



**Dow Centennial Centre  
Fort Saskatchewan, Alberta  
Oct. 25, 2018**

# **Redura® Sealing Systems & Persisto® Materials**

**David Flood, Burckhardt Compression**

## **2018 Maintenance, Reliability, Operations Technical Conference**



**2018 - MRO Technical Conference and Workshops**

# Agenda

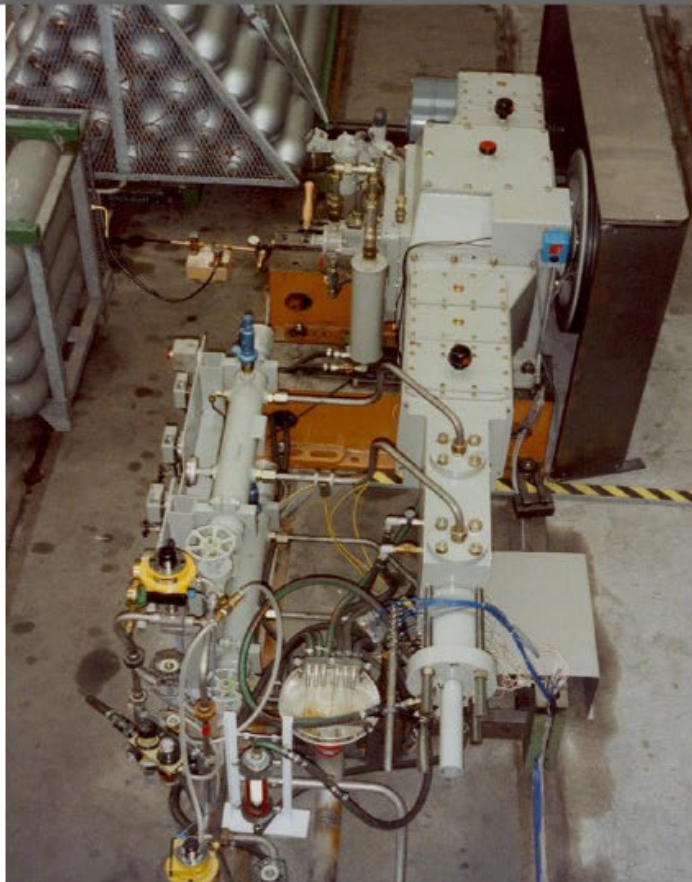
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- **The sealing philosophy**
- **Rings & Packings**
- **Materials**



