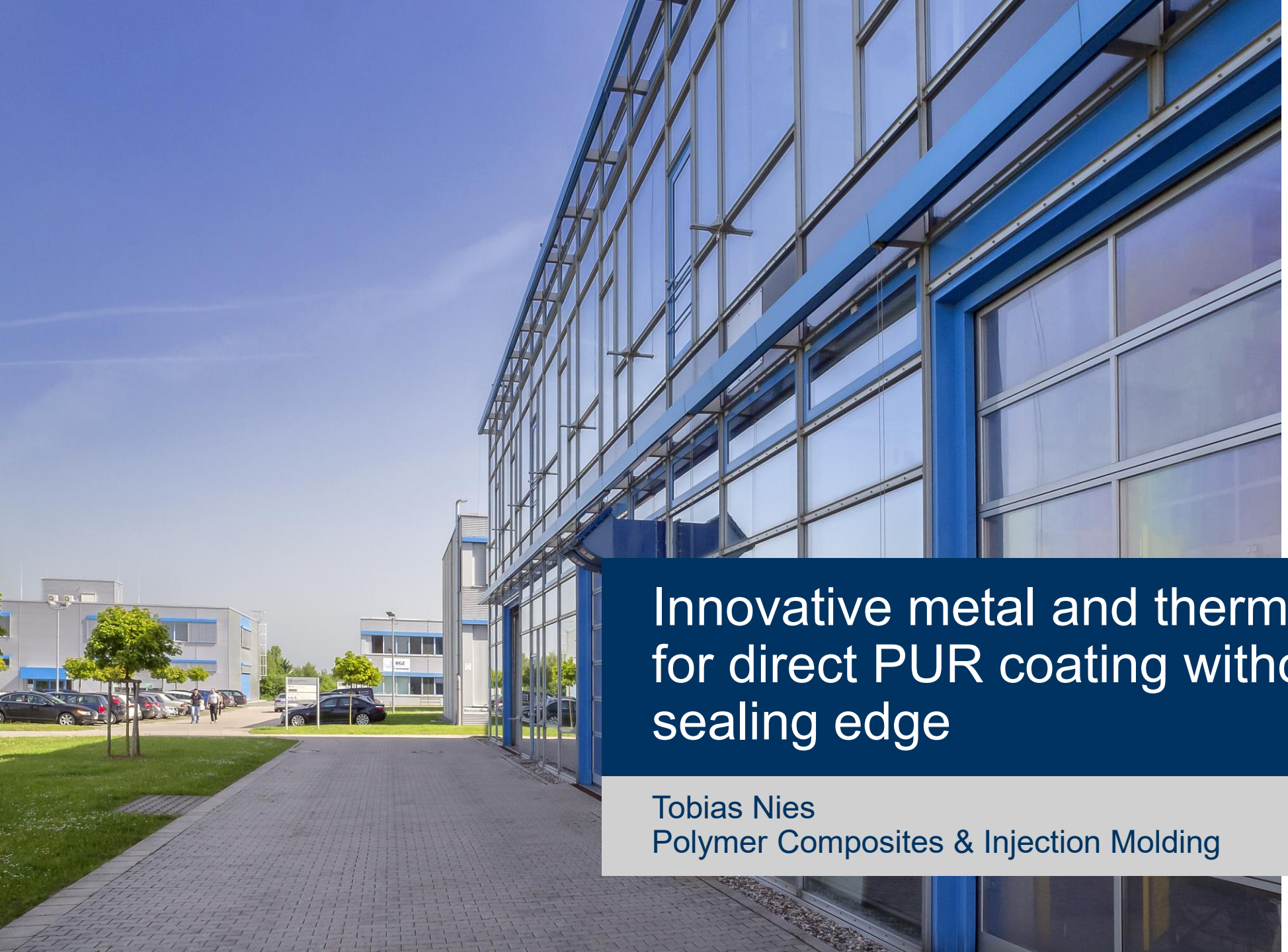


Neue Materialien Bayreuth

24.+25.02.2026

IMCcon 2026

Innovative metal and thermoplastics seals for direct PUR coating without visible sealing edge

Tobias Nies
Polymer Composites & Injection Molding

Applications of Polyurethane In-Mold Coating (PUR-IMC)

Automotive

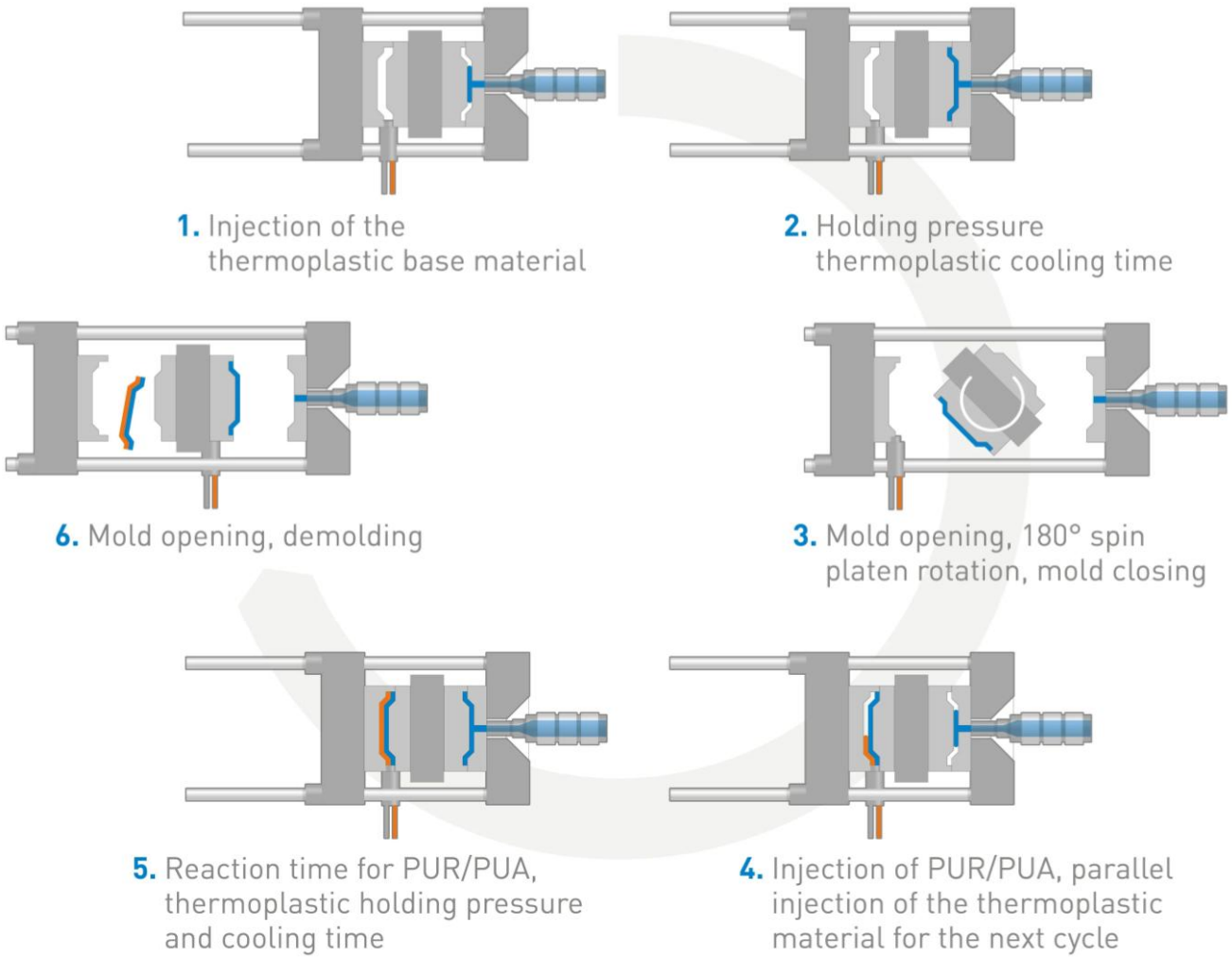
Everyday goods

PUR-IMC-coated Class-A-surfaces with PC or PC/ABS carrier and optional decorative PC-film

Special effects e.g. sensors or lightning beneath transparent coating

Picture source: © BMW AG, Daimler AG, KraussMaffei Technologies GmbH

Process of Polyurethan In-Mold Coating (PUR-IMC)



Picture source: © KraussMaffei Technologies GmbH

State-of-the-Art and Problem Definition

PUR resin

50 – 250 mPa•s

Water

1 mPa•s

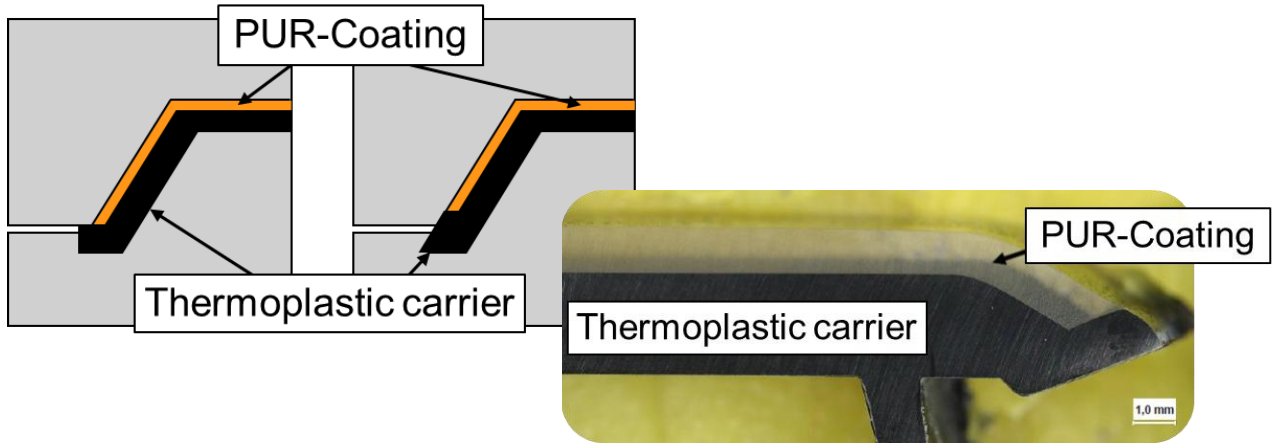
Olive Oil

100 mPa•s

Thermoplastic Melt

10,000 – 1,000,000 mPa•s

Flash at corner of PUR component



Direct sealing onto carrier

Picture source: polycpu.com; waykenrm.com; istock.com; europlas.com

Removing of Surrounding Edge

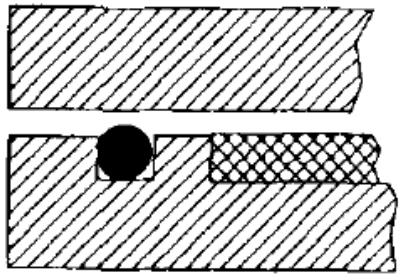
Manual Labor

Roboter Aided Milling

How do we solve this? What are current solutions?

