



**IVS 2019 - Industrial Valve Summit Conference
Bergamo (Italy) - May 22/23, 2019**

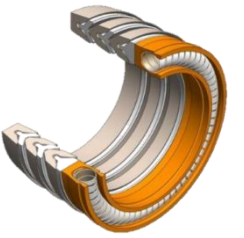
Qualification of Low-E polymer spring-energised seals in compliance with class AH fugitive emission standards.

**Filip Rousseau – R&D Group Leader
Saint-Gobain Seals**

Overview

- 1. Project background**
- 2. Project Scope**
- 3. Testing Capabilities**
- 4. Our development**
- 5. Summary**

Project Background



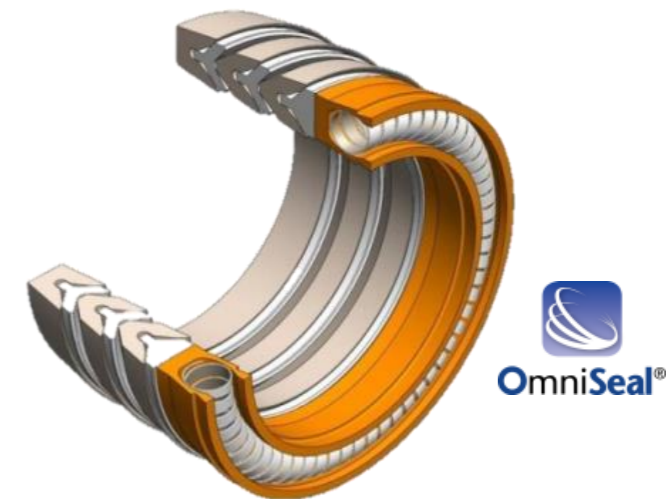
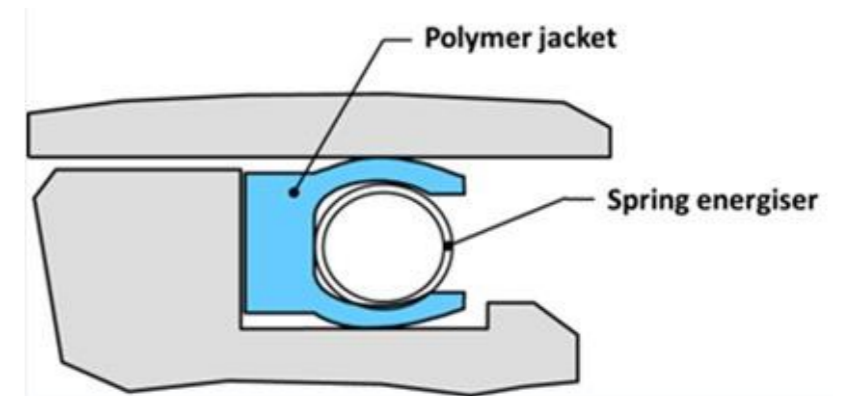
- In 2014, Saint-Gobain Seals developed a bespoke OmniSeal® stem sealing solution consisting of single seal compliant with ISO 15848-1 and SHELL MESC SPE 77-300 class BH for quarter-turn valves
- The solution has been validated by numerous valve OEMs



- Since, we see the demand evolving towards class AH leakage requirement

Main benefits of spring-energised seals for FE stem sealing applications

- **Simplified hardware design**
- **Self-energised solution, does not need to be compressed axially**
- **Reduced length**
- **No need for secondary seal**
- **Low operating torques / forces**
- **Long life**



Low-E polymer spring-energised seals in compliance with class AH fugitive emission standards

■ Project Scope

- Temp: -50°C / +200°C (-50.8°F / +392°F)
- Pressure: up to #2500 (6000psi)
- Quarter-turn motion
- Endurance class ISO15848-1 CO1 (205 cycles) / SHELL MESC SPE 77-300
- Focus on Low Temperature tightness

■ There is a need for fundamental understanding of material behaviors and further design optimizations.

