

VIPA research project: „Validation of the lift-off technique for internal pressure measurement on VIPs“



Christoph Sprengard, Max Engelhardt, Susanne Regauer

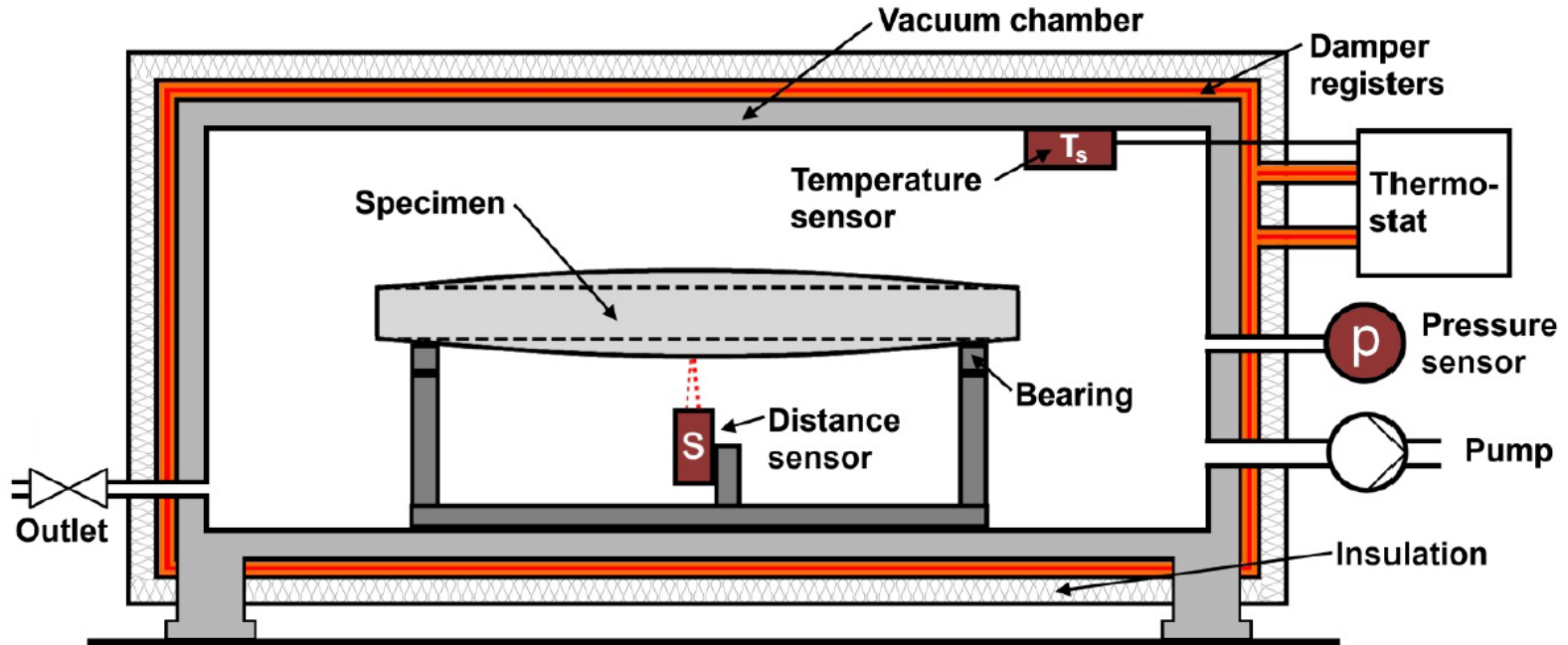




Influence Factors on the measurement of internal pressure of VIPs – Part 1

Study Project (and ongoing Master Thesis):
Susanne Regauer

Foil lift off method (if $p_{VIP} > p_{chamber}$)