# Research & Development – Test Compressors

Nitrogen compressor

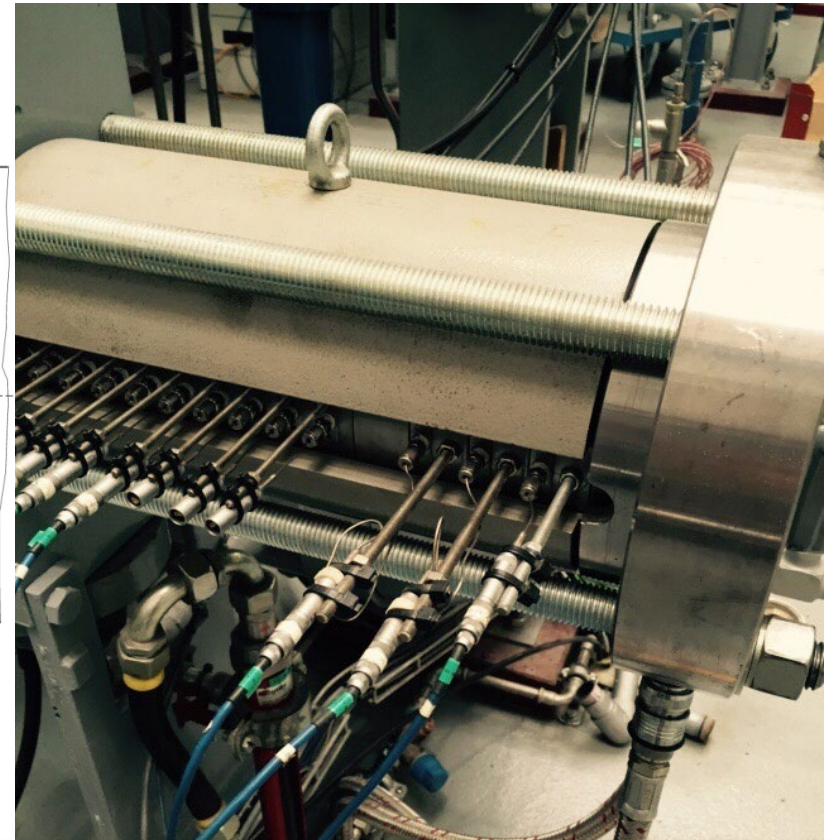
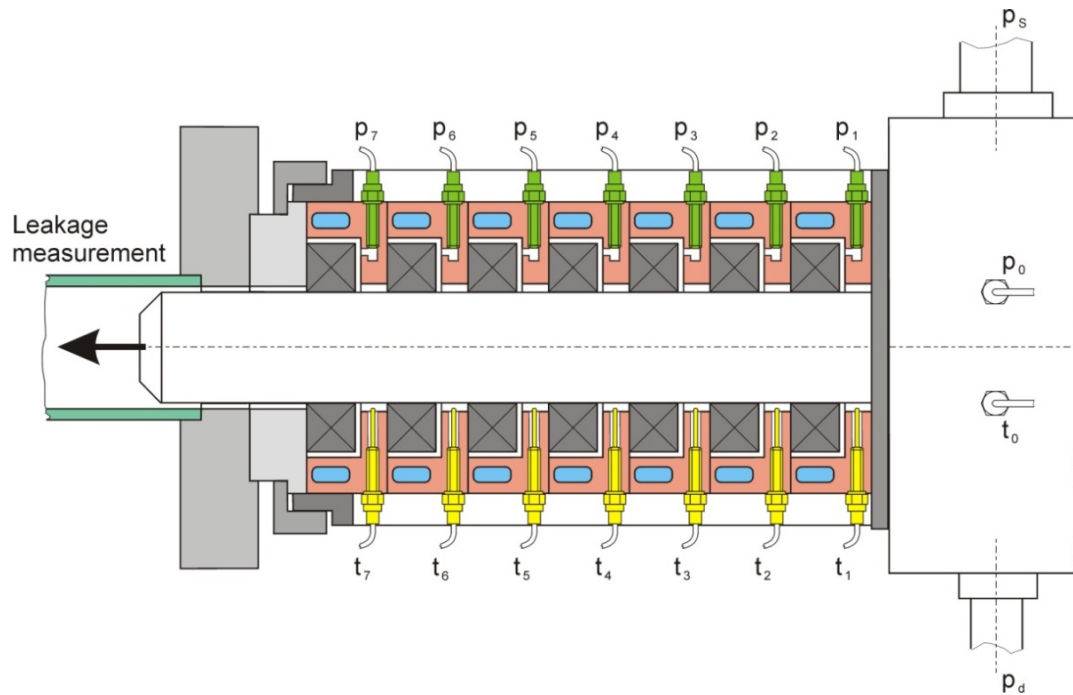