- Internal mockup testing
- Simulation (FEA)
- Basic understanding

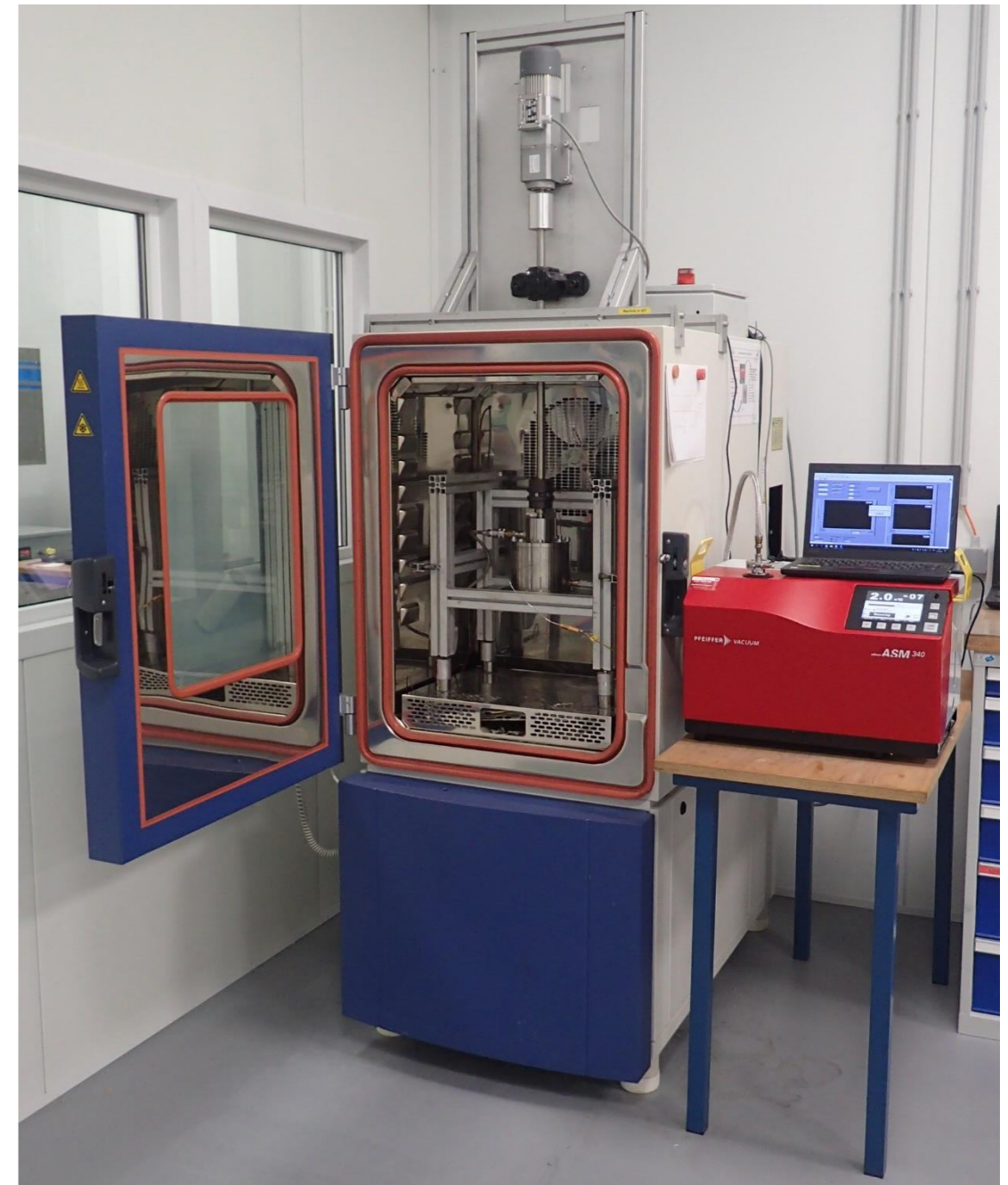
Our internal testing capabilities in full compliance with ISO 15848-1 standard

■ Data acquisition

- Leakage rate (full vacuum + mass spectrometer)
- Pressure
- Temperature
- Torque

■ Test parameters

- Pressure: up to 100 bar (1500PSI) Helium
- Temperature: -50 °C (-58 °F) to +160 °C (320 °F)
- 205 up to 2500 ¼ turn cycles
- Gland ID 34.8 mm (1.37”) x OD 46.0mm (1.81”)



Measurement techniques used to measure leakage class AH in ISO15848-1 and SHELL MESC SPE 77-300

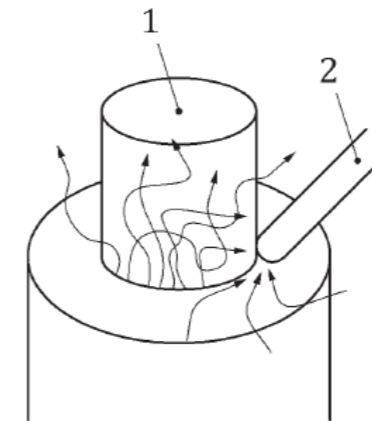
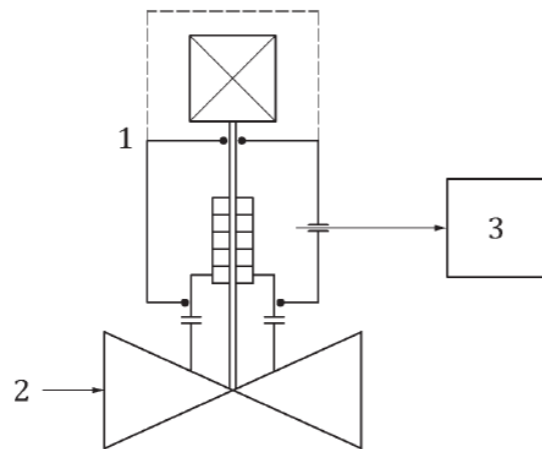
■ Leakage measurement of Helium

- Helium is the 2nd smallest molecule to be sealed
- Accuracy of the measurement will depend on the measurement technique
- Two main methods to measure Helium leakage for class AH

Testing methods used to qualify valves for Fugitive Emissions

Vacuum method (ISO15848)

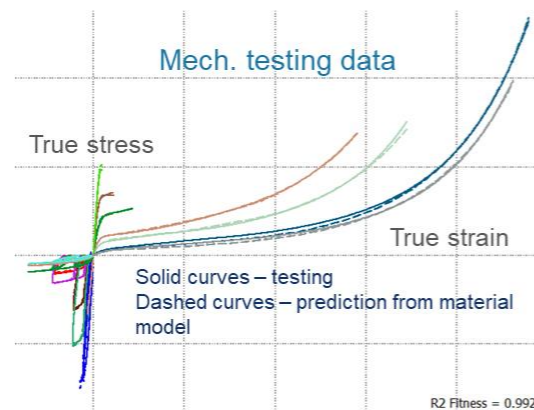
Sniffing Method (Shell MESC 77-300)



Solution development supported by Design Assessment by Simulation (FEA)

- Simulation platform:  
- Advanced material constitutive models developed by Saint-Gobain:

- Viscoelastic
- Plastic
- Creep
- Relaxation
- Large deformation

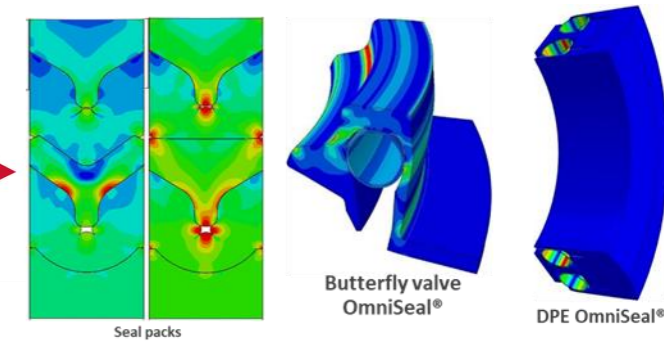
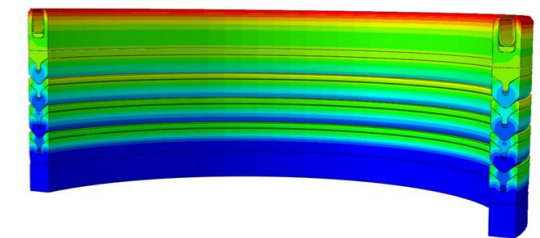


Parameters Extraction → Constitutive model

Fitting constitutive model to mechanical testing data generates model parameters

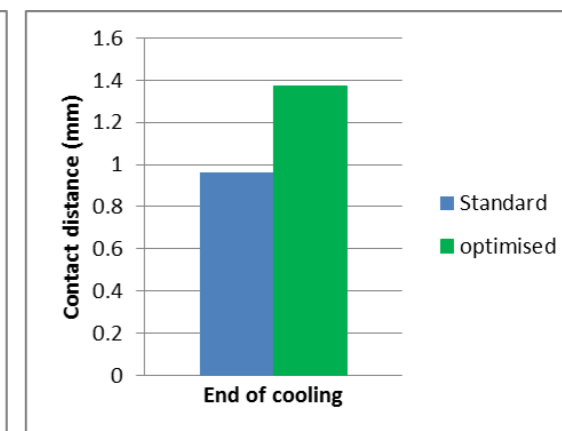
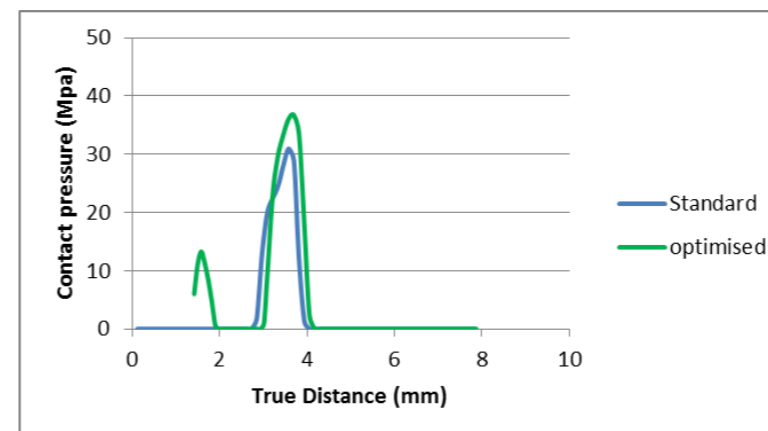
Set of parameters for a material is the material model for that specific material

Inputs to simulation →



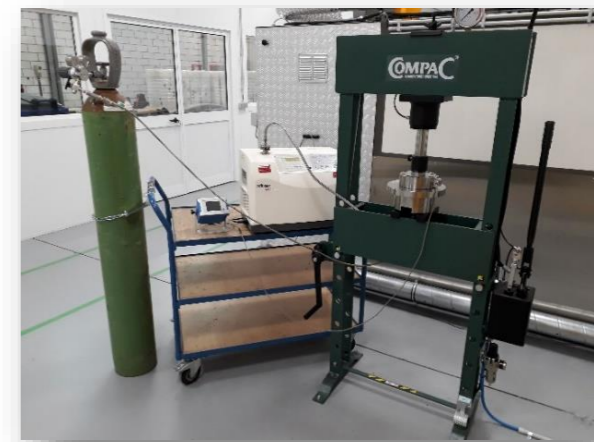
■ FEA design optimization

- Optimization of contact length and load distribution as a function of pressure and temperature