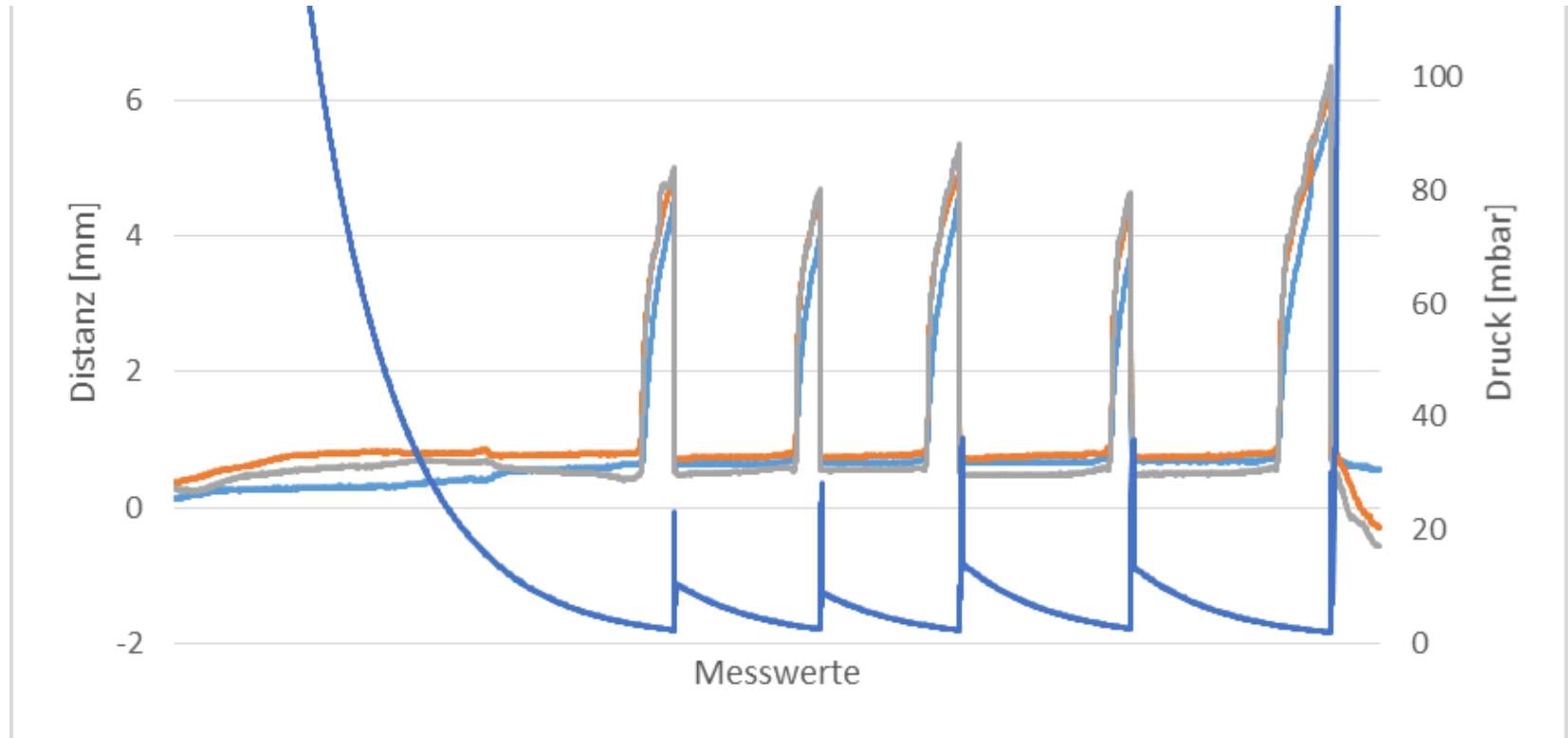
Sketch of vacuum chamber at FIW

Foil lift off method (if $p_{VIP} > p_{chamber}$)