Hydrogen compressor





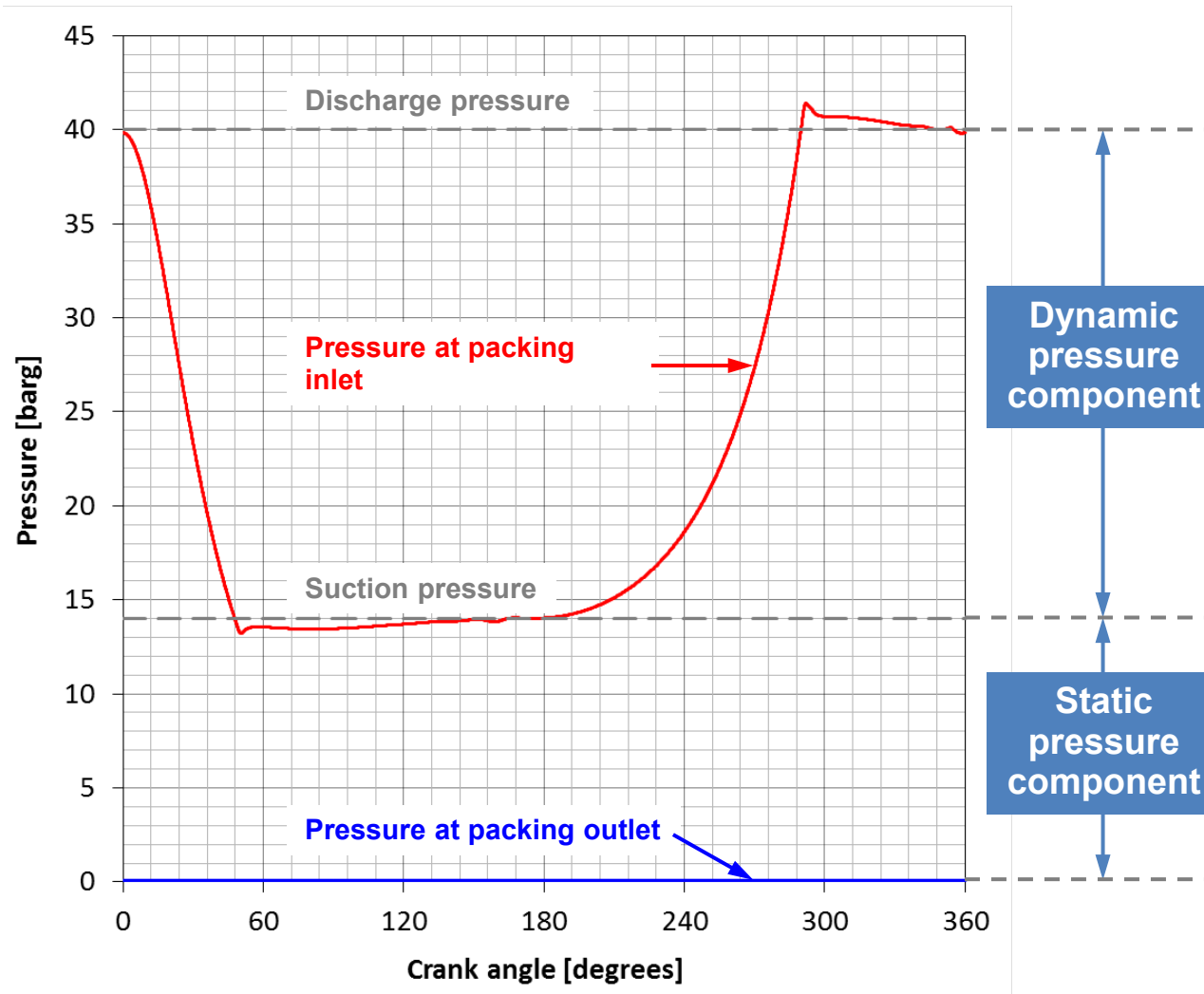
# Research & Development



Schematic representation with pressure and temperature sensors

Test packing of variable overall length

# Pressure



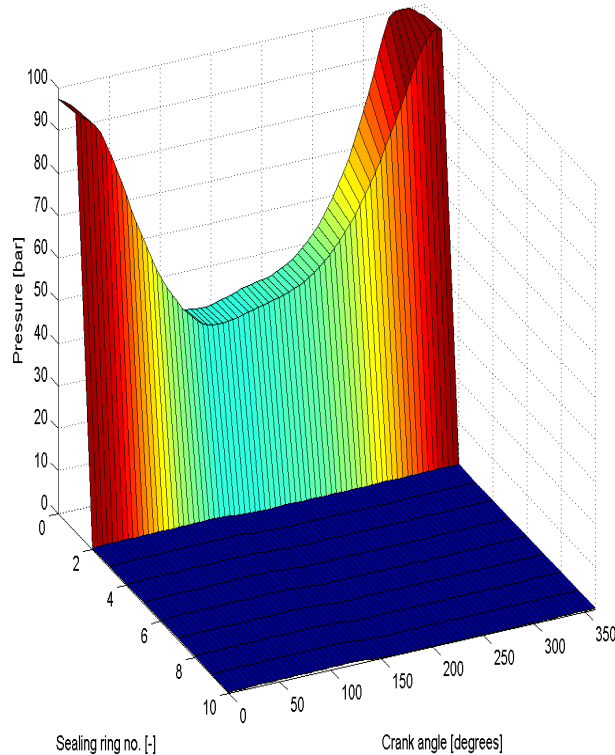


## Components of pressure

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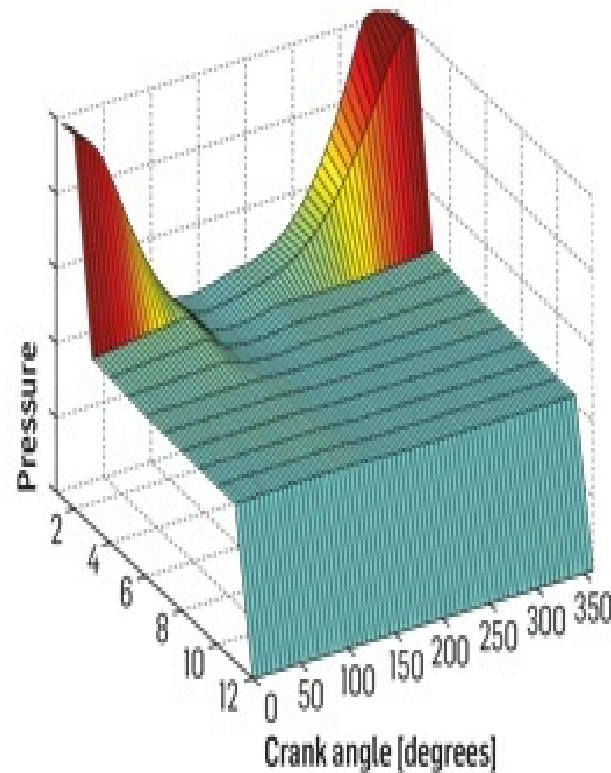
- The "**dynamic pressure component**" is the difference between final pressure and suction pressure of the respective compression stage
  - The "**static pressure component**" is the difference between the suction pressure and the pressure after the last sealing element
    - Ambient pressure for a packing assembly
    - Suction pressure of the same or a lower compression stage
  - The two pressure components differ considerably in terms of their influence on the sealing system's operational behavior!
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# Various pressure distributions of packings