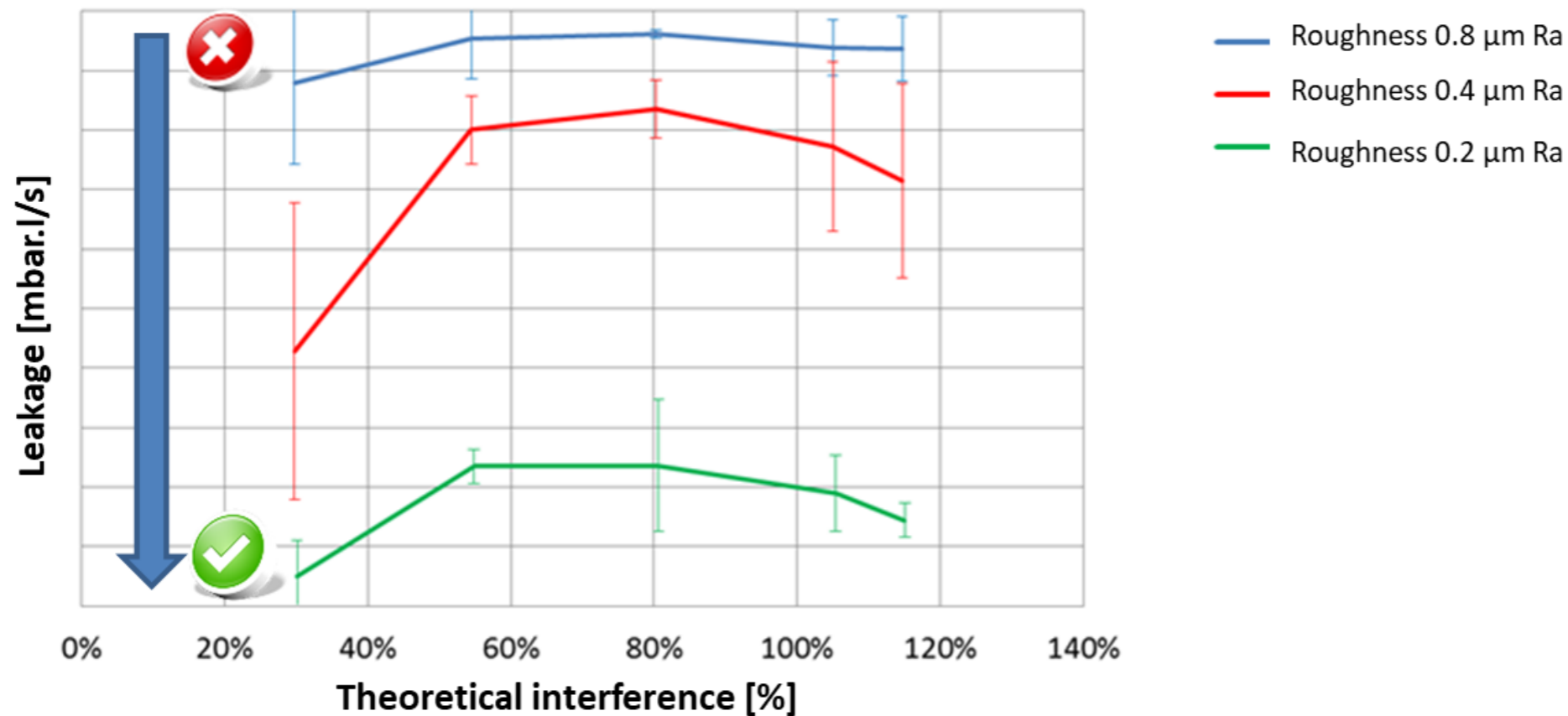
Our development of ISO 15848-1 class A stem sealing solution based on the understanding of key parameters

- **Class A is a bigger challenge compared to class B due to:**
 - Intrinsic jacket material property (permeability)
 - Mating surface roughness and stem coating permeability
- **For each parameter, tests were performed to understand their impact on He leakage:**
 - Seal contact pressure
 - Seal contact length
 - Roughness of mating surface
 - Material
- **Tests are performed on an in-house made system, allowing us to control sample dimensions, contact load, pressures, temperatures and roughness.**



Our development of ISO 15848-1 class A stem sealing solution based on the understanding of key parameters

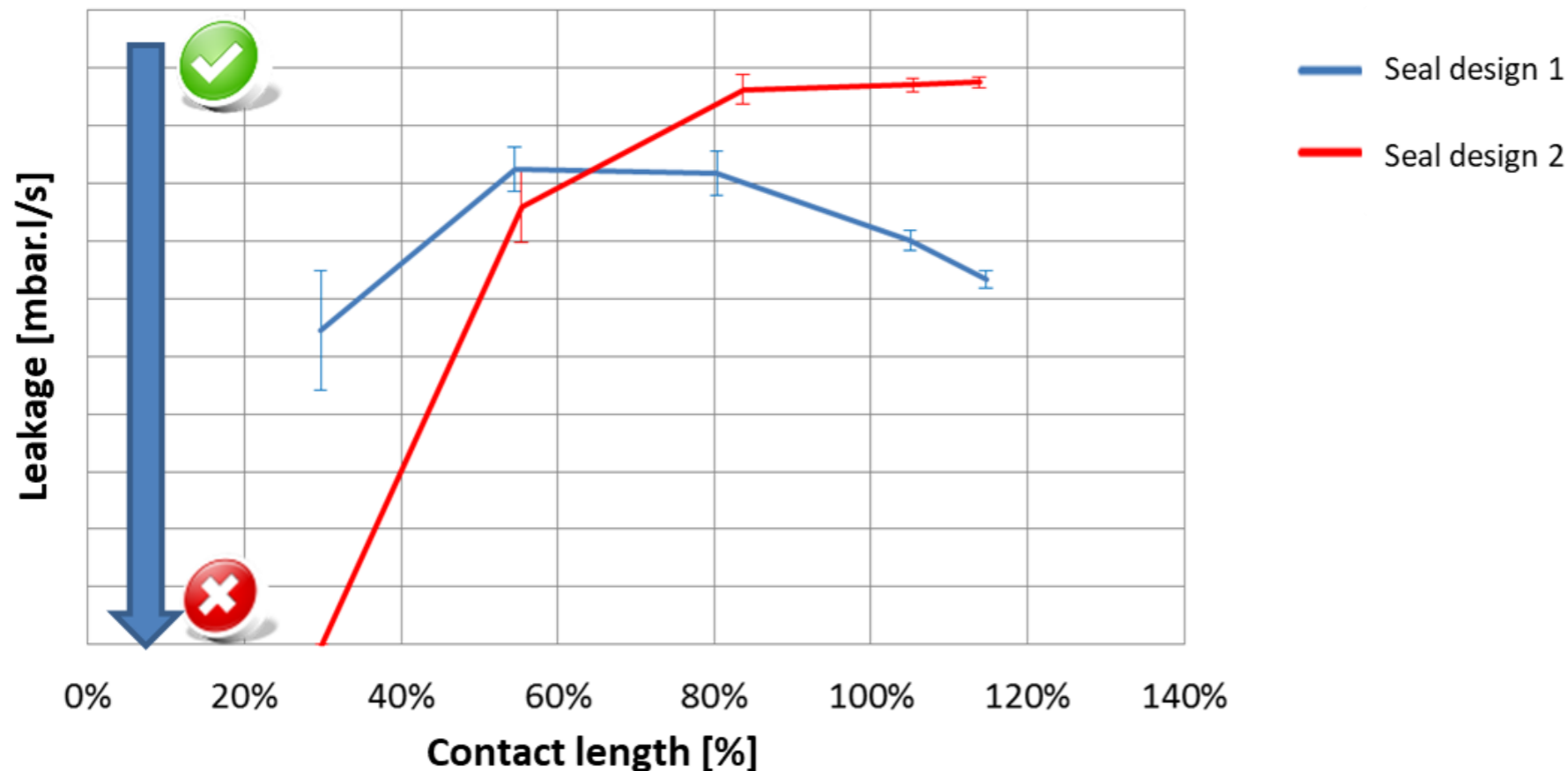
Impact of the hardware finish:



Control of the hardware quality is required to control seal performance.

Our development of ISO 15848-1 class A stem sealing solution based on the understanding of key parameters

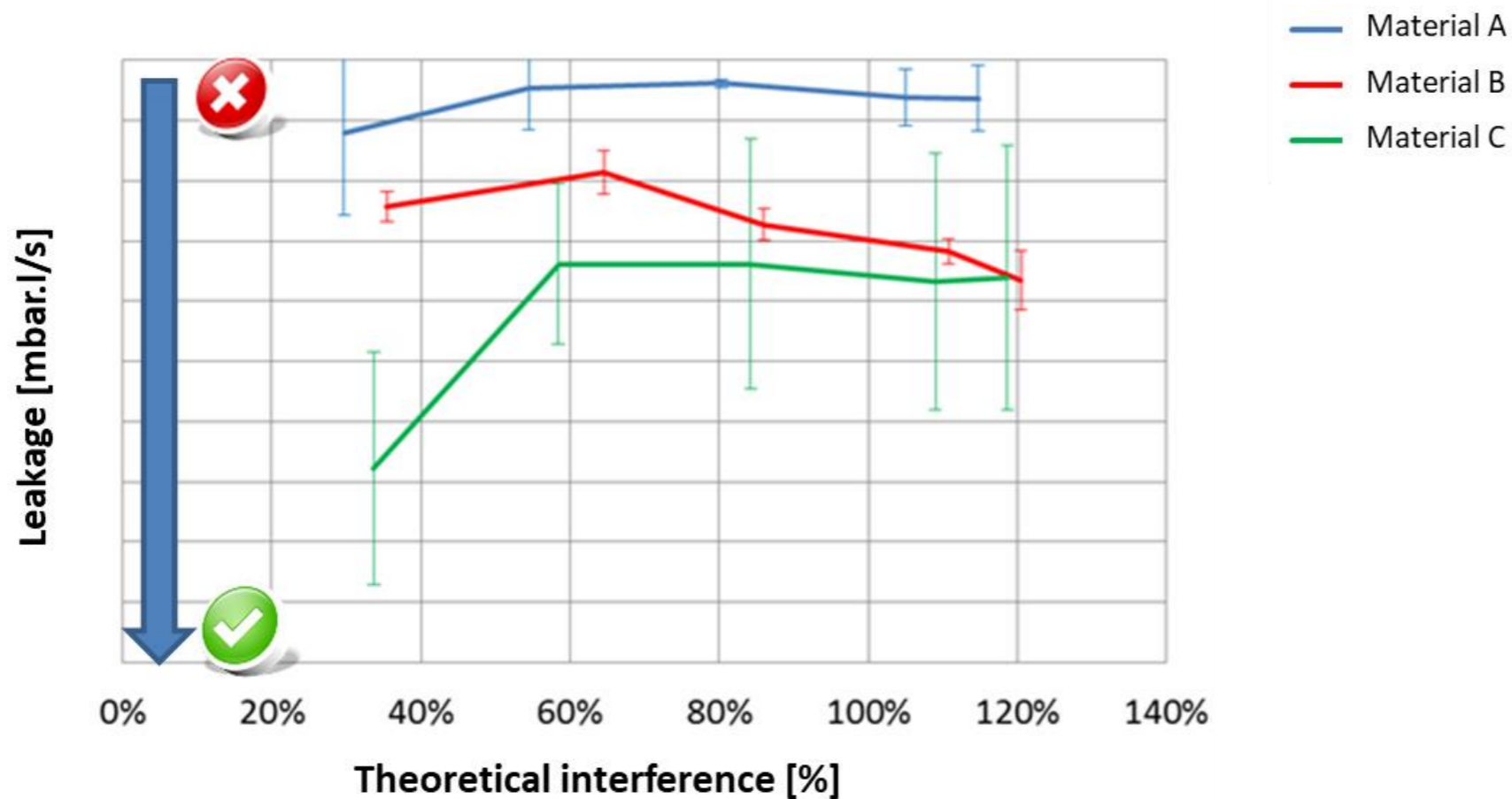
Impact of the design: (contact pressure and contact load)



Understanding the impact of seal design is required to control seal performance.