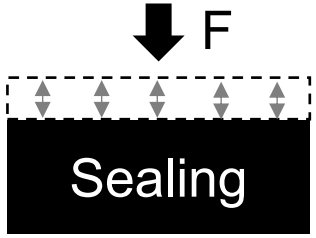
Possible Solution: Flexibel/compressible sealing around article geometry, but

- Needs to also **define geometry of product**
- Needs to withstand **closing force** and **inner pressures**
- Needs to **detach** from the **hardened resin easiliy** without residues

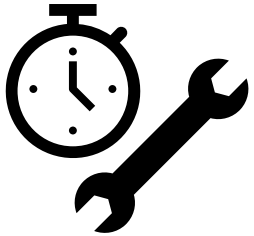


C. D. Rudd, „Mould design,“ in *Liquid Moulding Technologies*, Woodhead Publishing, 1997.
KraussMaffei, „Krauss Maffei: Polyurethan-Werkzeuge halten dicht,“ K-Aktuell, 28 06 2016.

Requirements for a new Generation of Sealings



Elastic deformation



Minimum service life
10,000 cycles

Sealing of viscosity
down to 50 mPa•s

Pressure resistance up
to 120 bar

Temperature resistance
up to 95 °C

No visible sealing
edge

Polyurethan Direct Coating Equipment @ NMB

One-Shot

Industrial scale

Injection molding

ENGEL 450 Duo

PUR coating

KraussMaffei, RimStar Flex 8-8

Two-Shot

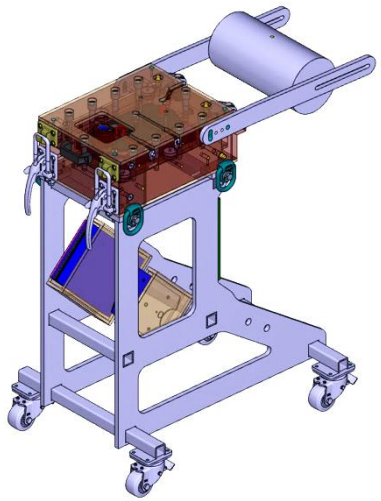
Lab scale

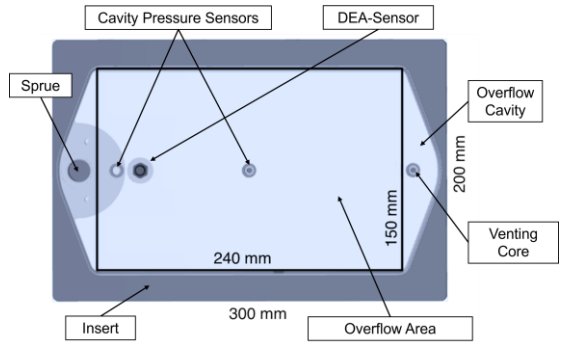
Injection molding

ENGEL 450 Duo

Insert
300 x 200 mm

PUR coating in standalone mold



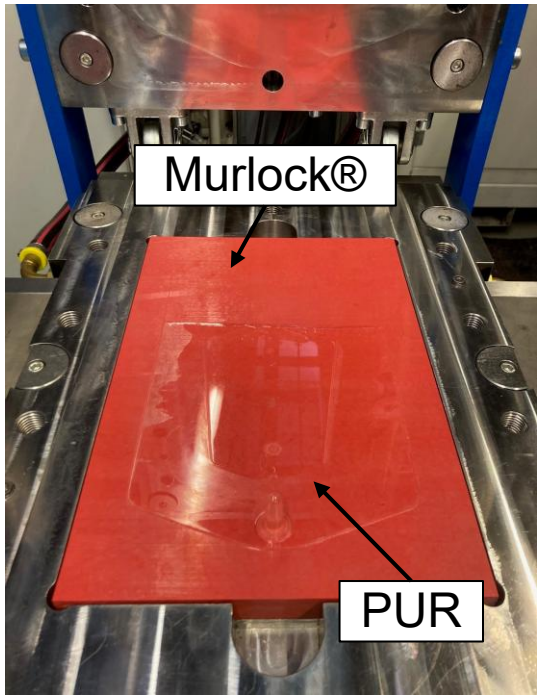


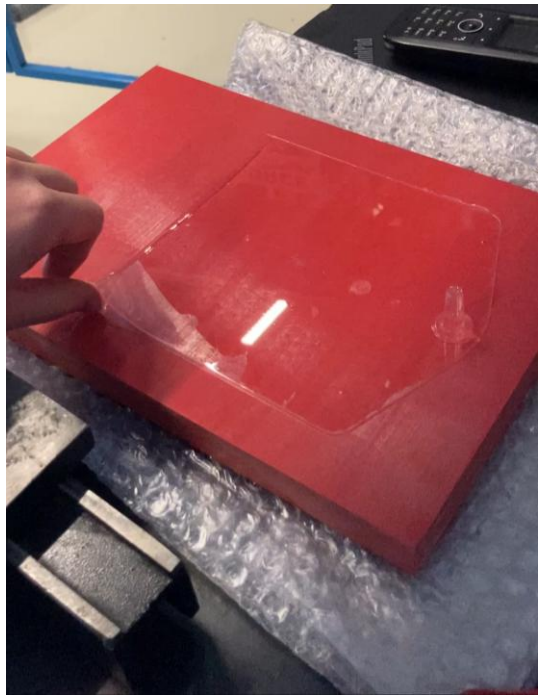
Picture source: Neue Materialien Bayreuth GmbH

Choices for Sealing Materials within Project

High Performance Thermoplastics

→ PEEK-based Murlock®
from **MURTFELDT GmbH & Co. KG**





Bulk Metallic Glasses

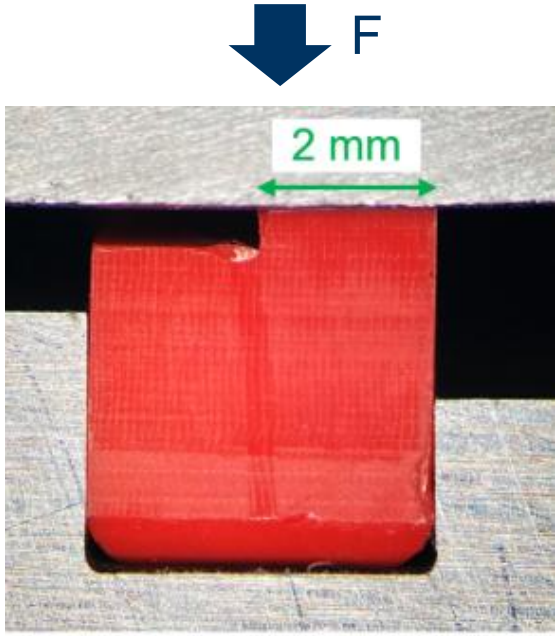
→ Zr-based ZR01; 3D-printed
from **Heraeus Amloy Technologies GmbH**

Picture source: MURTFELDT GmbH & Co. KG, Heraeus Amloy Technologies GmbH

Iterative Design of the Sealing Elements

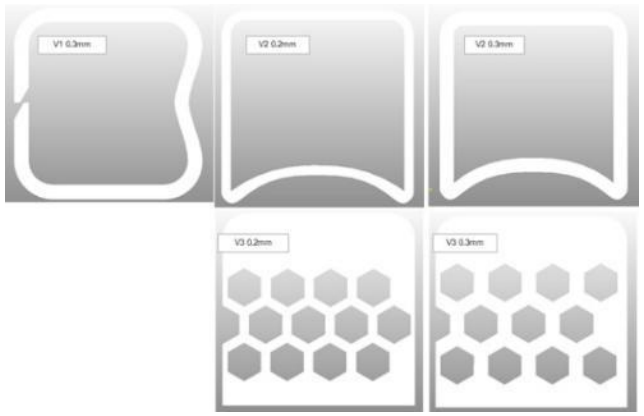
PEEK-based:

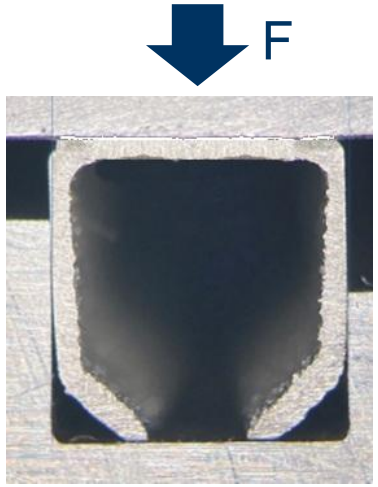
- Thicker base for stability
- 2 mm sealing edge



Metal-based:

- Iterative adjustment of cross-ection for enhanced elasticity

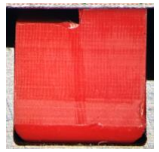


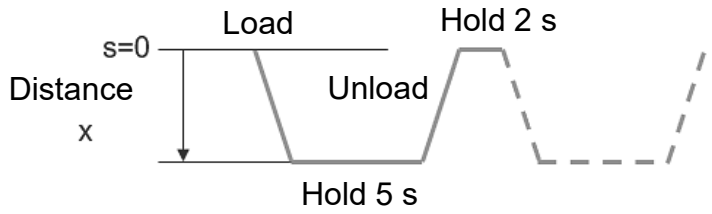


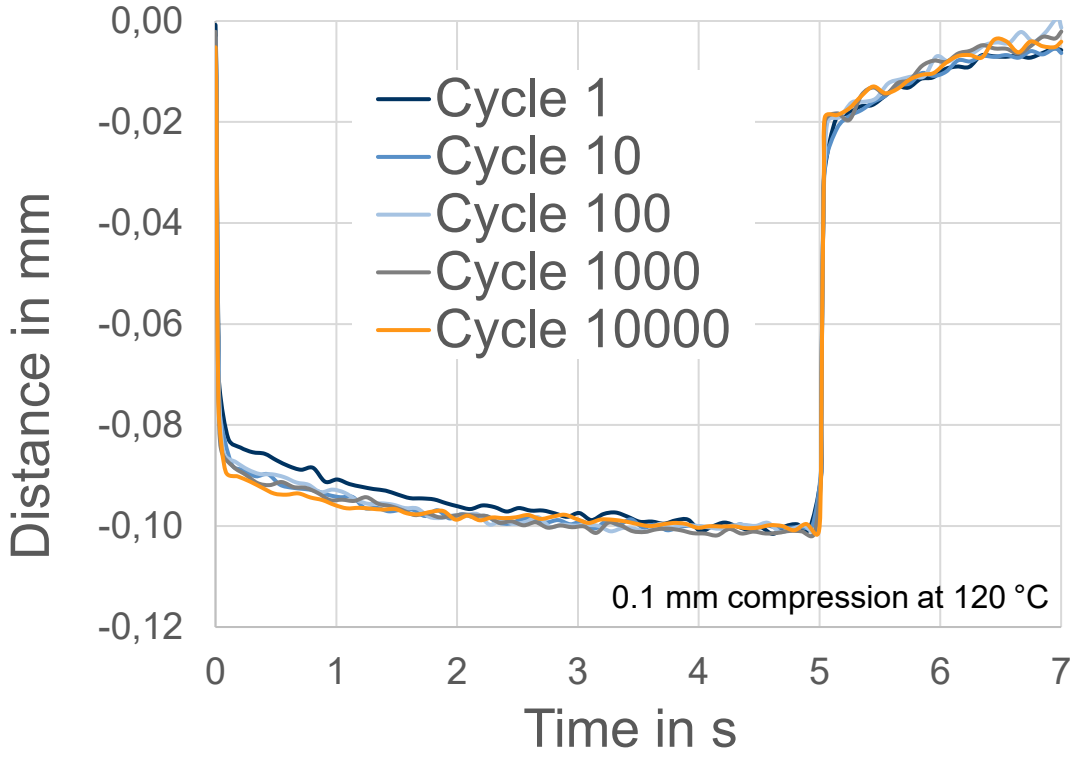
Picture source: Neue Materialien Bayreuth GmbH, Heraeus Amloy Technologies GmbH