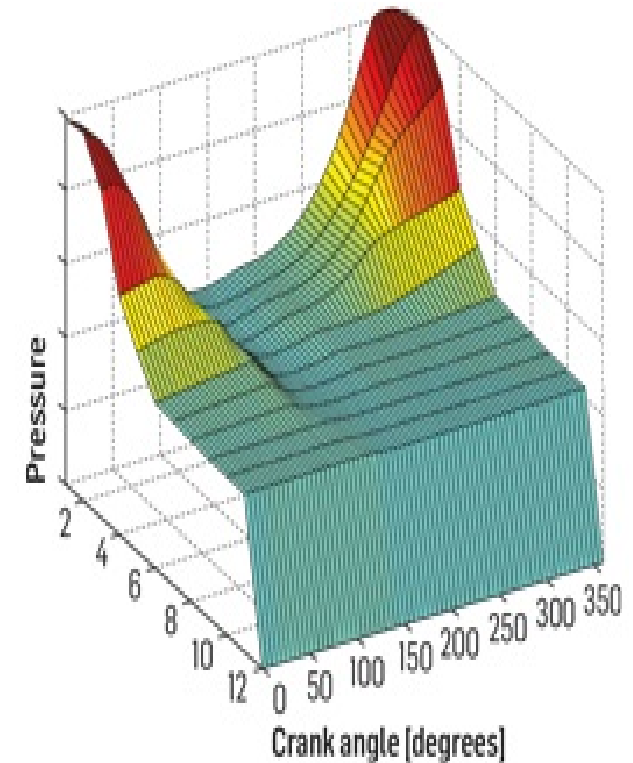
### Gas-tight sealings:

Dynamic and static pressure component sealed by only one sealing element



### Standard sealings:

Dynamic and static pressure component sealed by different sealing elements

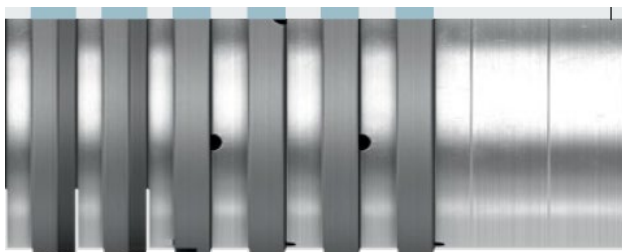


### Optimized sealings:

Dynamic pressure component distributed over several sealing elements

## Dynamic pressure:-

- Causes high wear and failure by fracture.
- During suction stroke, pressure-relief into the compression chamber are required. Allowing the hot gas generated in the compression stroke to be released.
- Pressure-relief grooves can either be on the sealing elements or the groove of the piston or the packing cup. This has no influence on leakage.

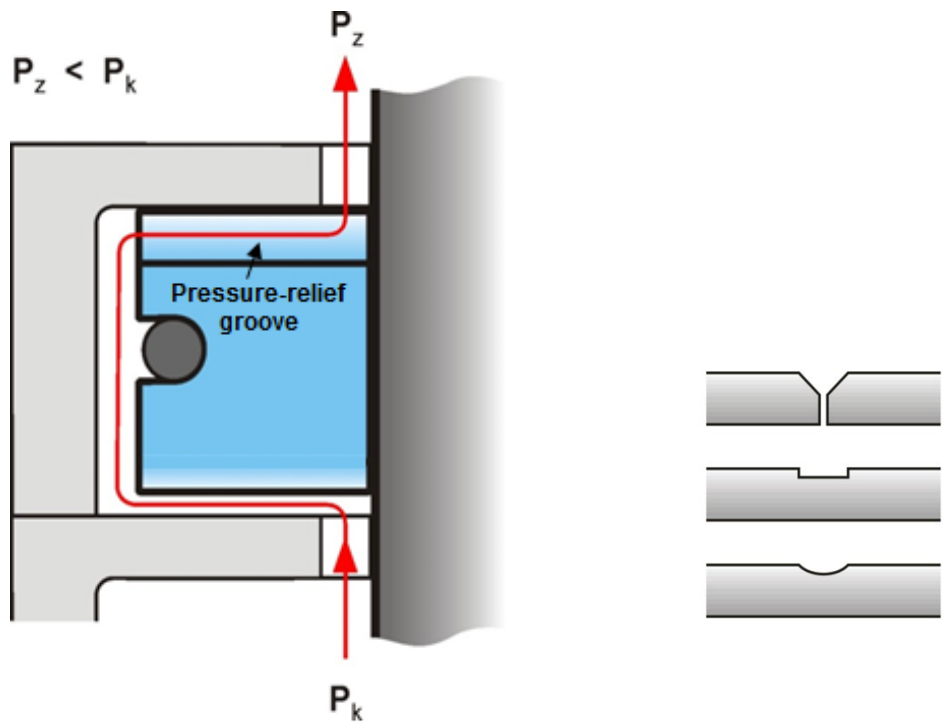


PRESSURE BREAKER





# Effect of pressure relief grooves



- Reduce negative impact of dynamic pressure component on sealing rings
- Allow cooling effect of expanding gas