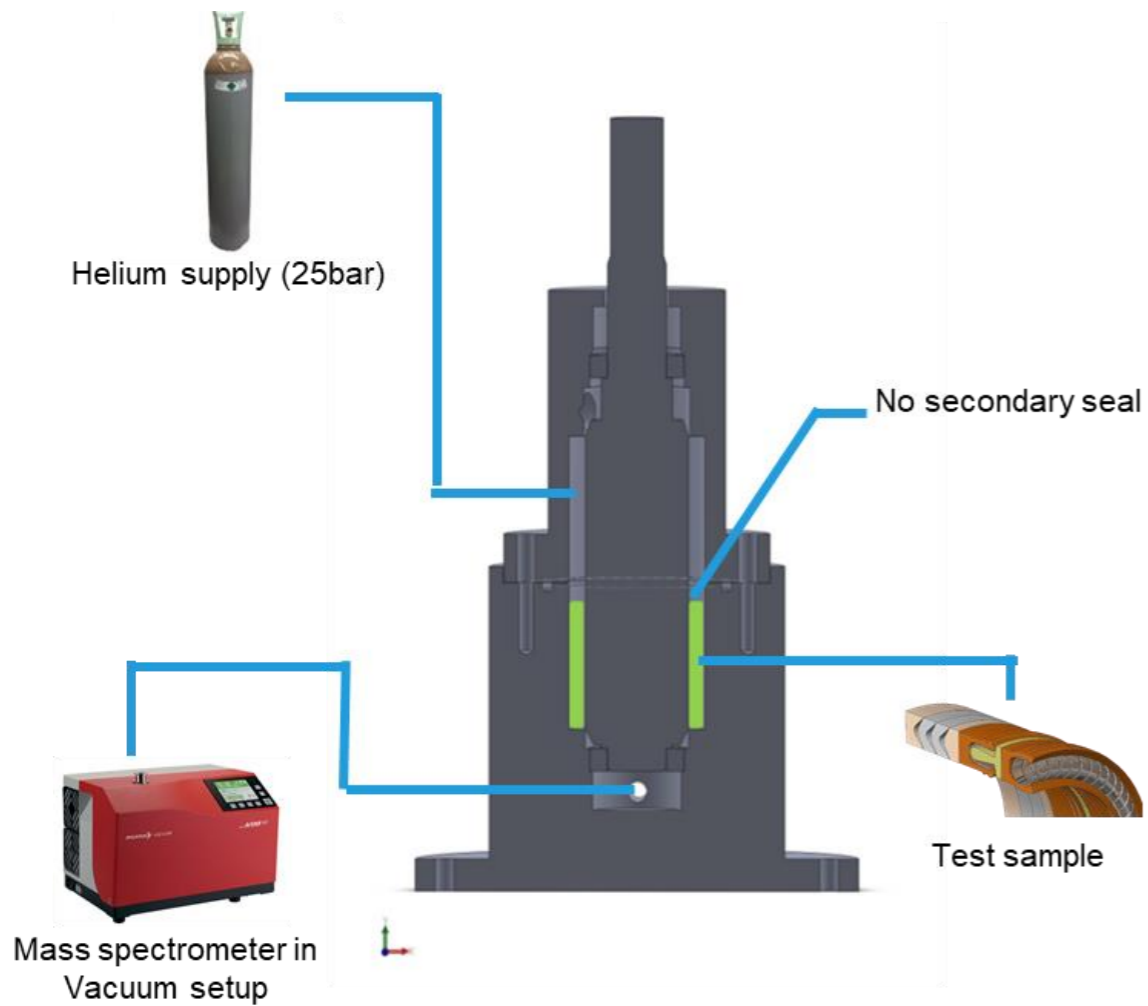
Our development of ISO 15848-1 class A stem sealing solution based on the understanding of key parameters

Impact of the sealing material:

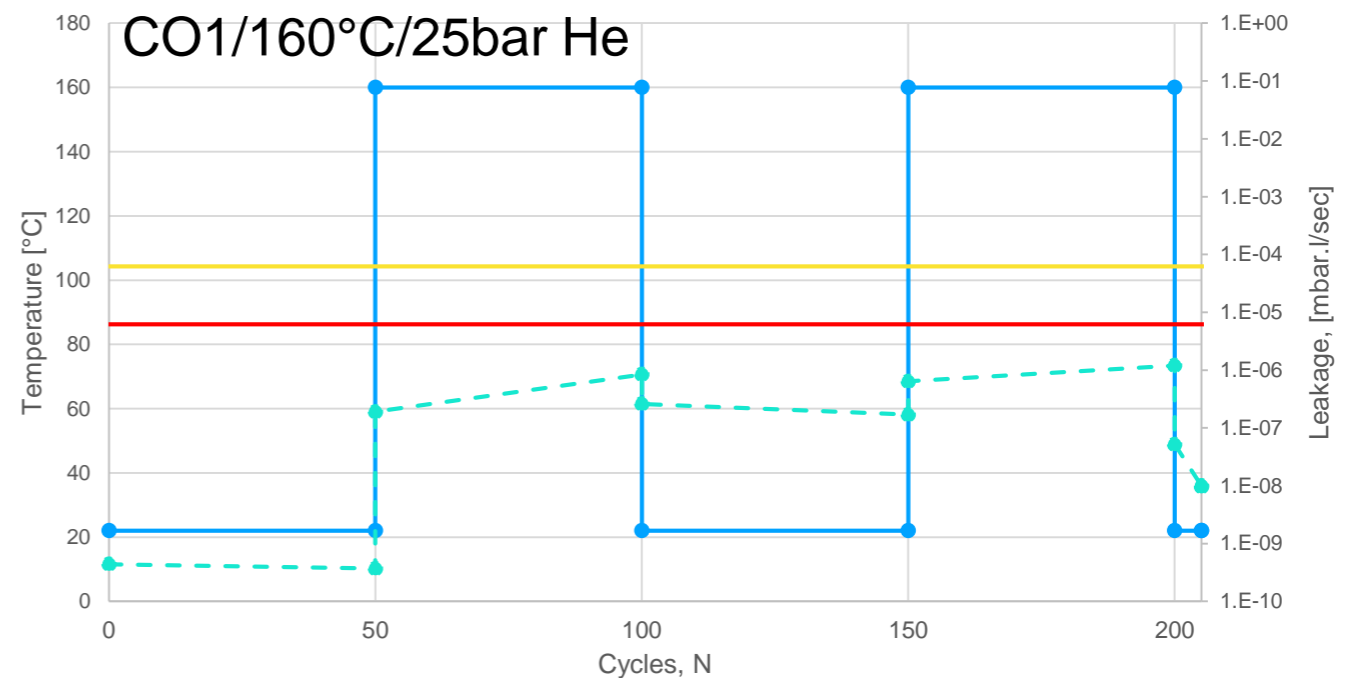
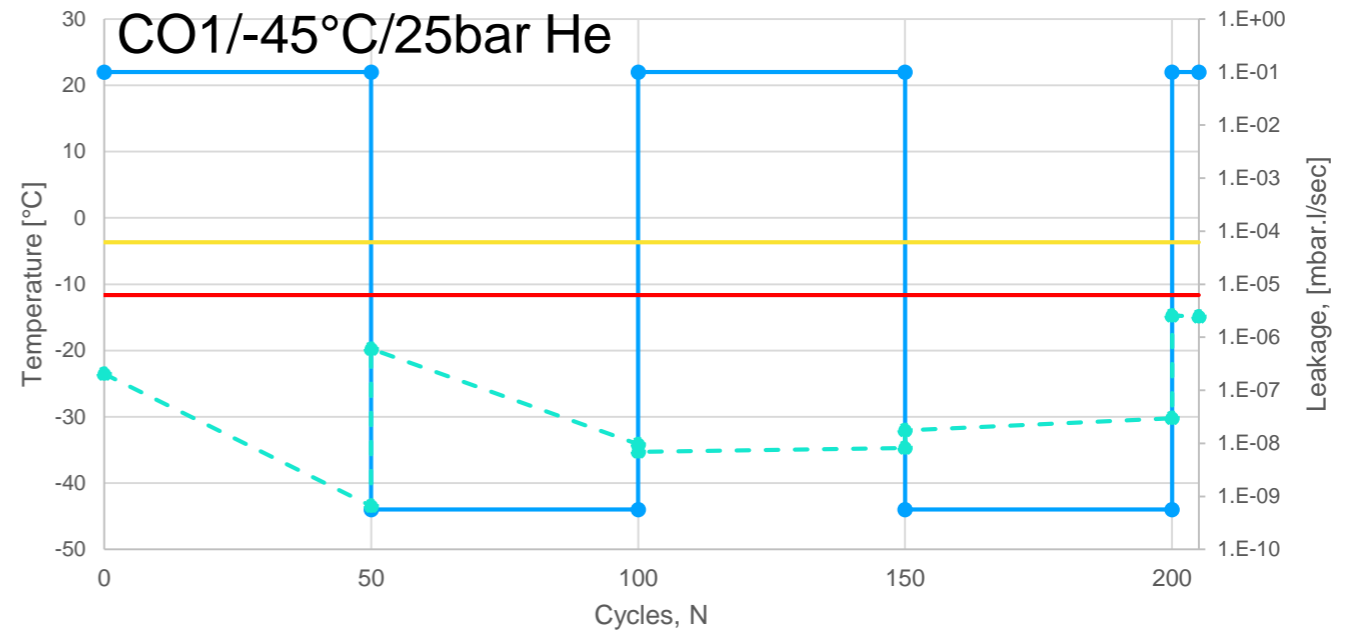


Careful selection of material is required to control seal performance.

Our ISO 15848-1 class AH stem sealing solution tested on internal mock-up



Gland ID 34.8 mm (1.37") x OD 46.0mm (1.81")
 Stem and gland roughness +/- 0.2µRa