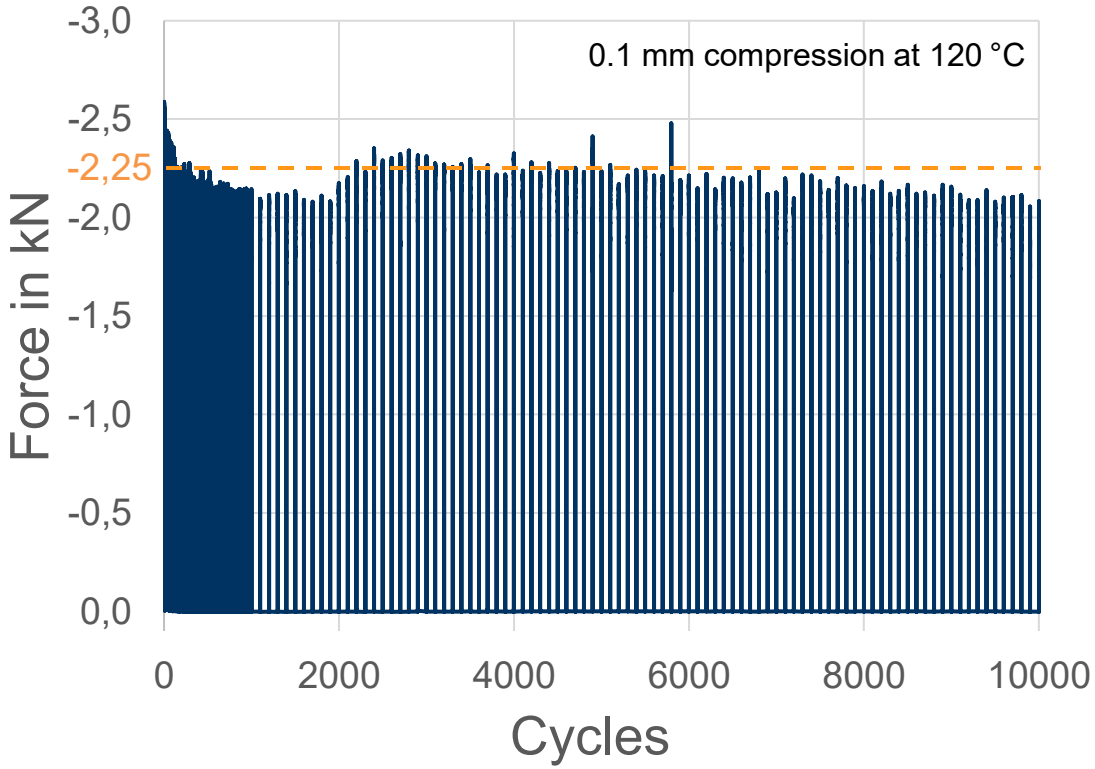
Life Analysis of 2D Seals

PEEK-based Murlock® from MURTFELDT GmbH & Co. KG



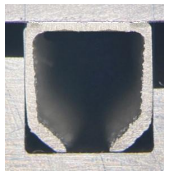


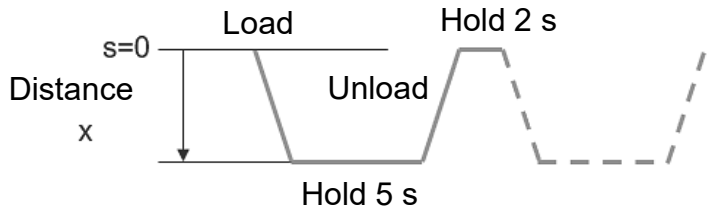


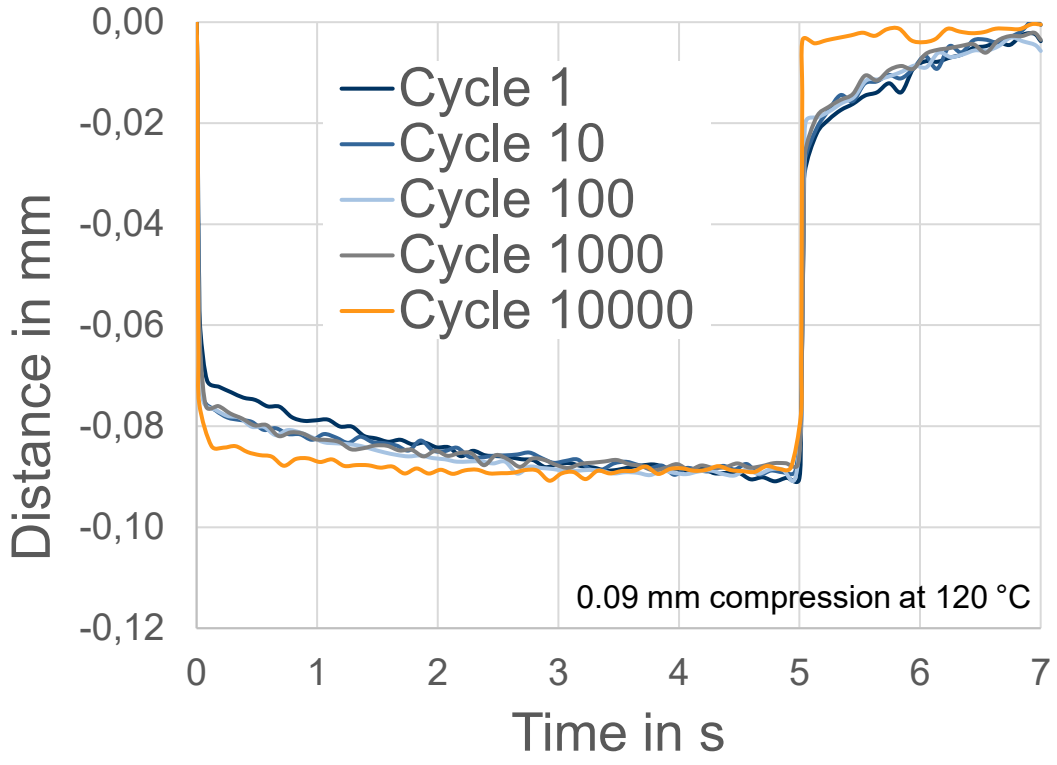


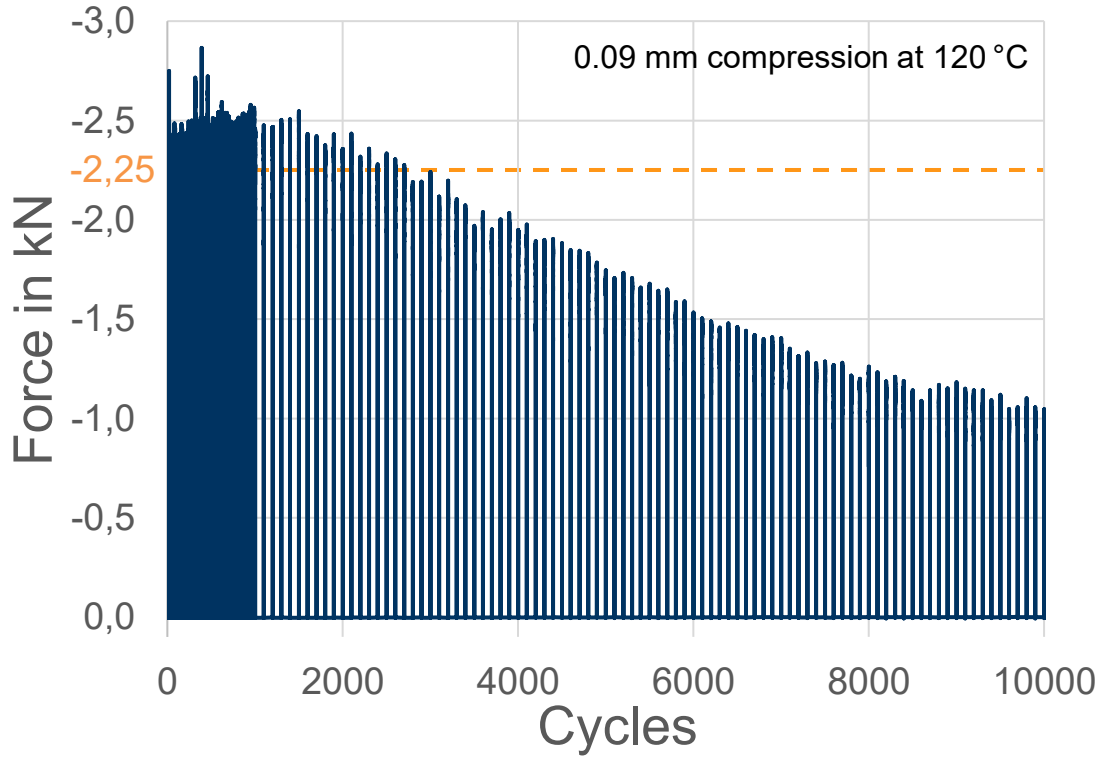
Life Analysis of 2D Seals

Zr-based ZR01 from Heraeus Amloy Technologies GmbH

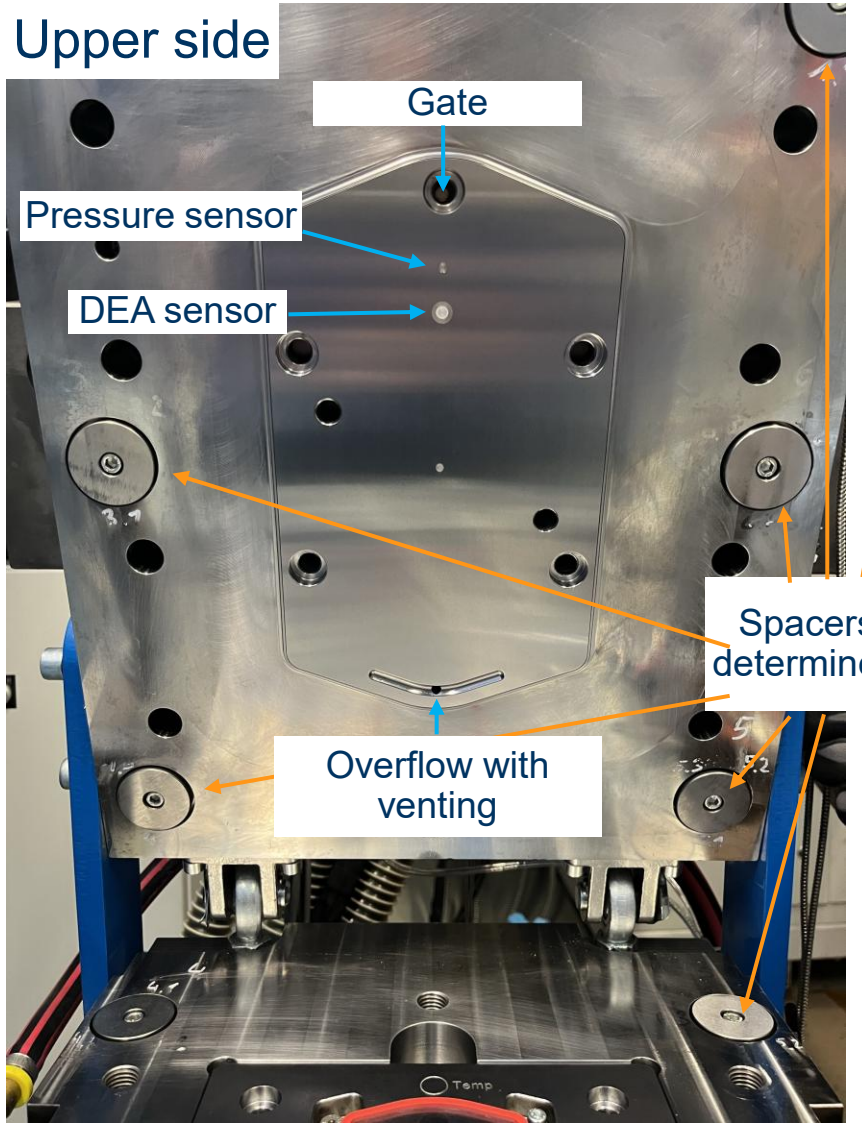


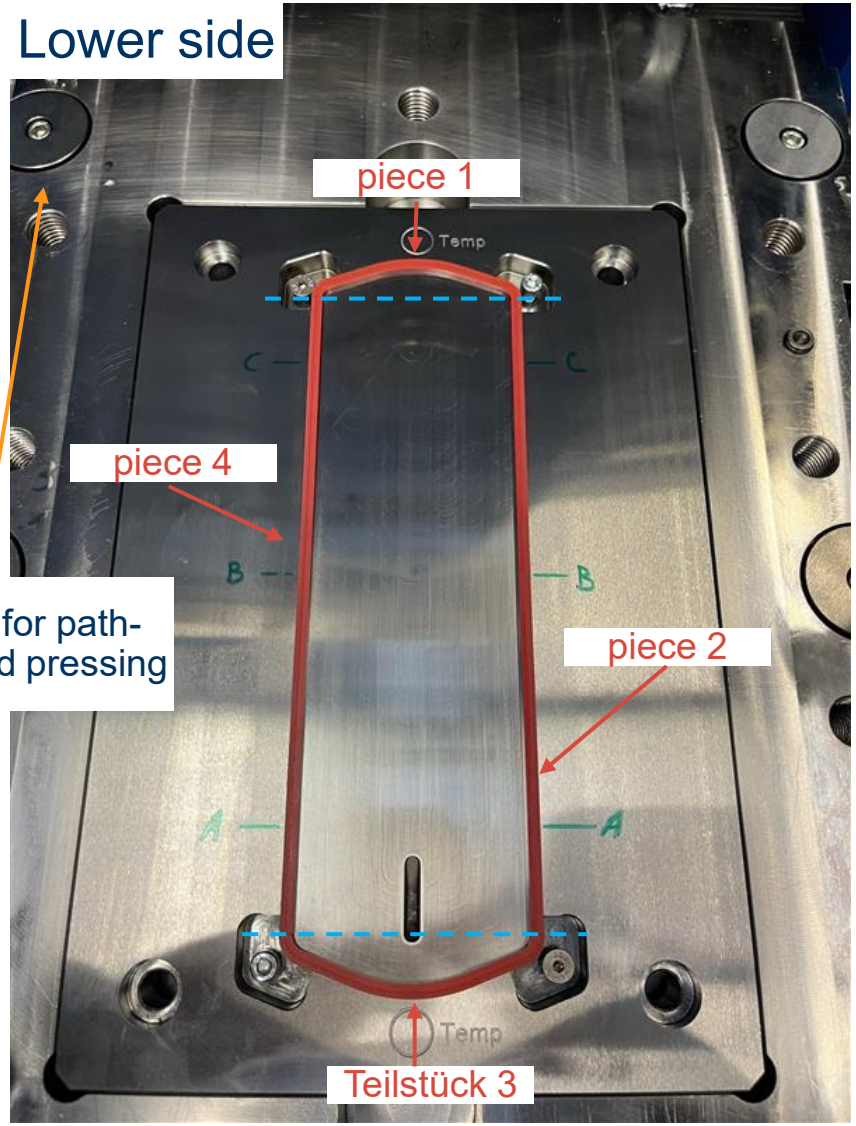






Mold setup



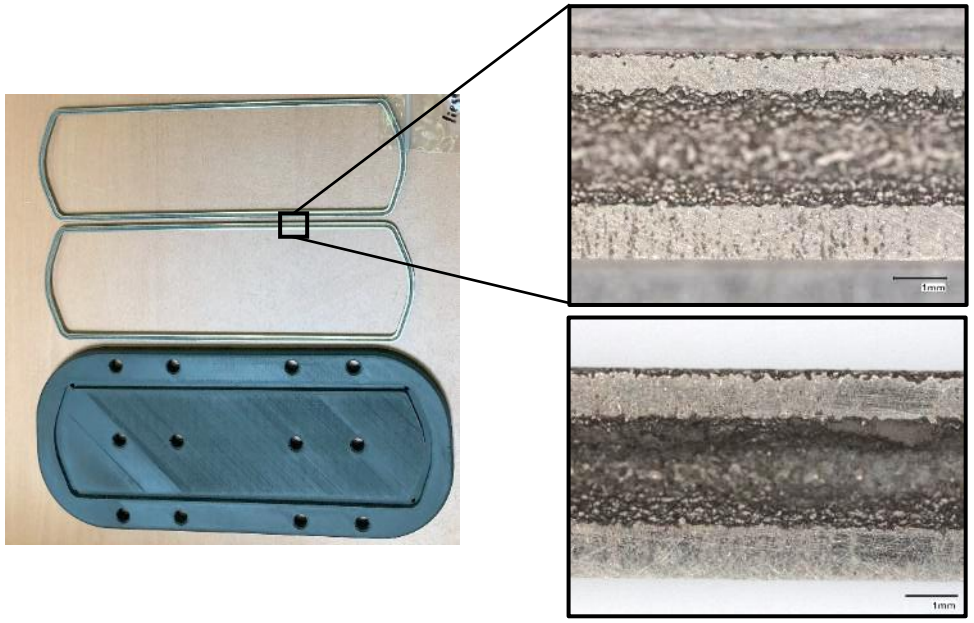


- Temperature control
- PEEK-based seals (4-piece) inserted (fixation by thermal expansion)
- Sealing to top side (inside in contact with PUR)
- Top surface polished and hardened
- Pneumatic vent core at the end of the flow path

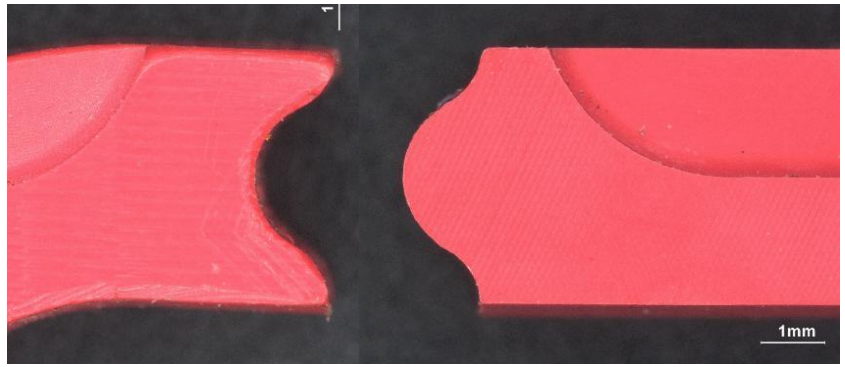
Picture source: Neue Materialien Bayreuth GmbH

