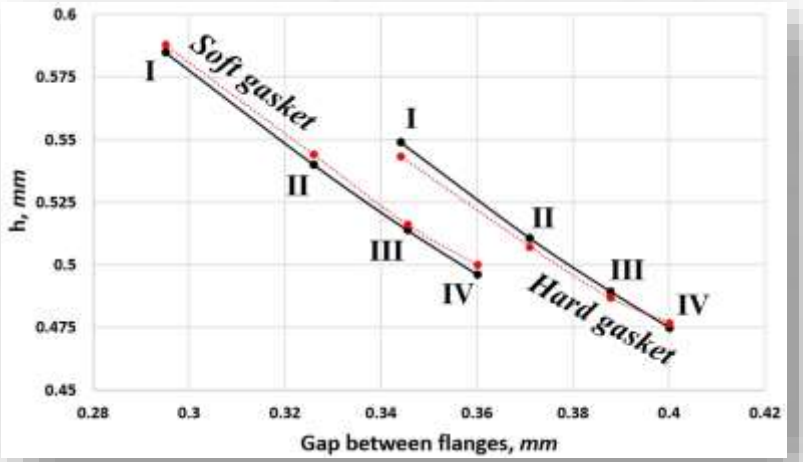
CERN's model

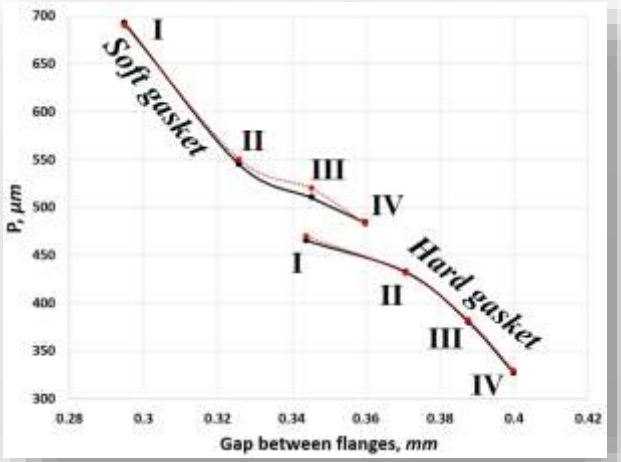




¼ Hard Gasket

Soft Gasket



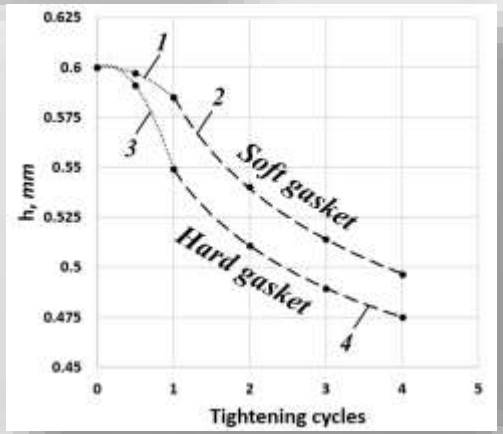


Experimental Data
Simulation Data

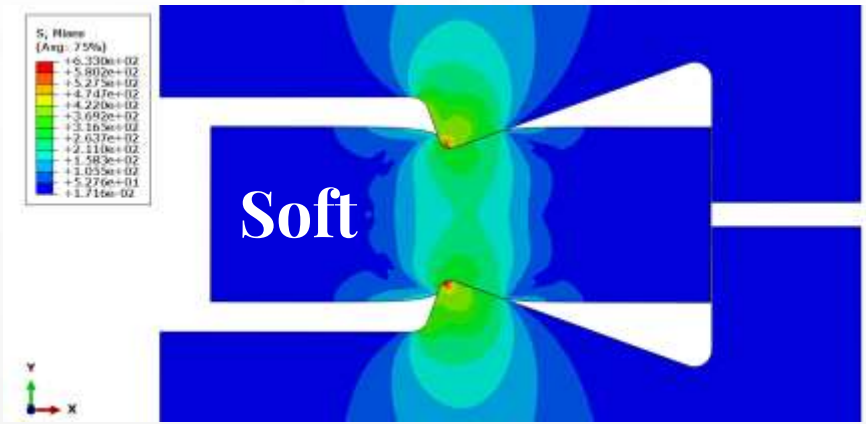
The Empirical Functions Obtained:

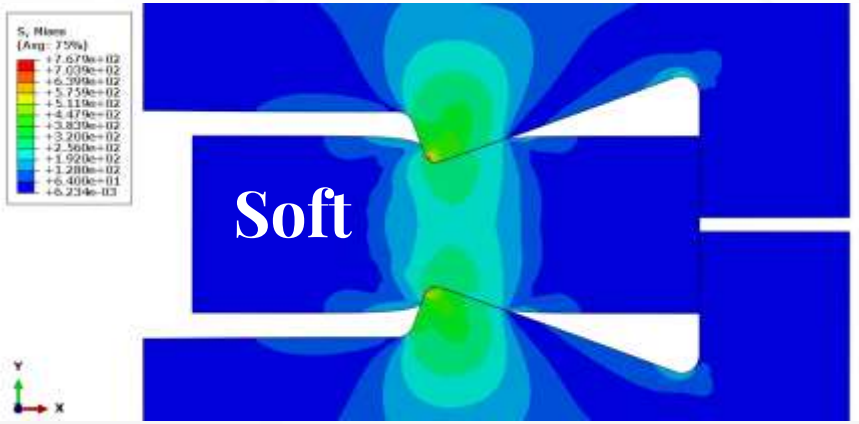
$$h_S = \begin{cases} -0{,}018{x_{c.n.}}^2 + 0{,}003x_{c.n.} + 0{,}6\ [mm], & 0 \le x_{c.n.} \le 1 \\ 0{,}585{x_{c.n.}}^{-0{,}119}\ [mm], & x_{c.n.} \ge 1 \end{cases}, \quad (1)$$

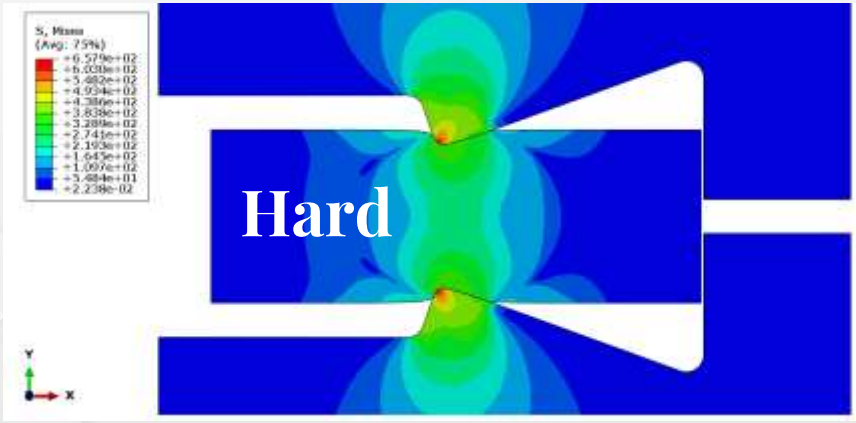
$$h_H = \begin{cases} -0{,}066{x_{c.n.}}^2 + 0{,}015x_{c.n.} + 0{,}6\ [mm], & 0 \le x_{c.n.} \le 1 \\ 0{,}549{x_{c.n.}}^{-0{,}104}\ [mm], & x_{c.n.} \ge 1 \end{cases}, \quad (2)$$