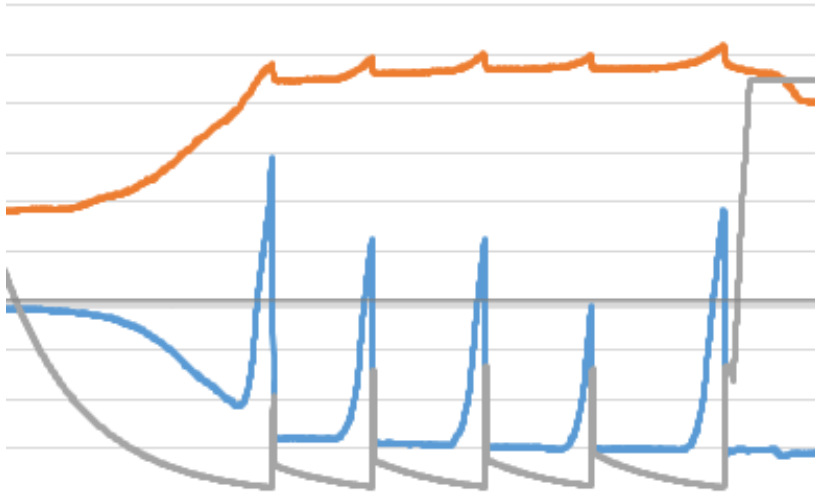


Photo of vacuum chamber at FIW

Typical measurement data

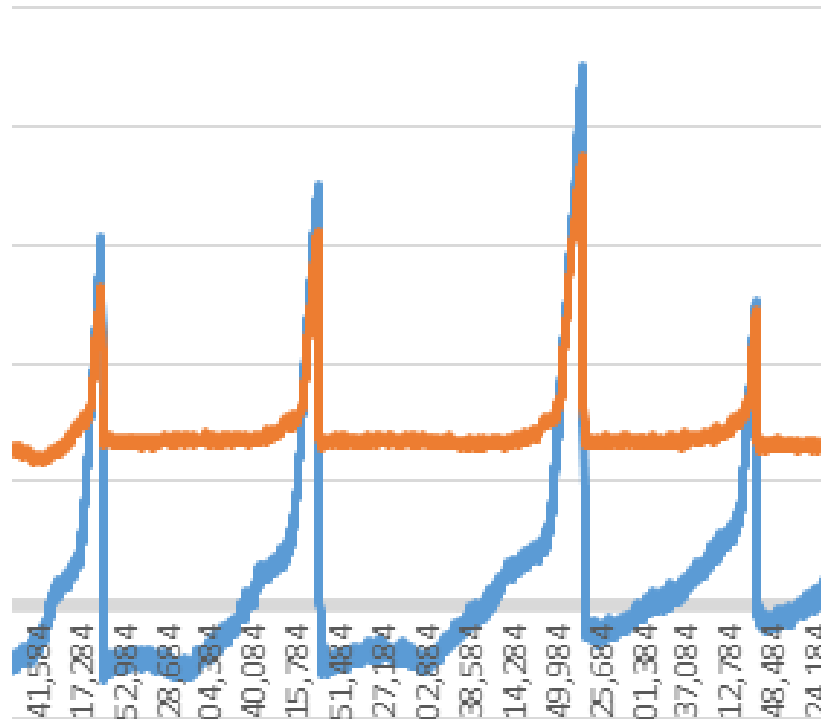


Occurring problems...



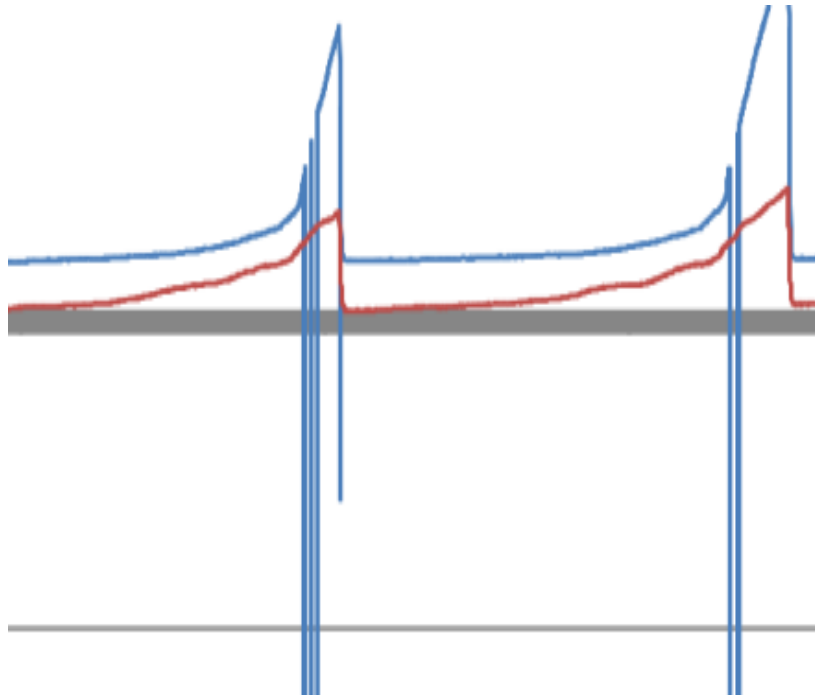
- Bending of the panel
 - Linear bearings are too far from each other
 - Especially for thin panels

Occurring problems



- Differences in results if measuring from above and from below
 - Adhesion of the foil
 - Gravity
 - Stiffness of the foil

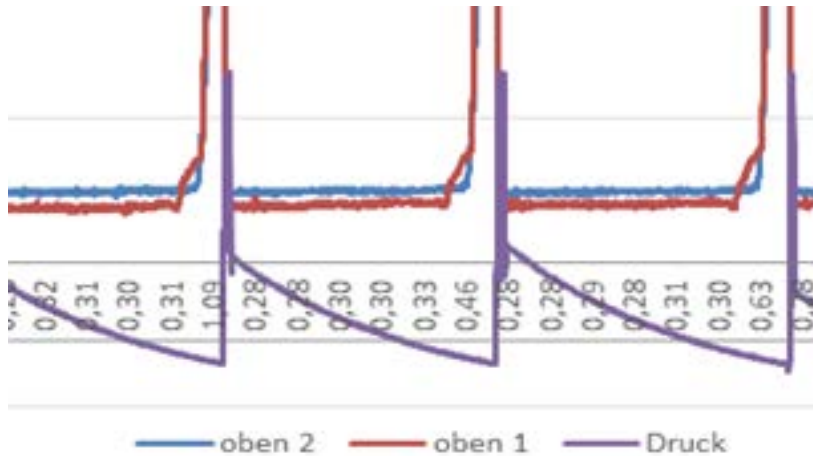
Occurring problems...