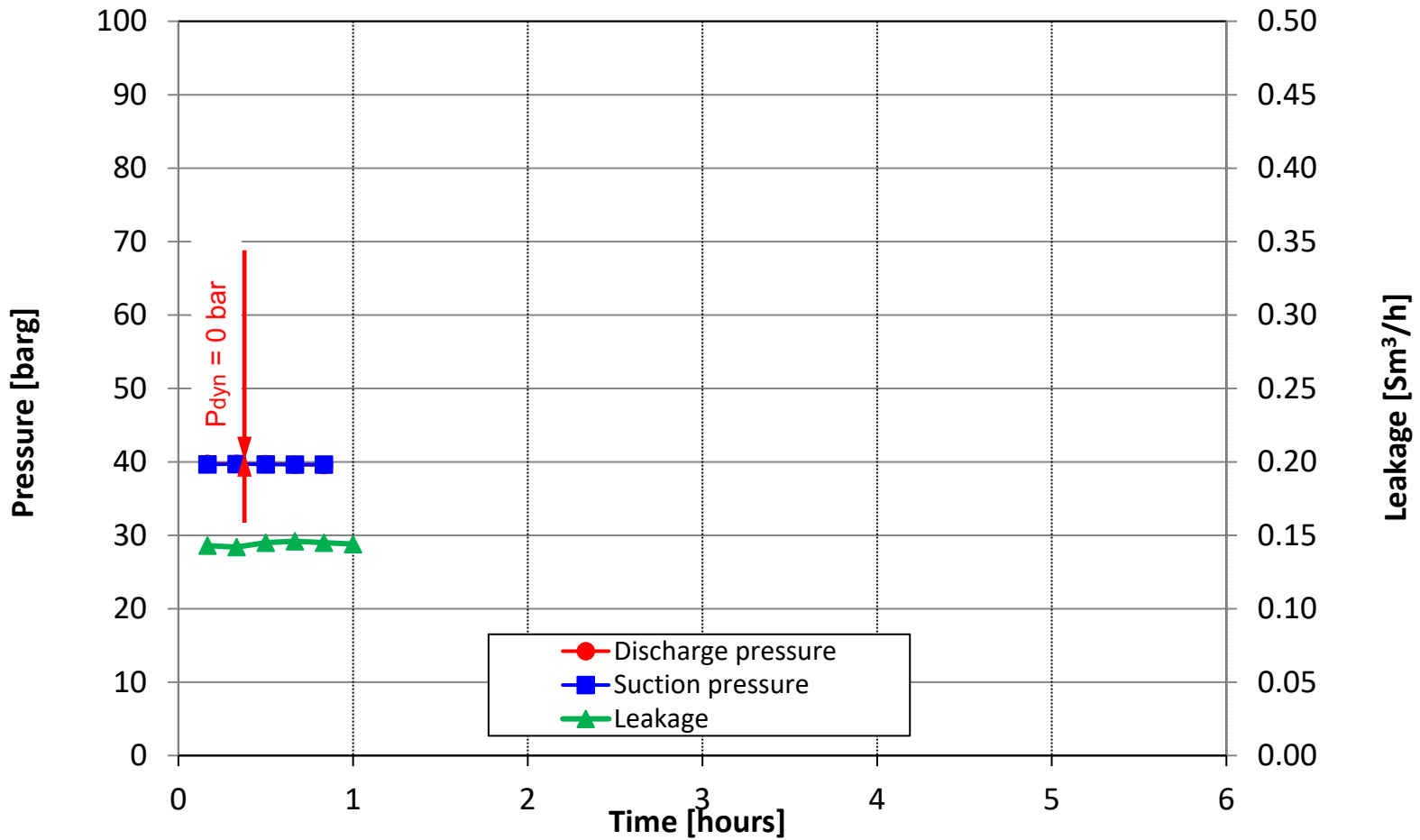


## Static pressure:-

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- **Static pressure component is constant during a crankshaft revolution**
  - **Static pressure difference constitutes the primary parameter influencing the leakage rate, therefore placing the highest demands on sealing elements**
  - **Maximum allowable value for the static pressure difference is an important criteria for determining the use of a dry-running sealing system**
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# Effect on leakage by Dynamic pressure