Lessons learnt from 2D-trials

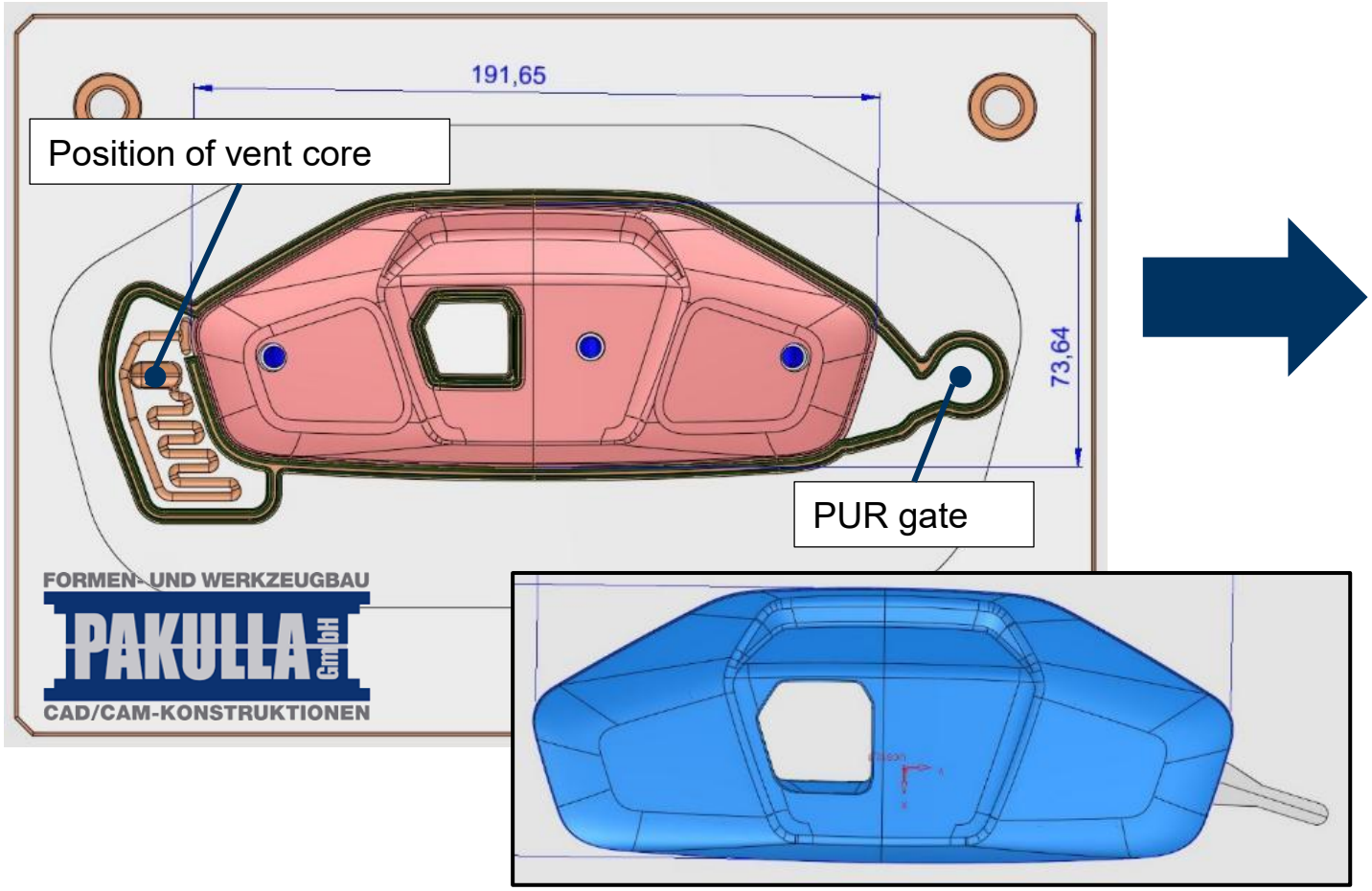
- Polishing of surface (thermoplastic + metal)
  → high impact on edge quality



- Connection at a butting edge shouldn‘t be flat



Transfer of results to the actual 3D-part



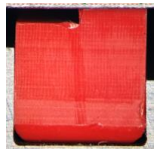
Demonstrator Geometry

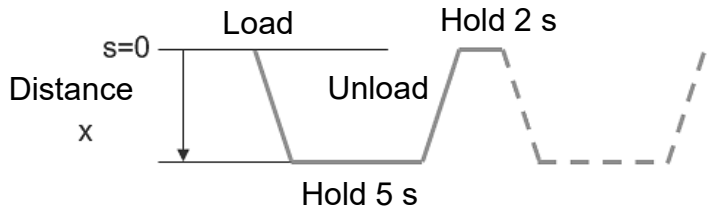
- Car interior lamp
- Breakthrough geometry for SOS button

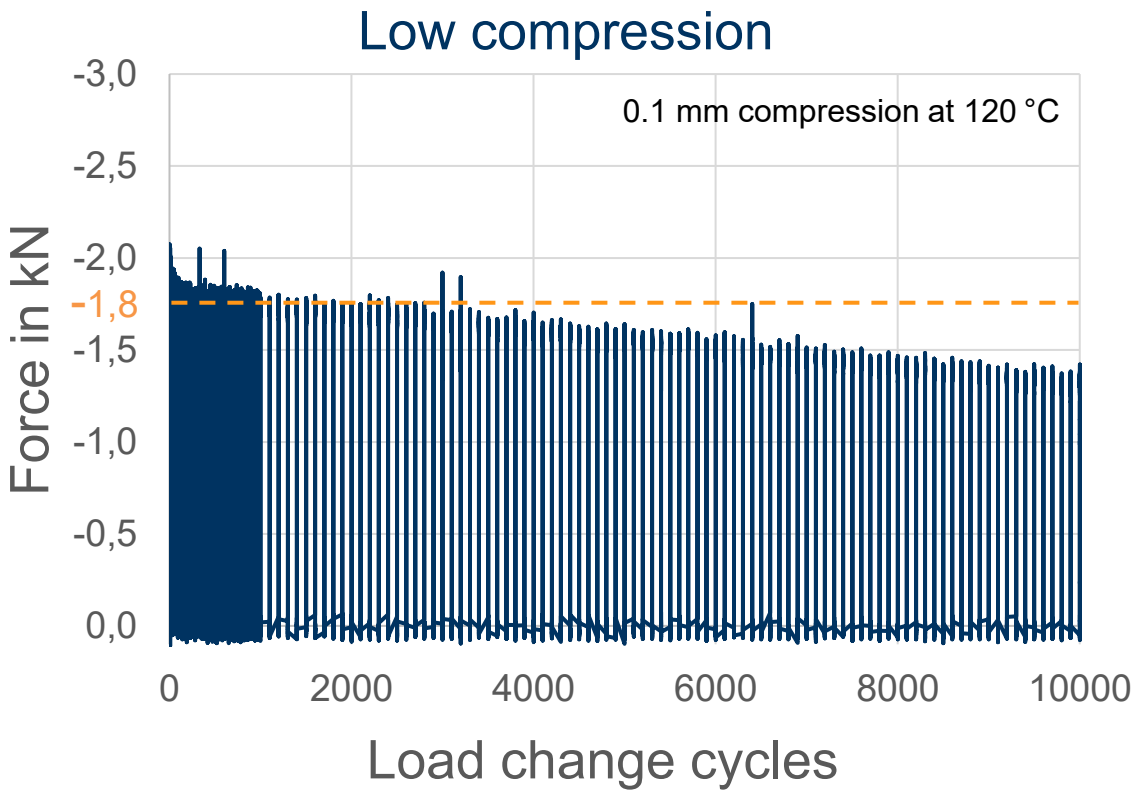
Picture source: Pakulla GmbH, Neue Materialien Bayreuth GmbH

