

# Modelling and experimental analysis of cryogenic semi-static sealings

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## Objectives

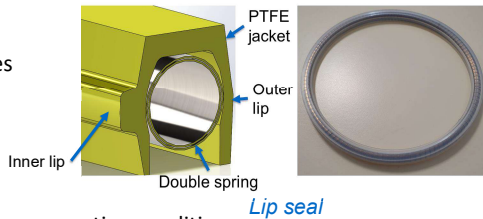
Research in the field of lubricated interfaces with the TRIBOLUB team  
Supported by ArianeGroup and CNES

Objectives:

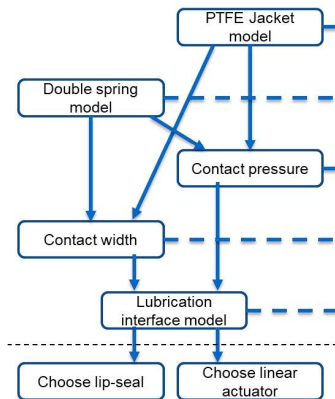
- Limit leakage
  - Reduce resistive forces
- In severe conditions :
- up to 30 bars
  - down to -195 °C

Methodology:

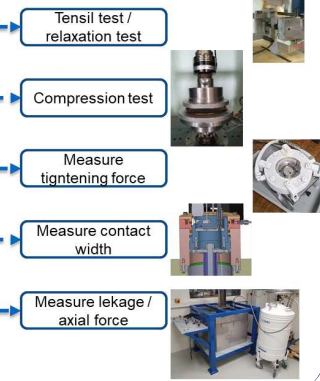
- Test rig design for severe operating conditions
- Modeling and experimental validation of the sealing system assembly
- Seal characterization
- Temperature influence evaluation
- Modeling of the lubricated interface



## MODEL



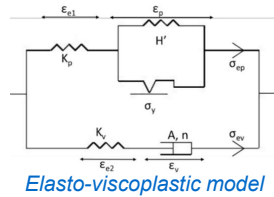
## VALIDATION



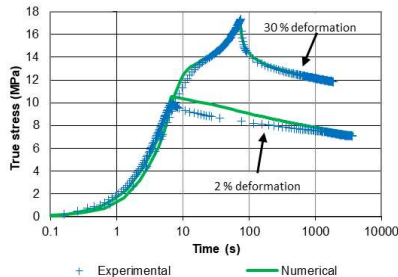
## Model and test rig

- Norton Hoff equation to define the elasto-viscoplastic model

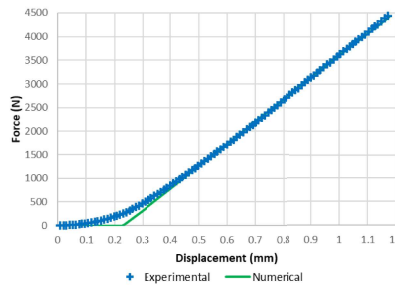
$$\dot{\sigma} + A * K_v (\sigma - \sigma_{ep})^n = 0 \Rightarrow \sigma = \left( ((n-1) * (A * K_v * t + c)) \frac{1}{n-1} \right)^{-1} + \sigma_{ep}$$



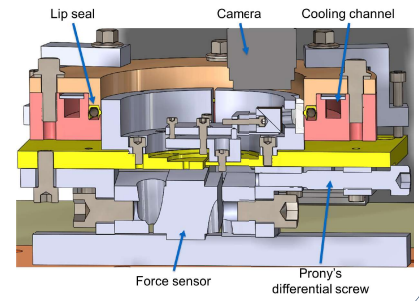
Elasto-viscoplastic model



Relaxation test at 2% and 30% deformation

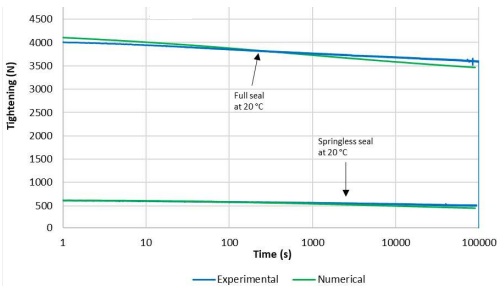


Spring compression

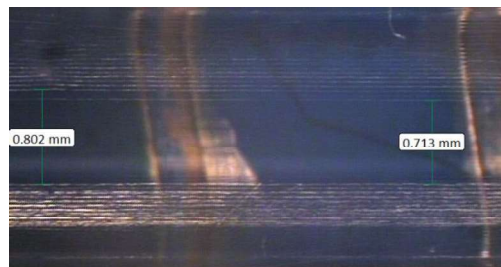


Radiometer

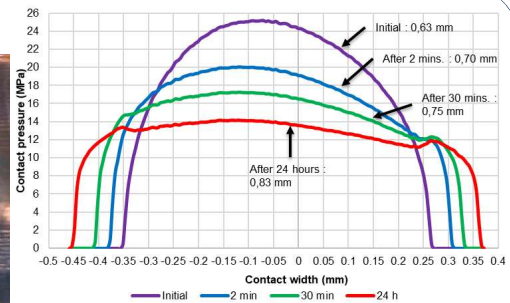
## Results



Radiometer: variation of the tightening over the time



Experimental inner lip contact width



Numerical inner lip contact pressure

## CONCLUSIONS

- ✓ Tightening decreases of 10 % over 24 hours
- ✓ Springless seal → 15 % of tightness
- ✓ Contact width increases of 30 % over 24 hours



## IMPROVEMENTS, PERSPECTIVES

- ✓ Evaluation of temperature dependency
- ✓ Modelling of the lubricated interface and associated leakage prediction
- ✓ Model validation on the test rig