- Sudden peaks on the distance measurements
 - Sudden movement of the foil (hidden tension)
 - Expansion of the core
 - Relaxation at wrinkles

Occurring problems...

- Sudden pop-ups of the foil
- Relaxation of adhesives
- Expansion of the core



Research program



■ Specimens

- 5 manufacturers
- 3 thicknesses
- Different dimensions
- Various foil types and surface properties

■ Other variations

- Positioning of lasers and number of lasers
- Additional loads and positioning devices
- Positioning of the measurement zone
- Rate of sensor readings

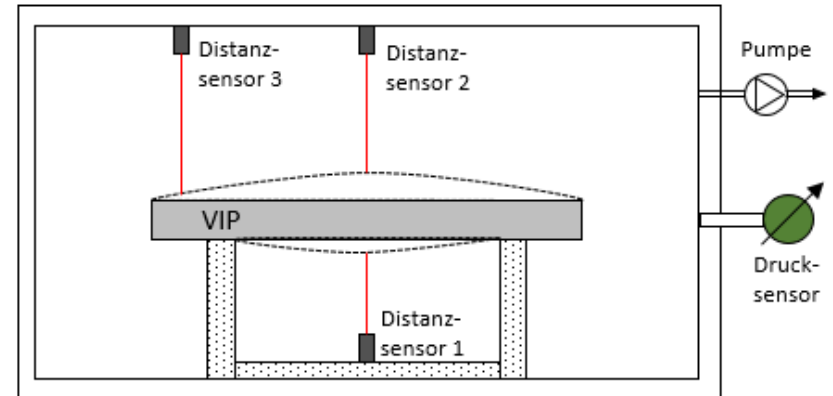
■ Boundary Conditions

- Linear type of bearing
- Positioning device with circle cut out
- Test on flat bearing (bottom of chamber)
- Profiles to form small square measurement zone
- Use of flexible material on the foil within the measurement zone (nylon stockings)

Boundary conditions

- Basic method (starting point)
- 2 top and 1 bottom sensor
- Linear bearings
- Various distances

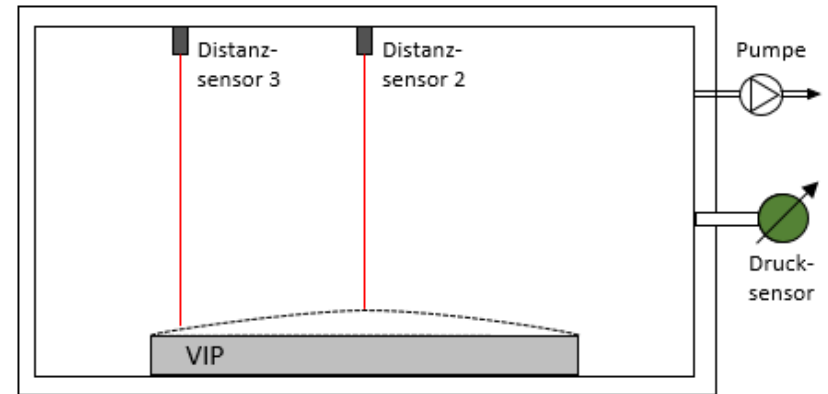
- **Bending of the panels**
- **Measurement zones not identic**