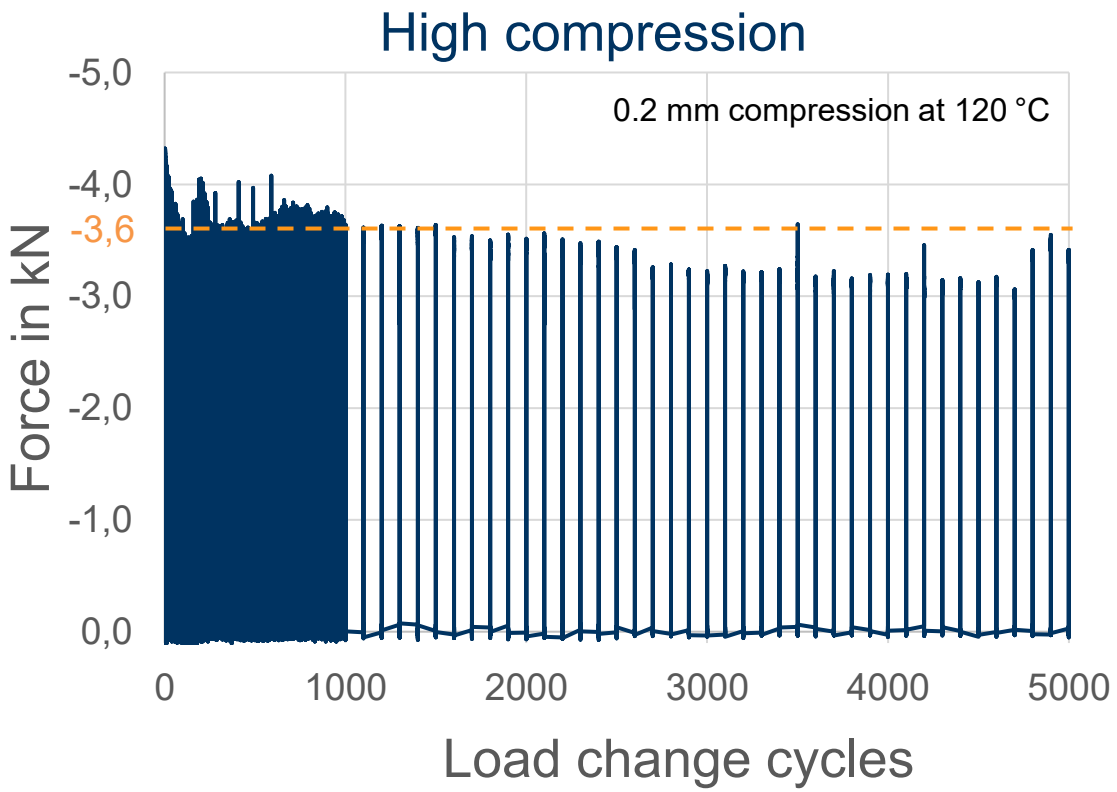
Life Analysis of 3D Seals

PEEK-based Murlock® from MURTFELDT GmbH & Co. KG



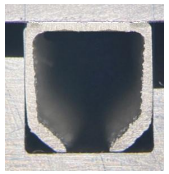


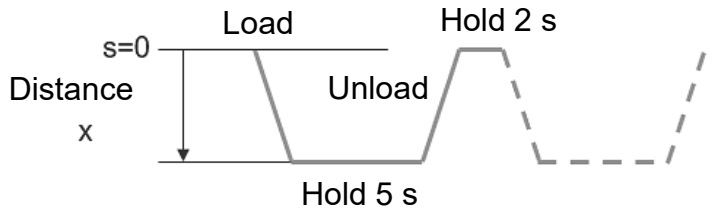




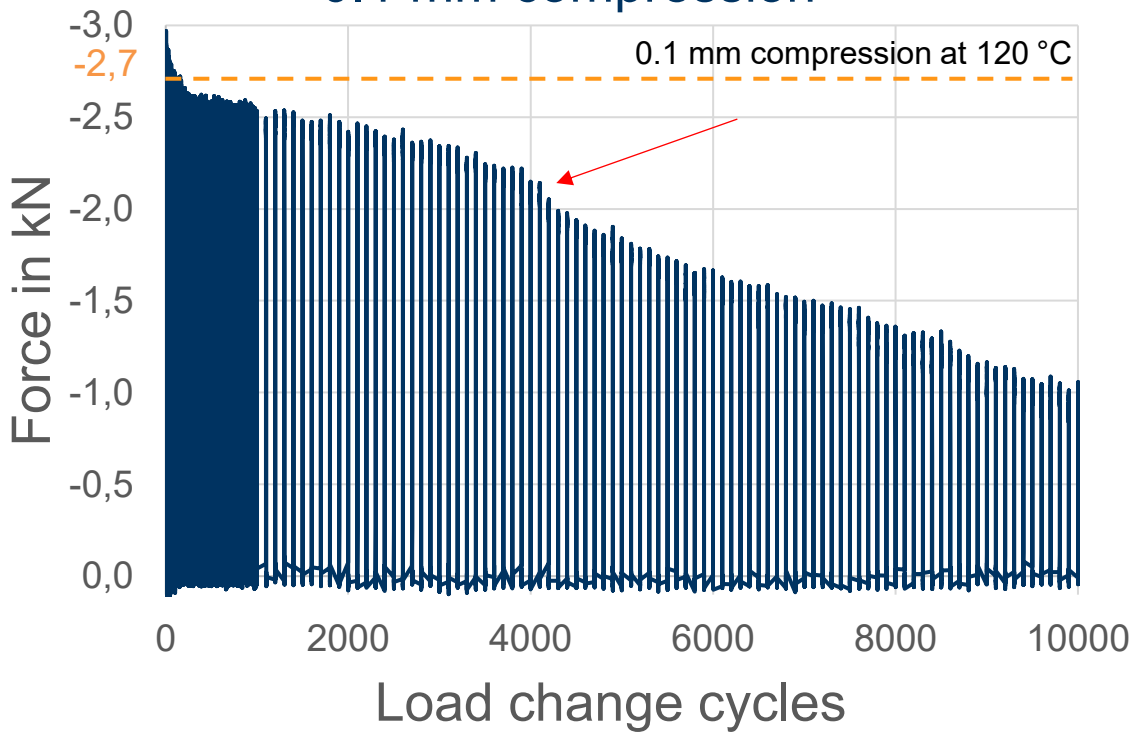
Life Analysis of 3D Seals

Zr-based ZR01 from Heraeus Amloy Technologies GmbH

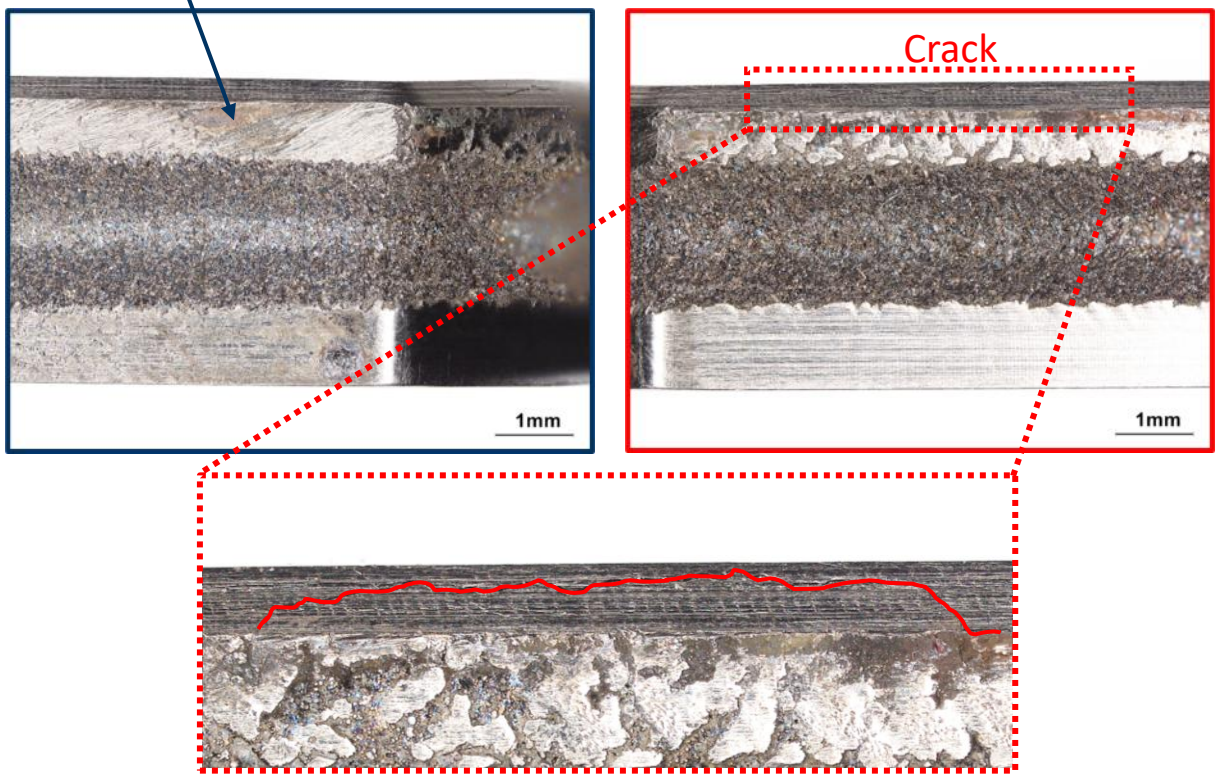




0.1 mm compression



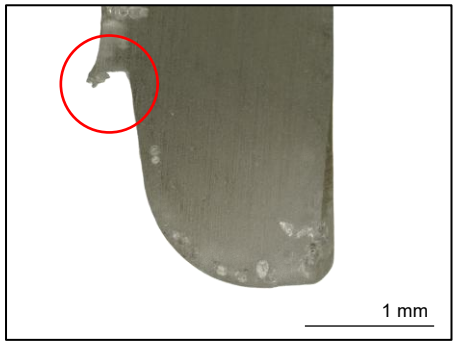
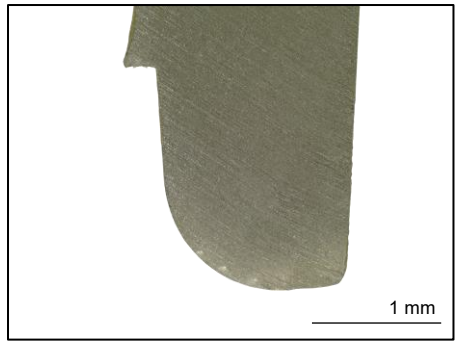
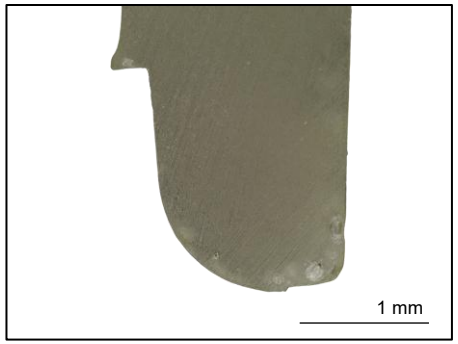
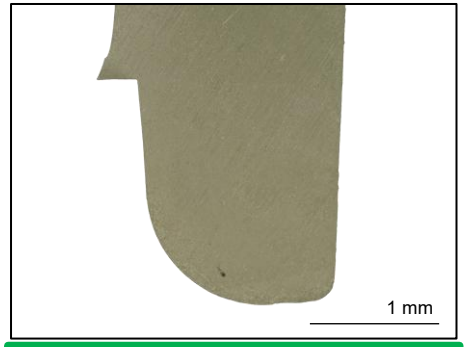
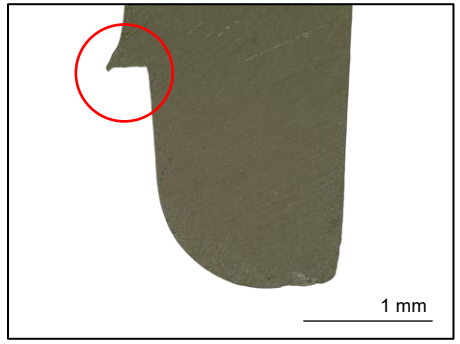
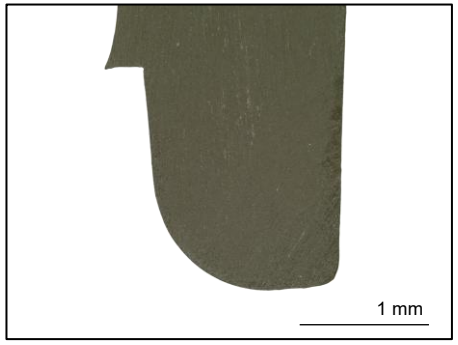
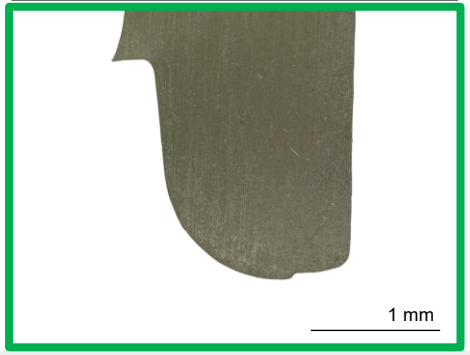
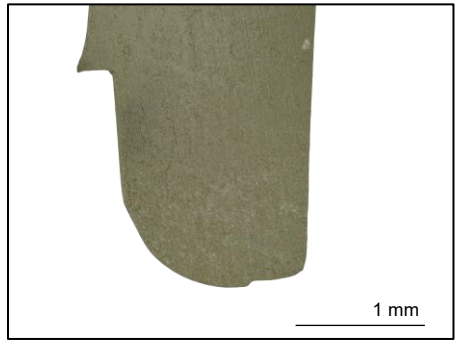
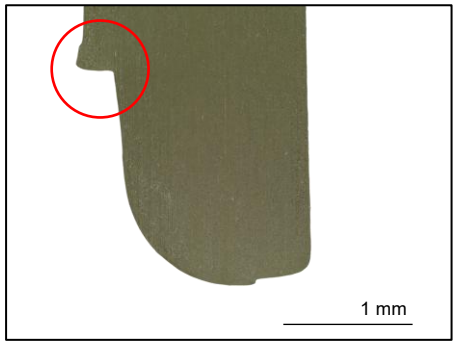
Friction corrosion