## Examples of systems (discharge pressure 100bar)

Sealing system	Suction pressure [barg]	Static pressure after last sealing element [barg]	Dynamic pressure component [bar]	Static pressure component [bar]
Piston - Double acting	40	40	60	0
Piston - Single acting	40	16*	60	24

**For successfully designing Redura® sealing systems:  
“We think in pressure components rather than final pressures!”**



# Optimized sealing system configuration

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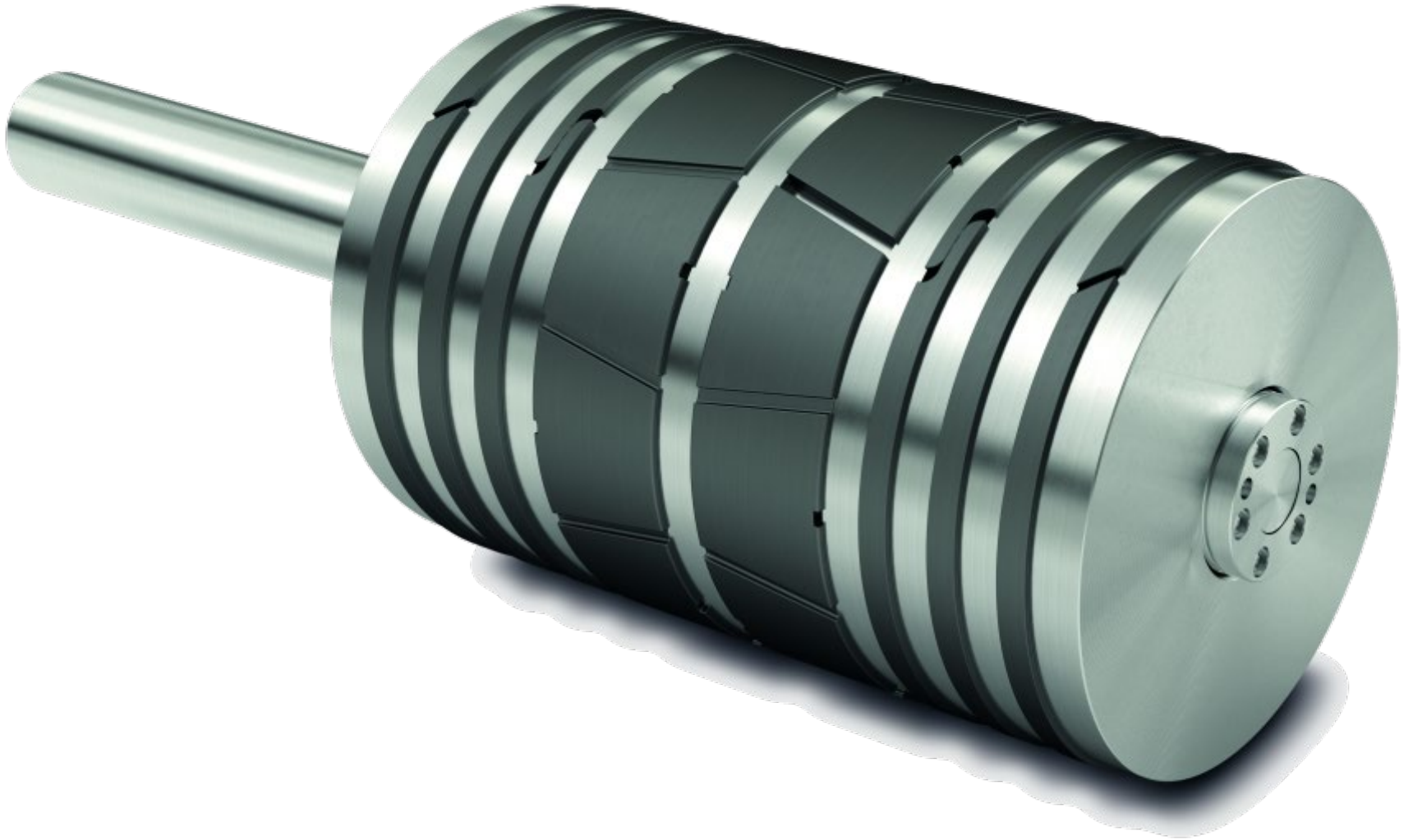
- **Distributing the two pressure components among various sealing element designs are used to optimize sealing systems' function**
  - **Using a variety of ring designs, each possessing specific properties, to handle a particular pressure component.**
    - **Robust sealing elements in the vicinity of the compression chamber to withstand the dynamic pressure**
    - **Subsequent gas-tight sealing rings intended for handling the static pressure**
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# Heterogeneous Design