Boundary conditions

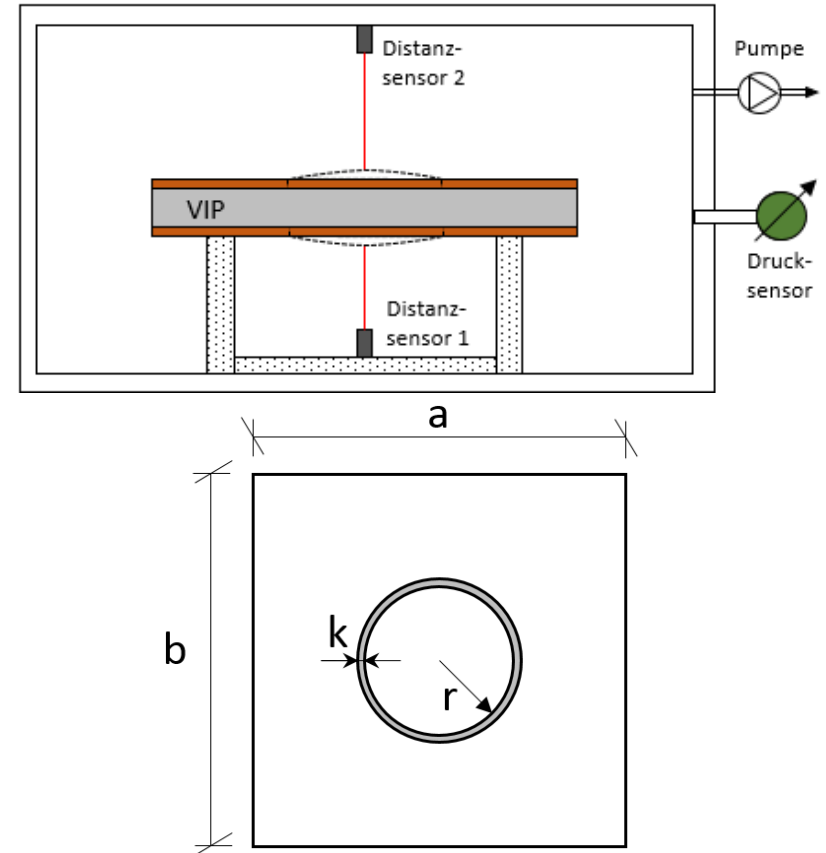
- Idea to avoid bending: flat bearing
- 2 top sensors

- **Unbelievable: the bottom of the vacuum chamber is bending!!! (40 mm stainless steel)**
- **No measurement from underneath**



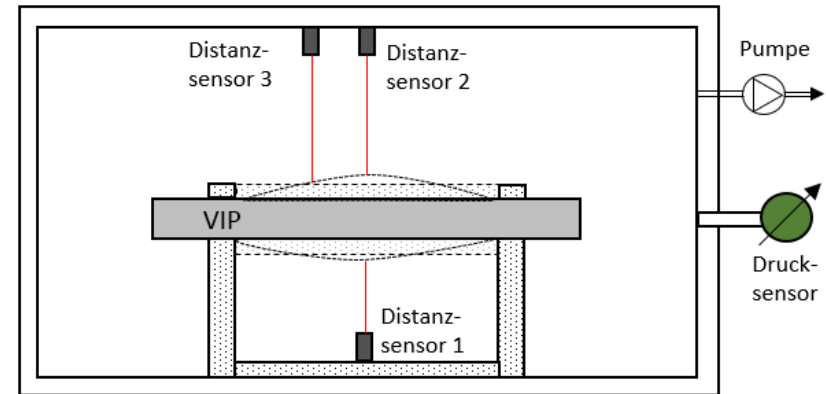
Boundary conditions

- Using patterns (circle cut-out in metal plate)
- Sensors from above and below
 - **Additional forming of undefined wrinkles when evacuating and ventilating again**
 - **Problems with ring seal (rubber foam – sudden moves of foil)**



Boundary conditions

- Square definition of measurement zone (aluminium profiles for restraining from top and bottom)
- Use of nylon stockings