Process-related Factors affecting the Sealing

Mold temperature in °C

Compression in mm

	90	100	110
0,05			
0,10			
0,15			

31g Shot weight
15 g/s Output rate
85 °C PUR temp.

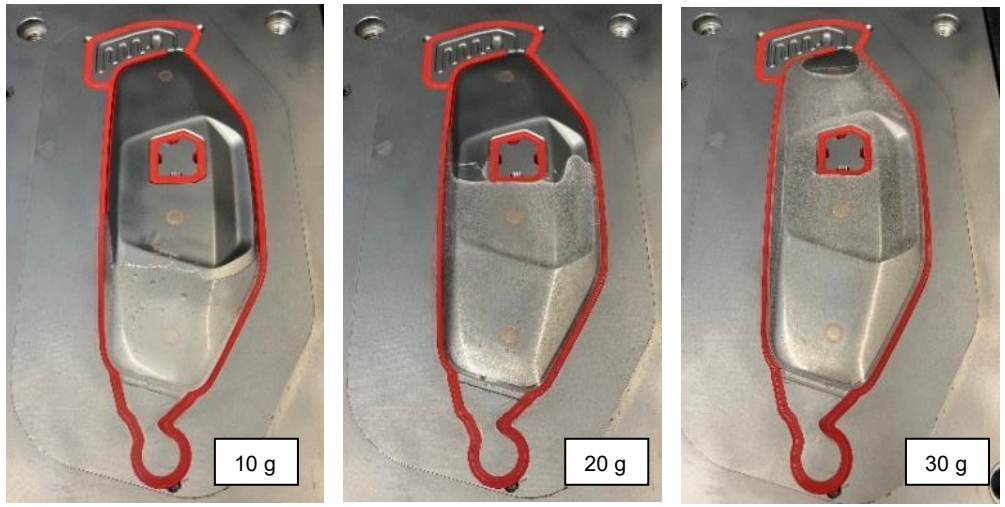
Murlock ®

Compression ↑ ↓ Mold temp. ➡ Flush ↓

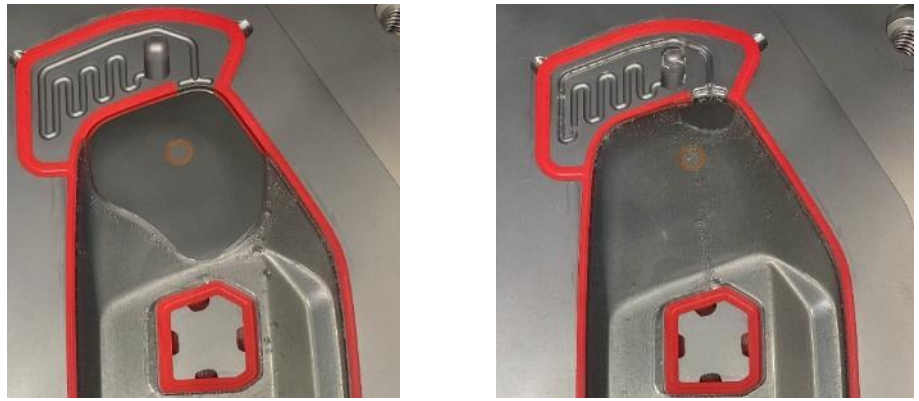
Slides © Neue Materialien Bayreuth GmbH

Results for Trials with 3D Geometry

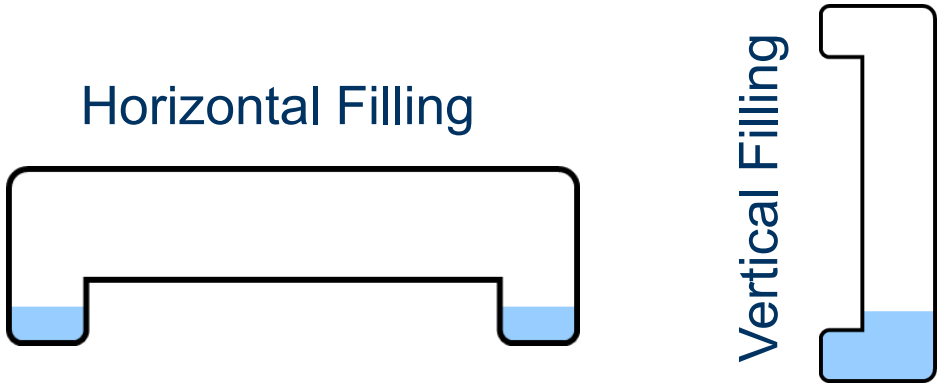
Filling of 3D cavity



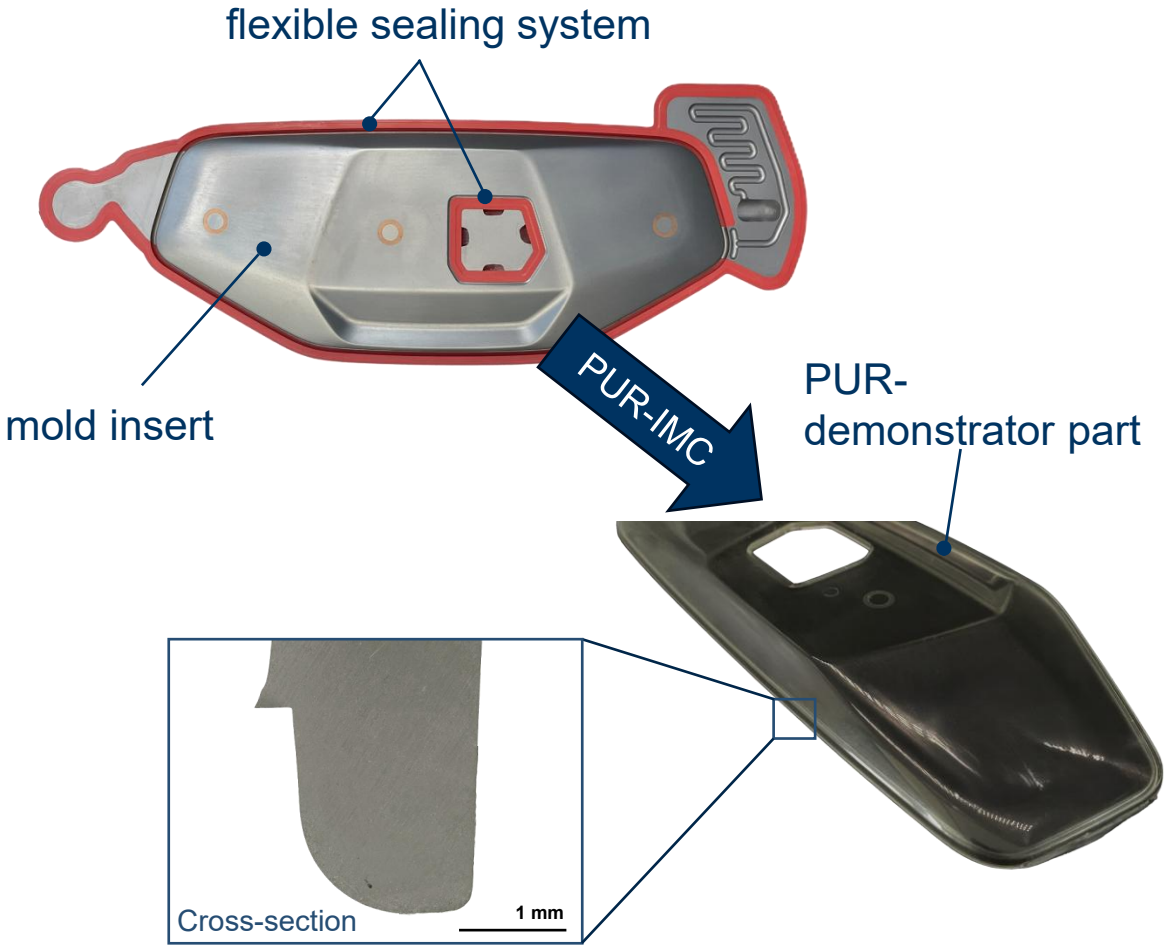
Entrapped air at end of flow path



Gravity influenced flow of water-like PUR



Flexible sealing systems for PUR In-Mold coated components



- **Contour-close sealing with high design freedom**
- **Identical mold pressure compared to the state of the art**
- **flash-free processing without reworking at the sealing edge**

Supported by:
ZIM Zentrales Innovationsprogramm Mittelstand
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