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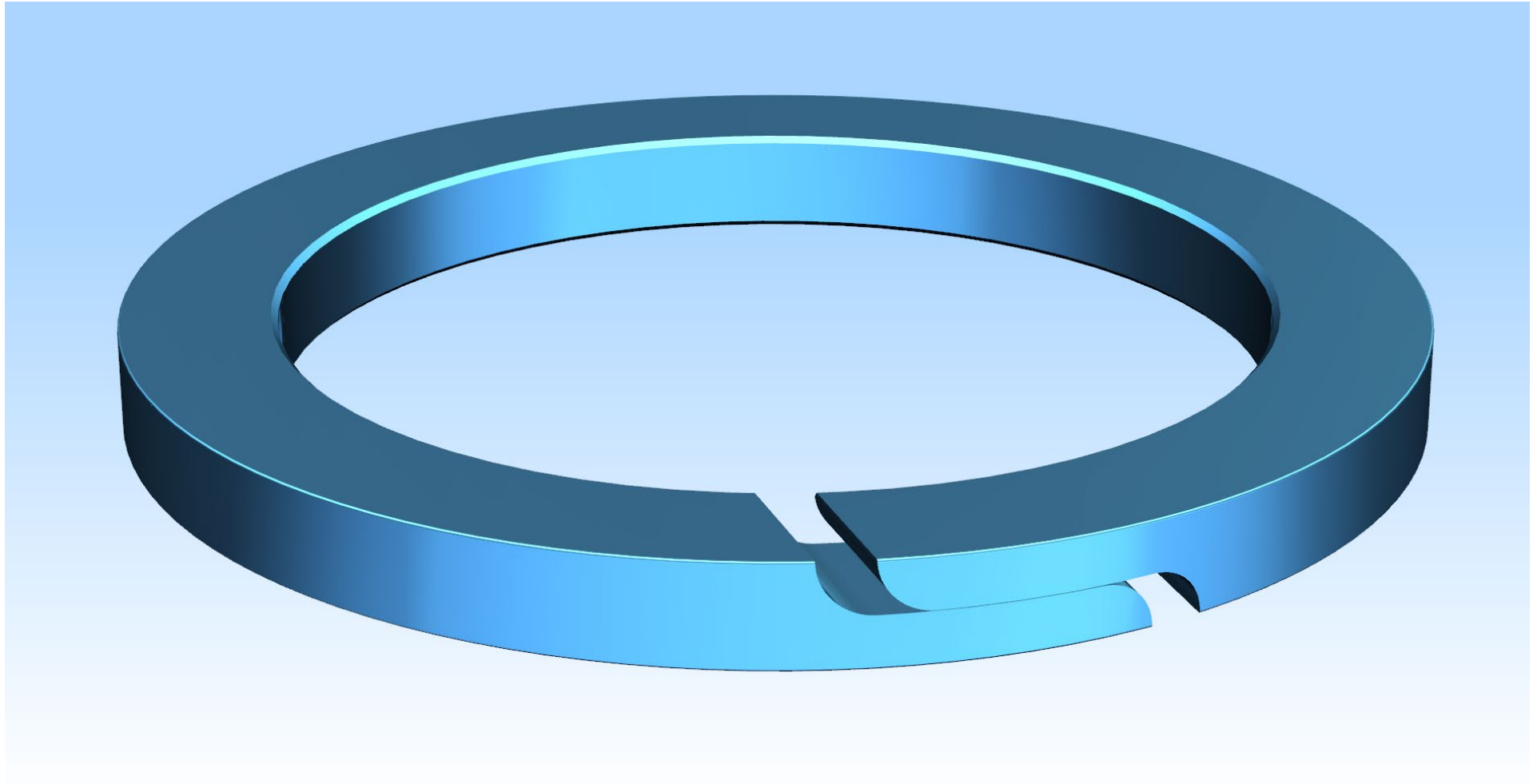
# PS 110 Pressure Breaker / Sealing Ring

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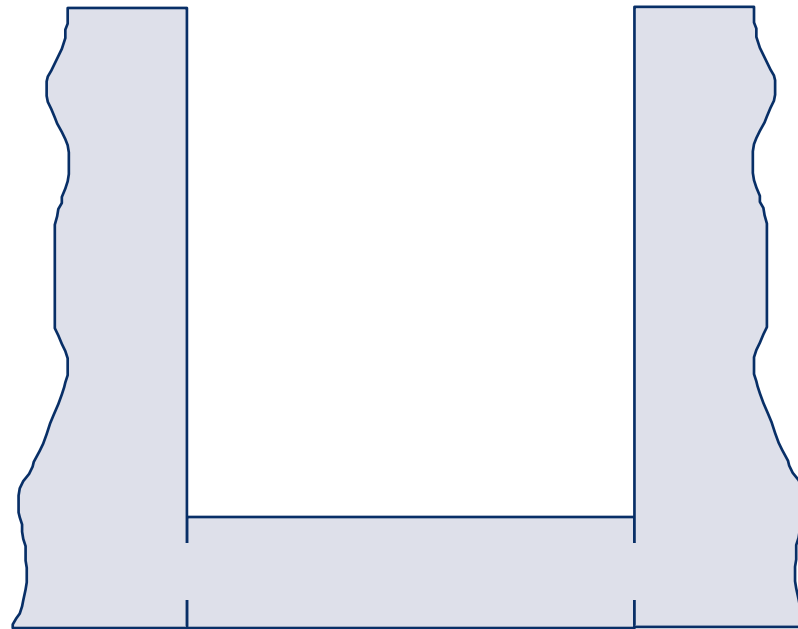
# PS 120 Sealing Ring