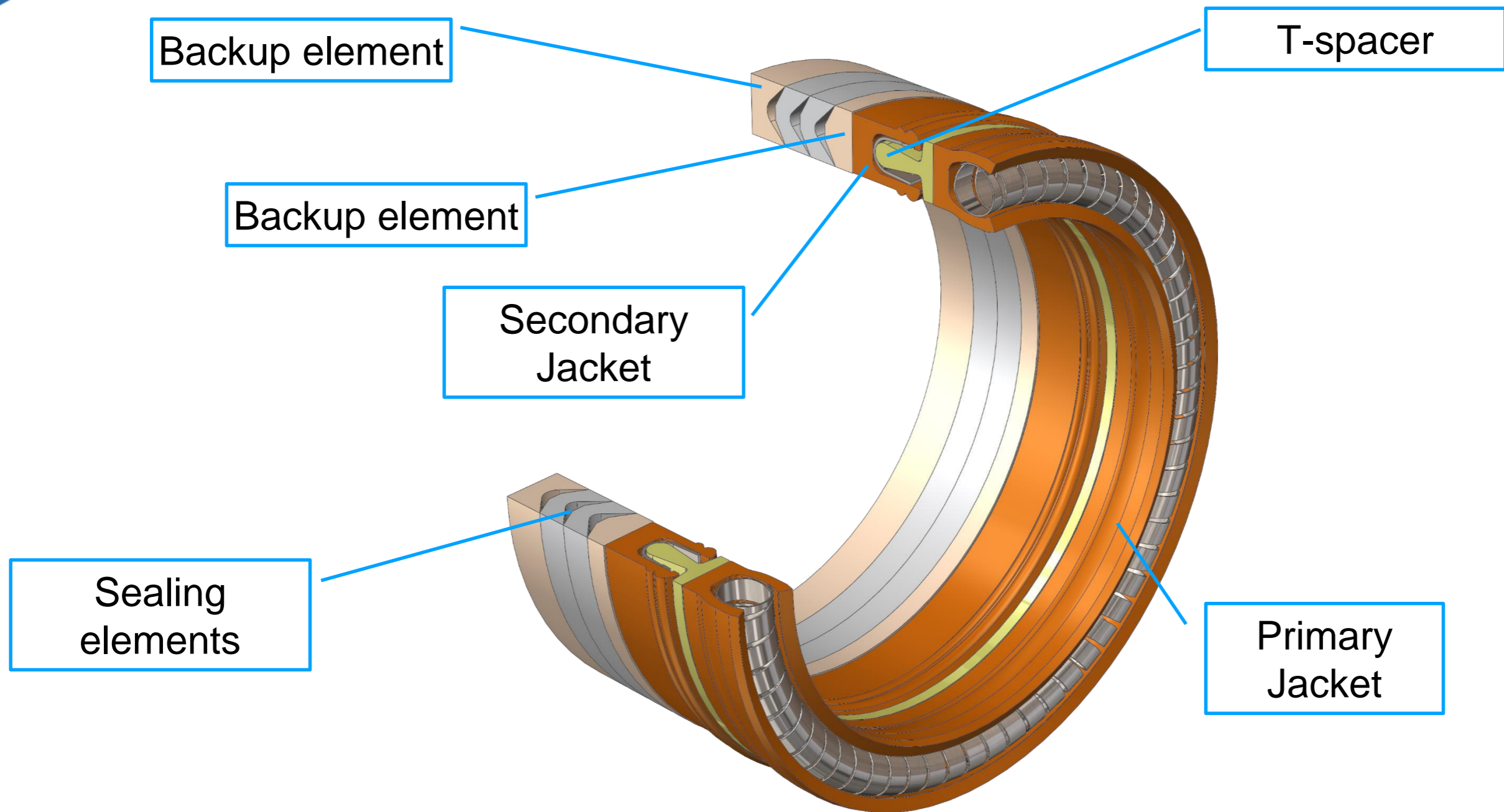


Third-party testing on TMBV 10 #1500 according to SHELL MESOC SPE 77-300 test protocol

Test sequence	Conditions	Pressure	Measured leakage rate (mbar.l/s)	Acceptance criteria for FE stem seal	Performance level
				SPE 77-300 Table C.7 & C.9 Stem dia = 81.80 mm	
1	RT Static	250 bar	2.00 E-06	<p>Class A $\leq 1.46 \text{ E-05 mbar.l/sec.mm}$</p> <p><i>Tightness classes for helium expressed in atm.cm³/s are equivalent to 1.013 mbar.l/s per mm of stem external diameter</i></p>	CLASS A
2	RT Dynamic 17 cycles	250bar	2.00 E-06		CLASS A
3	- 196°C Static	250 bar	5.45 E-06		CLASS A
4	- 196°C Dynamic 17 cycles	250 bar	6.87 E-06		CLASS A
5	- 80°C Static	250 bar	2.00 E-06		CLASS A
6	- 80°C Dynamic 17 cycles	250 bar	2.48 E-06		CLASS A
7	RT Static	250 bar	2.00 E-06		CLASS A
8	RT Dynamic 17 cycles	250 bar	2.61 E-06		CLASS A

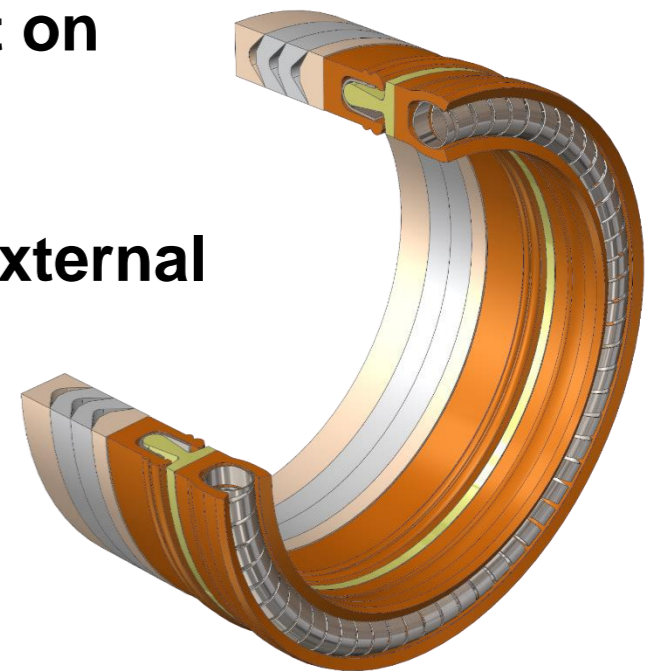


Polymer OmniSeal® compliant with ISO 15848-1 class AH leakage requirement



Summary:

- **Low Fugitive Emission applications require an understanding of the key sealing parameters to be able to pass leakage class AH of ISO15848-1 and SHELL MESC SPE 77-300.**
- **Successfully passed ISO 15848-1 class AH by internal test on mockup.**
- **Successfully passed SHELL MESC SPE 77-300 class AH external test on 10" valve (class 1500).**
- **External testing according to ISO 15848-1 ongoing.**



Thank you!

Do you have questions?

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