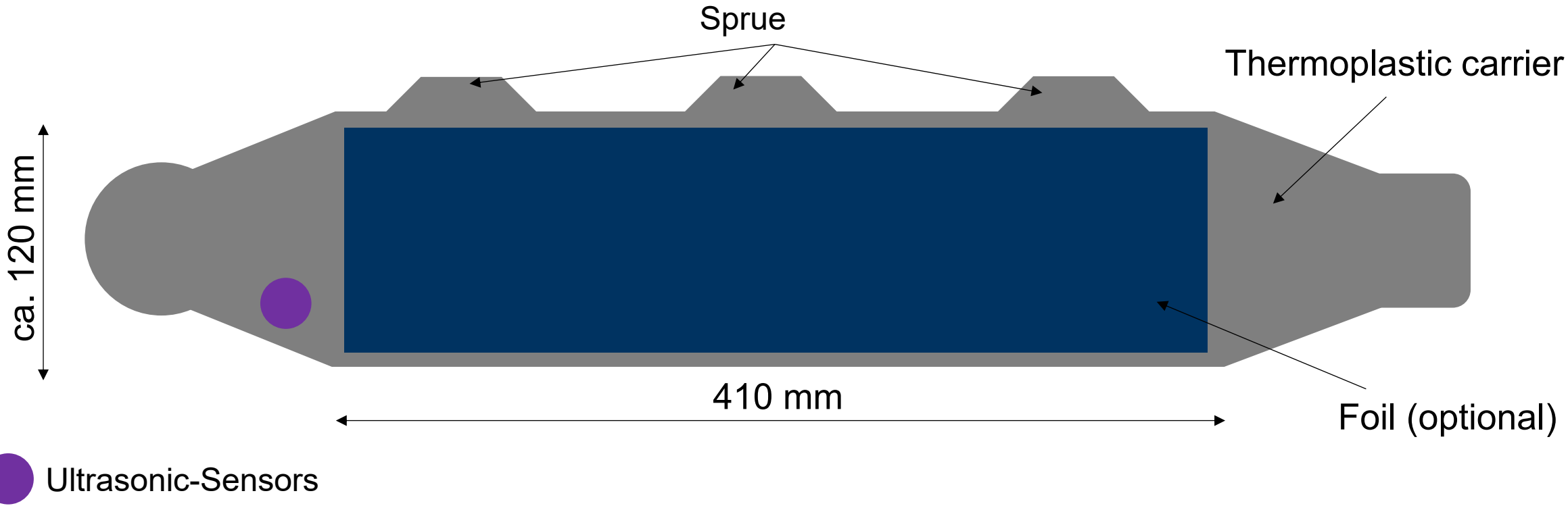
Heraeus AMLOY · FORVIA HELLA · Murtfeldt Kunststoffe · CAD/CAM-Konstruktionen Pakulla GmbH Formen- und Werkzeugbau

BMWK/ZIM-Project: IMC-Seal3D, FKZ: 16KN097323, 10.23 – 09.25; Picture source: Neue Materialien Bayreuth GmbH

ENGEL 450 Duo: Carrier side - Thermoplastic

Available @NMB
from the end of Q1/2026
currently in manufacturing

- Processing of PC, PP, PA & PC/ABS with up to 40% by weight talc and glass fiber
- Thermoplastic carrier plates from **1 – 6 mm** (0.5 mm increments)
- → 410 x 110 mm rectangle without marks from sprue, sensors, …
- **Back injection of foils** possible (foil fixation via vacuum)
- Separate temperature control of the mold halves



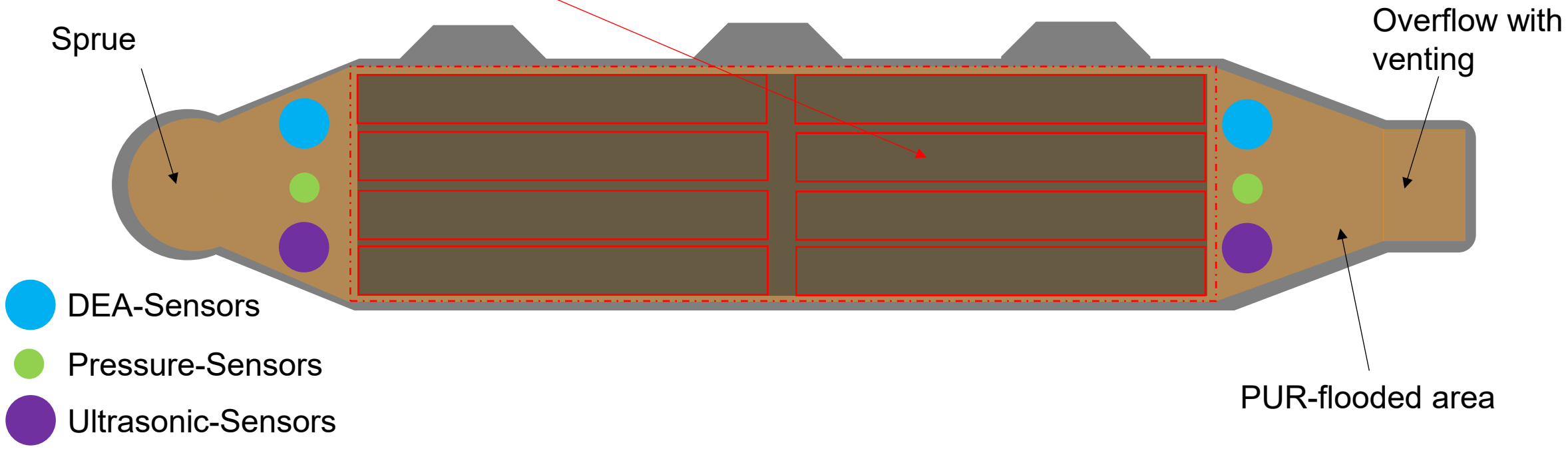
Picture source: Neue Materialien Bayreuth GmbH

ENGEL 450 Duo: Coating side - Polyurethane

Available @NMB
from the end of Q1/2026
currently in manufacturing

- Processing of **transparent and colored polyurethane** systems
- **Different wall thicknesses** of the polyurethane layer (0.2 mm to 2.0 mm) can be achieved using interchangeable inserts (currently **0.5 mm** and **1.0 mm** available)

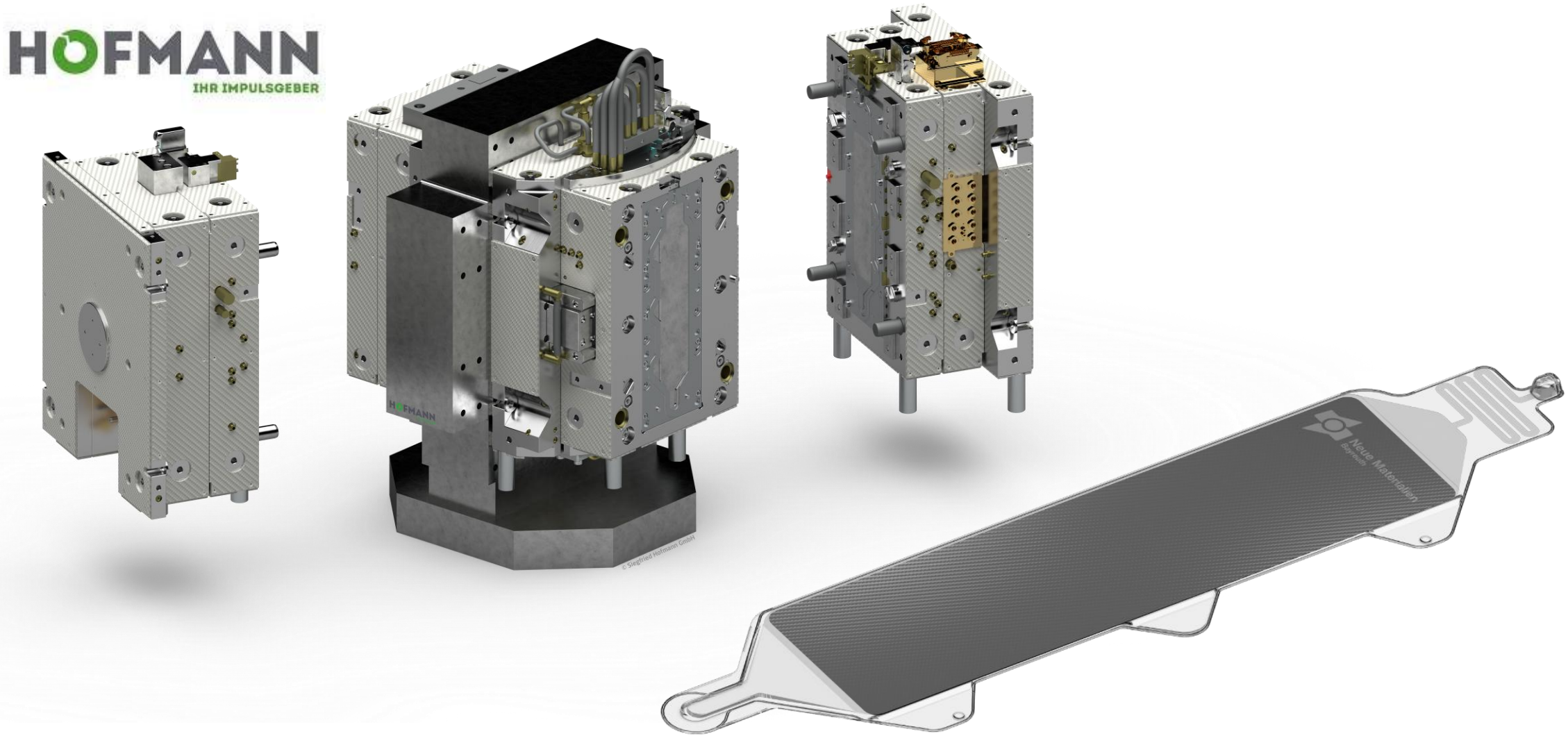
PUR-coated area for test specimens 410 x 110 mm
→ 8 test specimens 200 x 25 mm (roll peel tests)
→ 16 test specimens 50 x 50 mm (PosiTest)



Picture source: Neue Materialien Bayreuth GmbH

Rendering of Mold and 2K-PUR-Component with Foil

Available @NMB
from the end of Q1/2026
currently in manufacturing



Picture source: Siegfried Hofmann GmbH; Neue Materialien Bayreuth GmbH

Thank you very much

for your attention

Tobias Nies
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