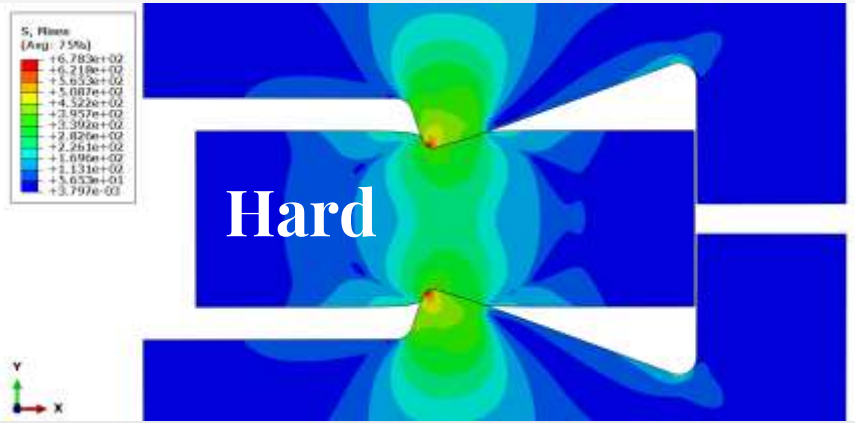


Simulations









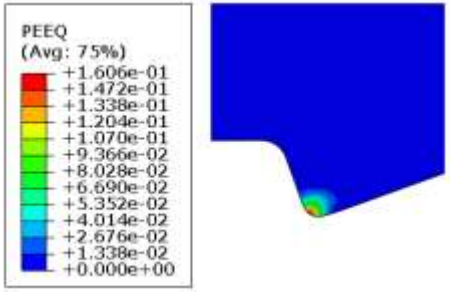
20 °C

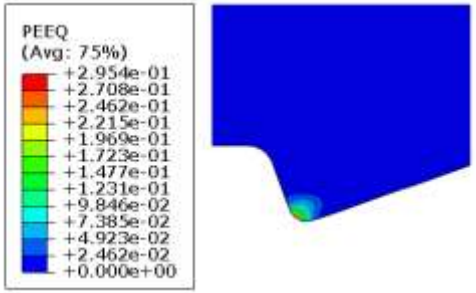
300 °C

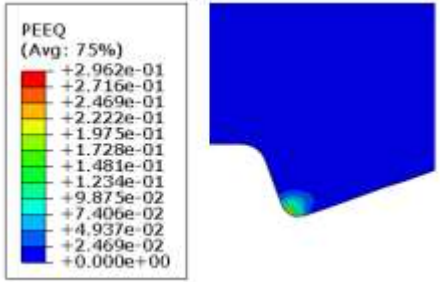
Simulations

Sealed | Heated | Cooled

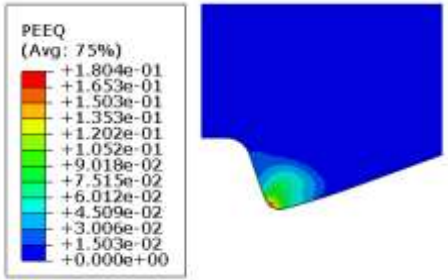
Soft Gasket

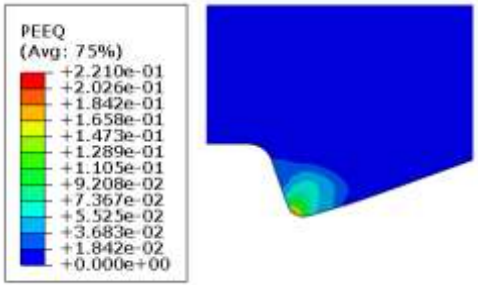


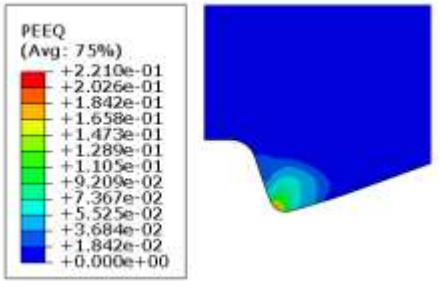




Hard Gasket

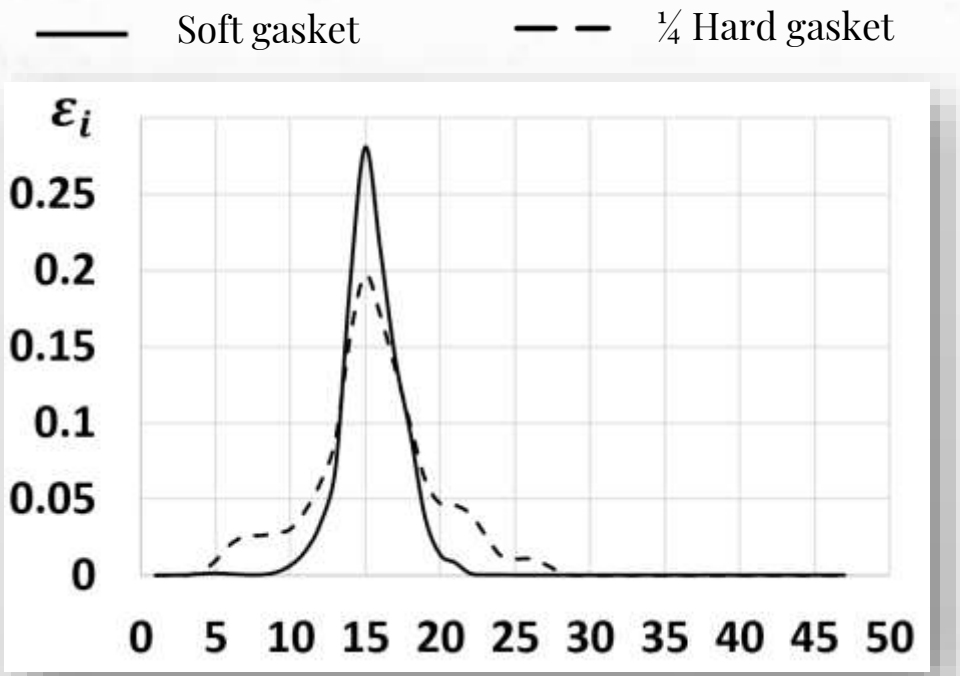




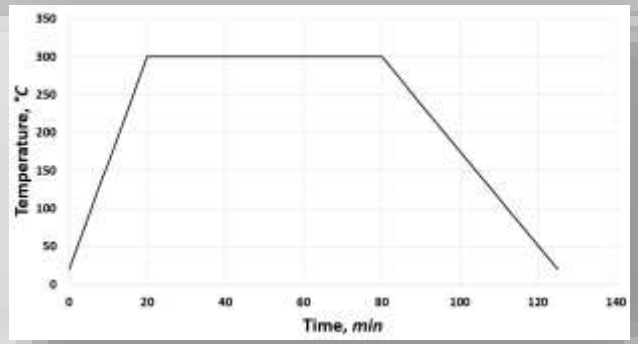


20°C | 300°C | 20°C

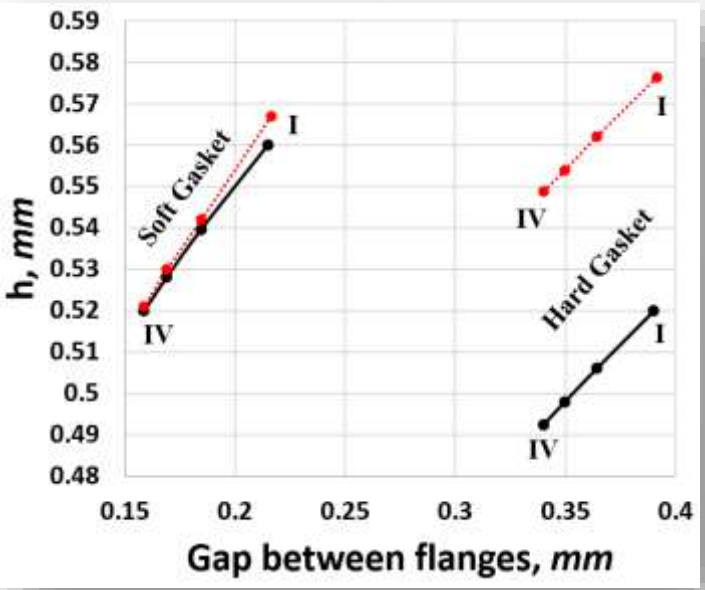
Plastic strain distribution at 300°C

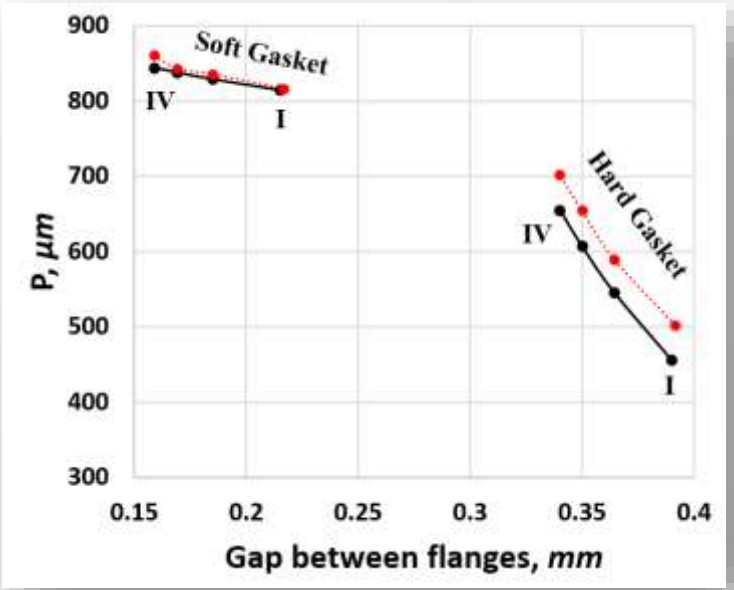


Experiments



Measurements & Data Analysis





Experimental Data

Simulation Data

$h_S = 0{,}56 x_{c.n.}{}^{-0{,}053}\ [mm],\ x_{c.n.} \geq 1,\ \mathrm{t} = 300°\mathrm{C}$

h_H= ?, t = 300°C

Future Activities

- Trying to solve data inaccuracies in the case of hard gasket
- Obtain approximate functions for the h parameter for not only room temperature and 300°C cases but for any temperature values (adding temperature coefficient)
- Conducting experiments of vacuum pumping and measurements with simultaneous temperature increases to investigate the grade of vacuum tightness loss
- Advancement of our technical recommendations for CF flanges used in the temperature gradient conditions
- Finishing our developed CANDLE design flanges taking into account obtained data of CF flanges in high-temperature gradients

Vacuum Technology Laboratory

CANDLE

THANKS!