Modified apparatus

15



Quelle: eigene Aufnahme

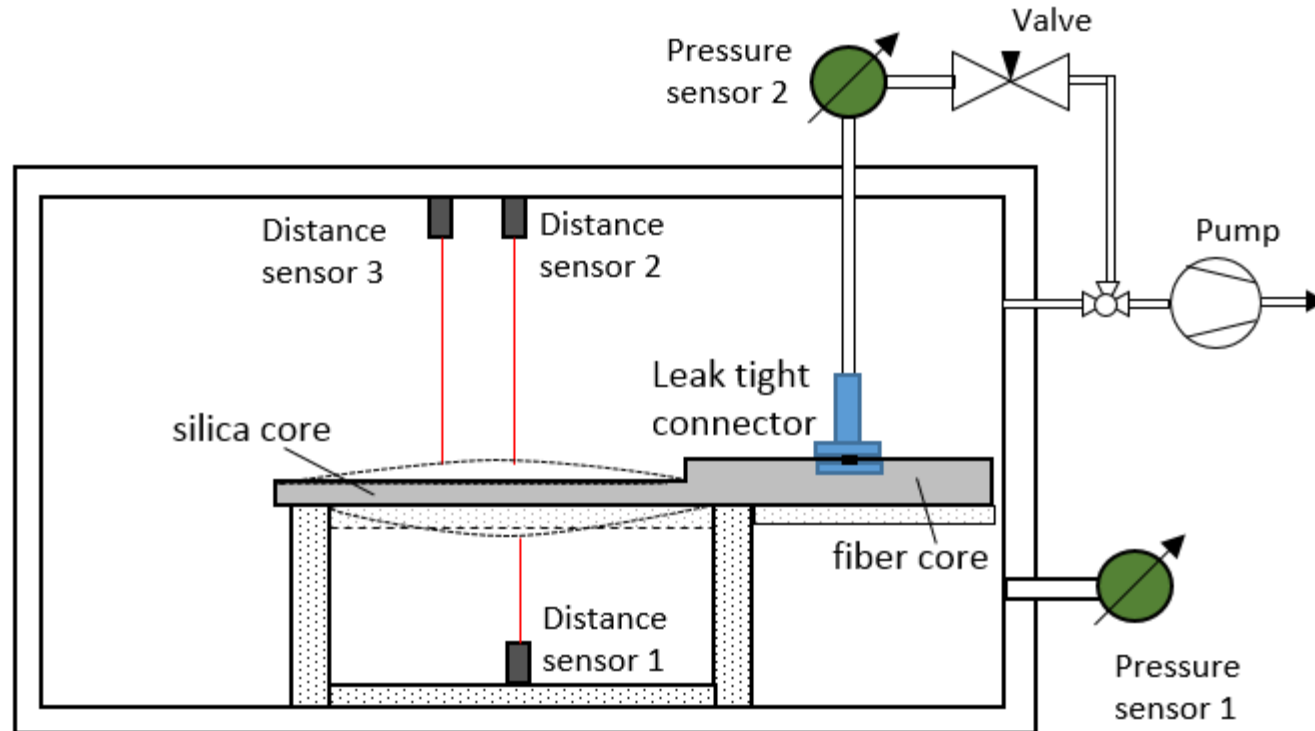
- VIPs show very „individual“ behaviour at pressure testing
- Method with square section works quite well
- Laser readings from top and bottom are almost identical
- Use of flexible material spanned over the measuring section improves results on wrinkled surfaces
- Positioning the lasers away from middle seals



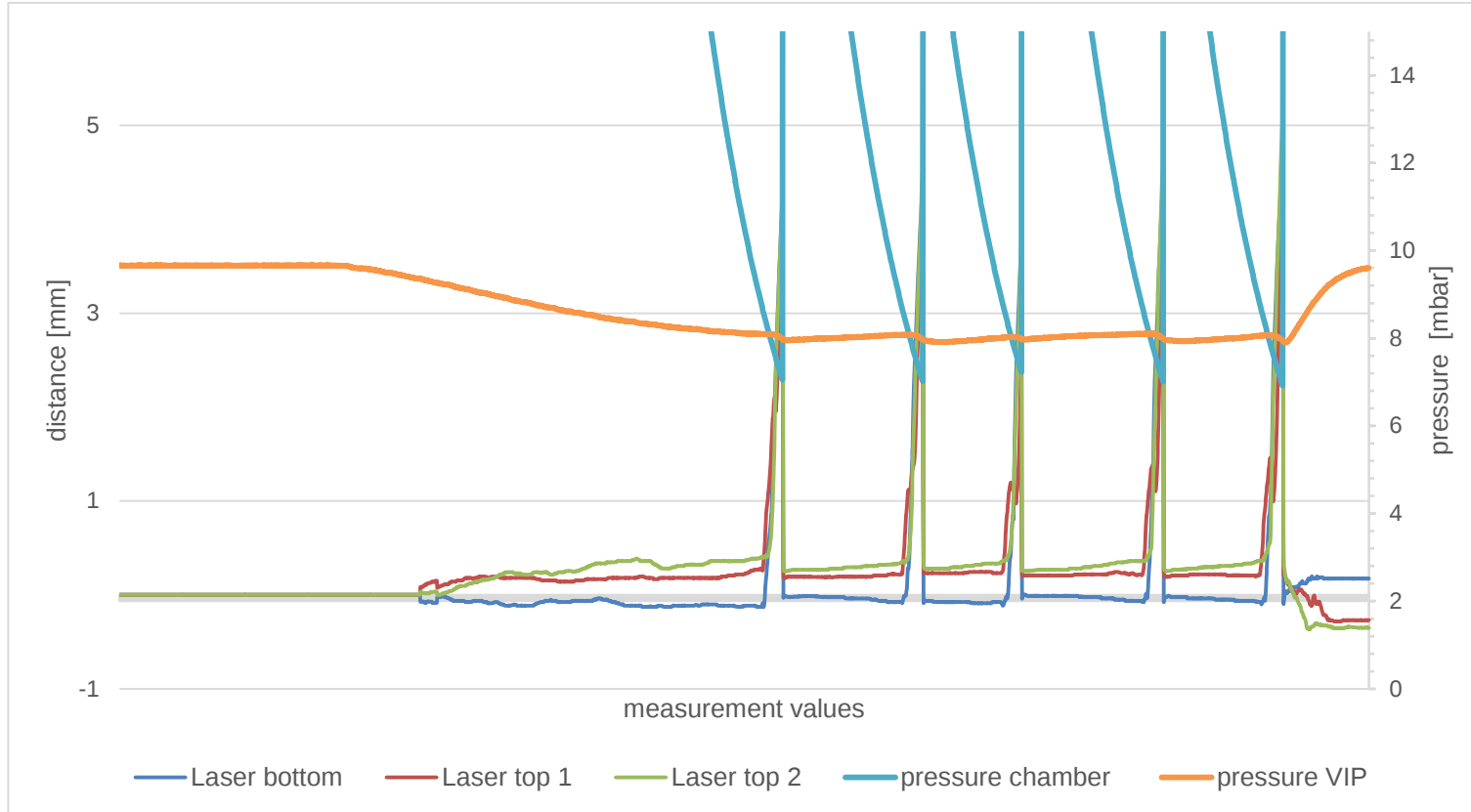
Conduction of validation measurements – Part 2

Max Engelhardt, Susanne Regauer

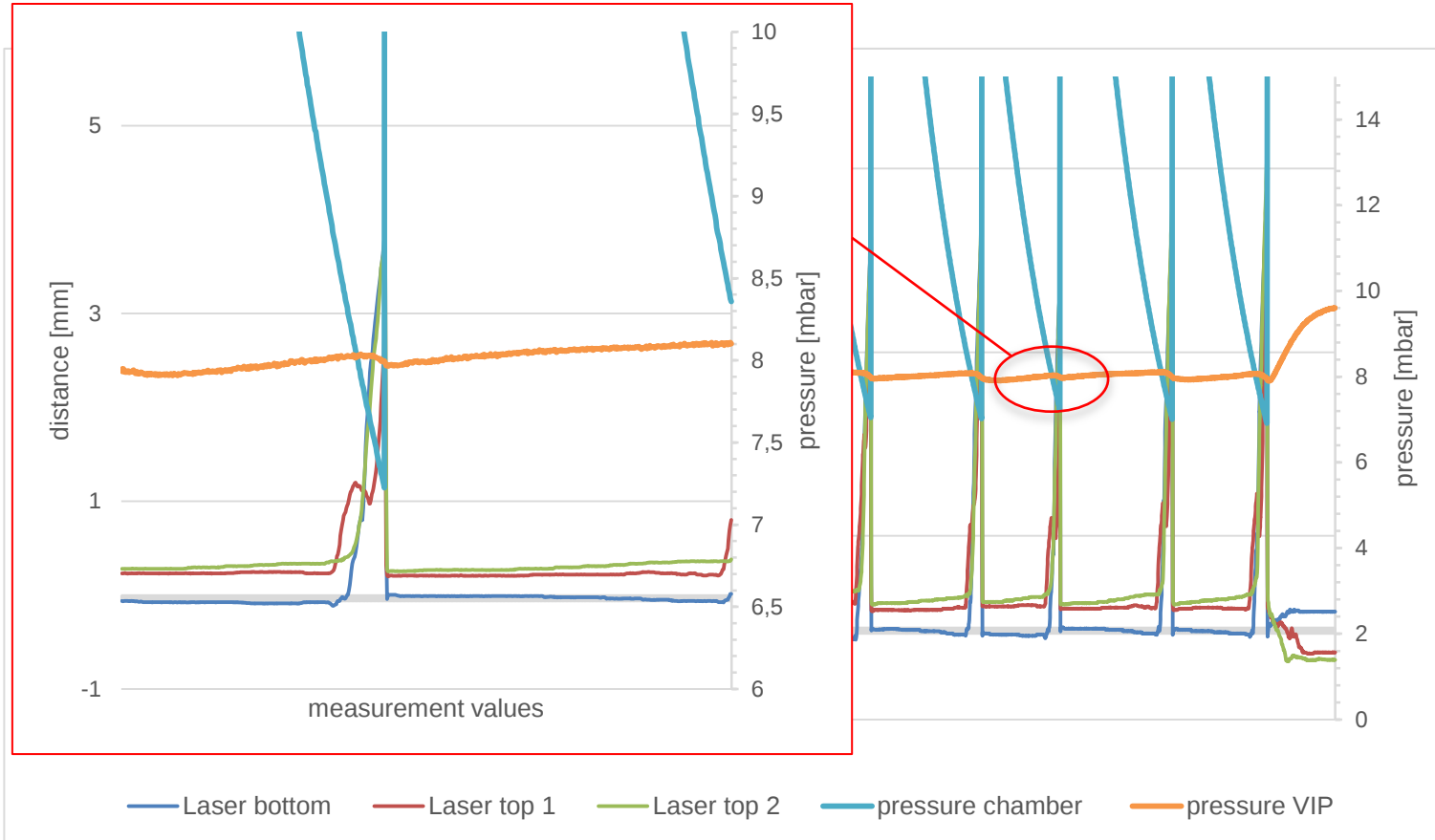
Setup with leak tight connector



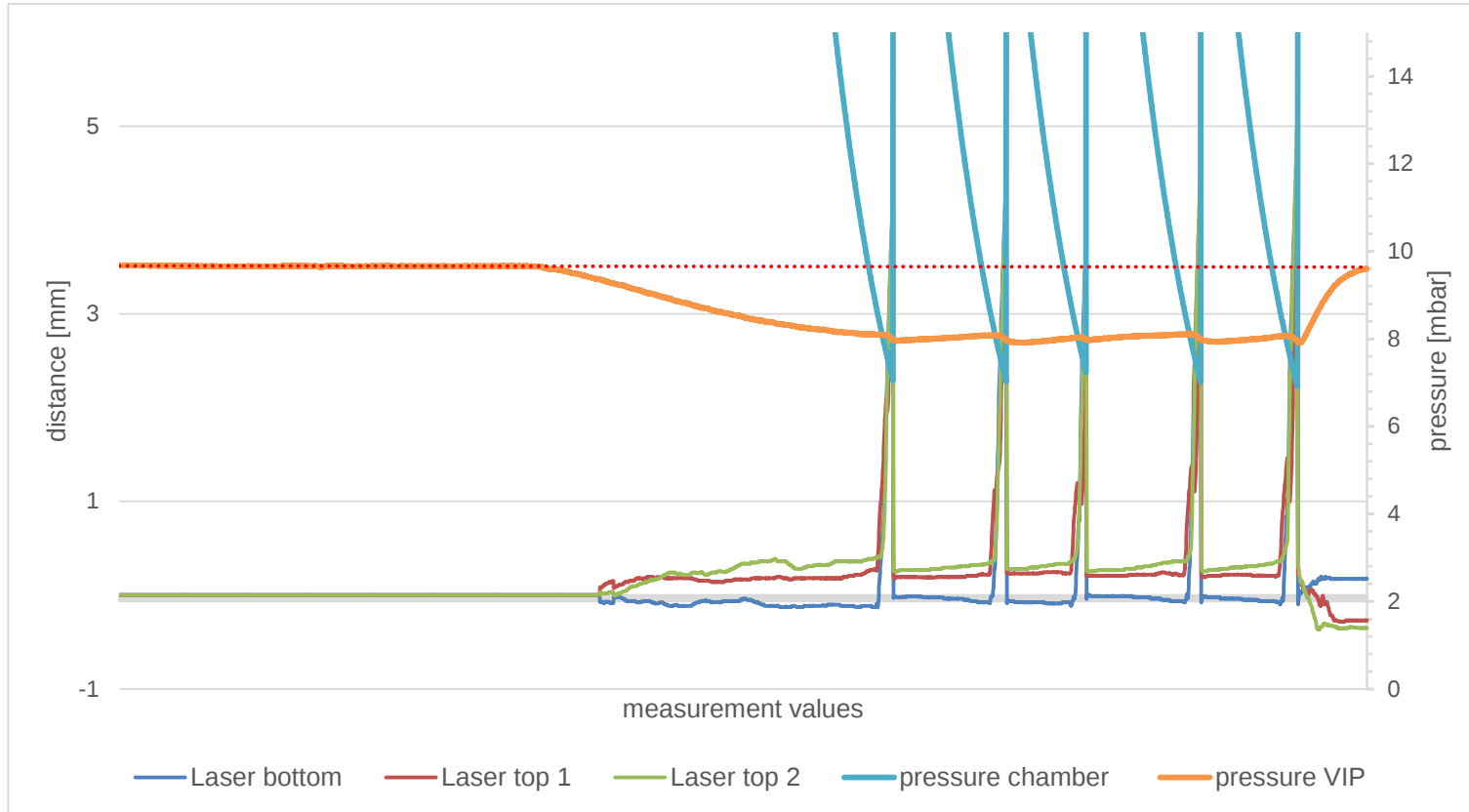
Measurement data with direkt internal pressure measurement curve



Measurement data with direkt internal pressure measurement curve



Determination of the internal pressure



Gained knowledge so far...



- Underestimated effect of outgassing and air and moisture attached to the pipes and gauges (very long evacuating time)
- Drop of internal pressure of panel when evacuating chamber (expansion of the core?)
- Determination of the rate of pressure increase to calculate internal pressure at the point of time of indirect measurement (needs to fit to each other!)