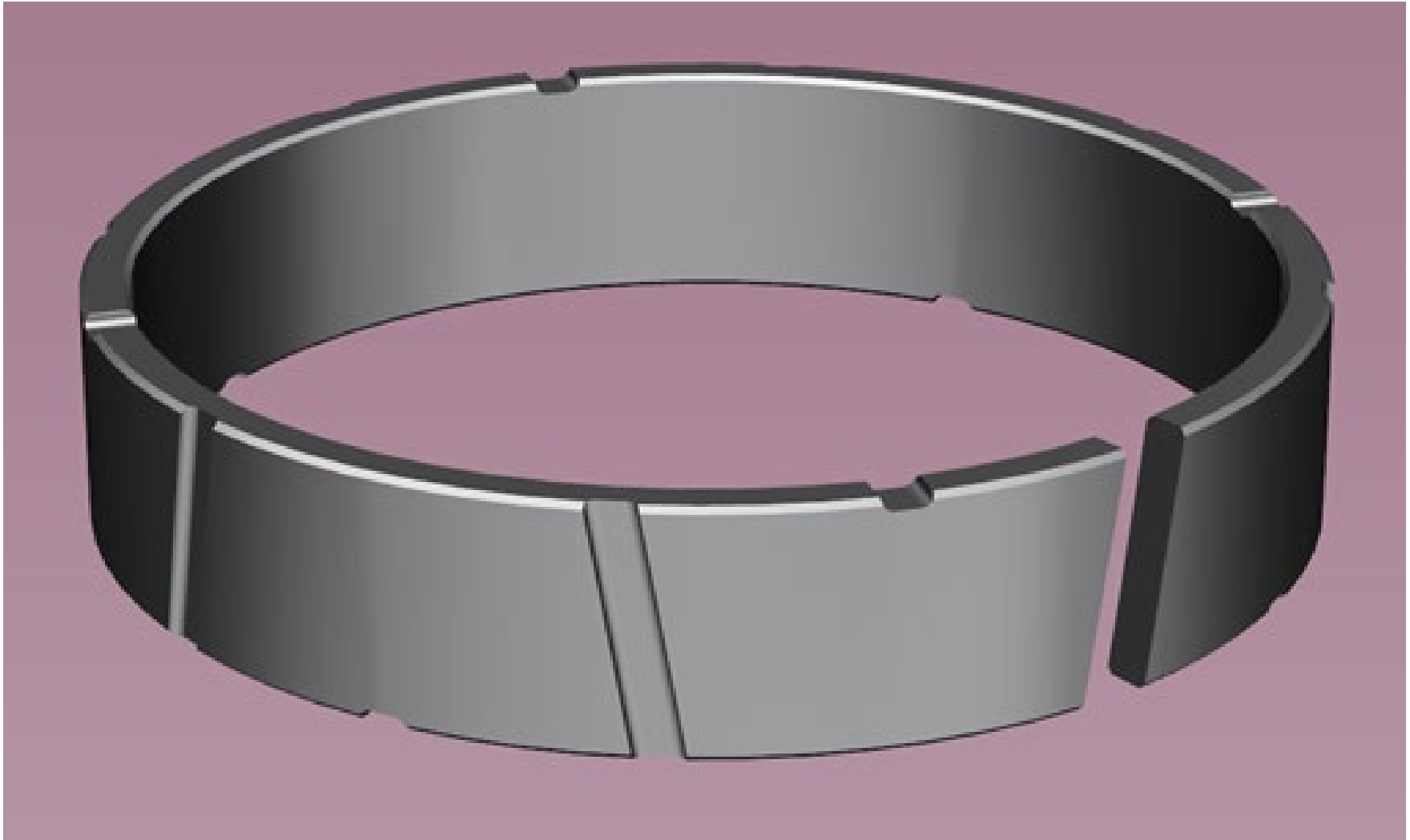
# Compression Ring

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# PG 900 Rider Ring



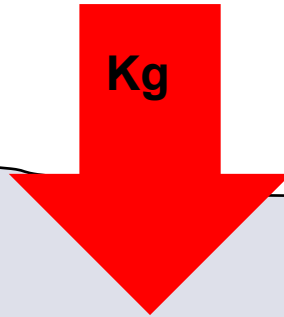


# Rider Rings

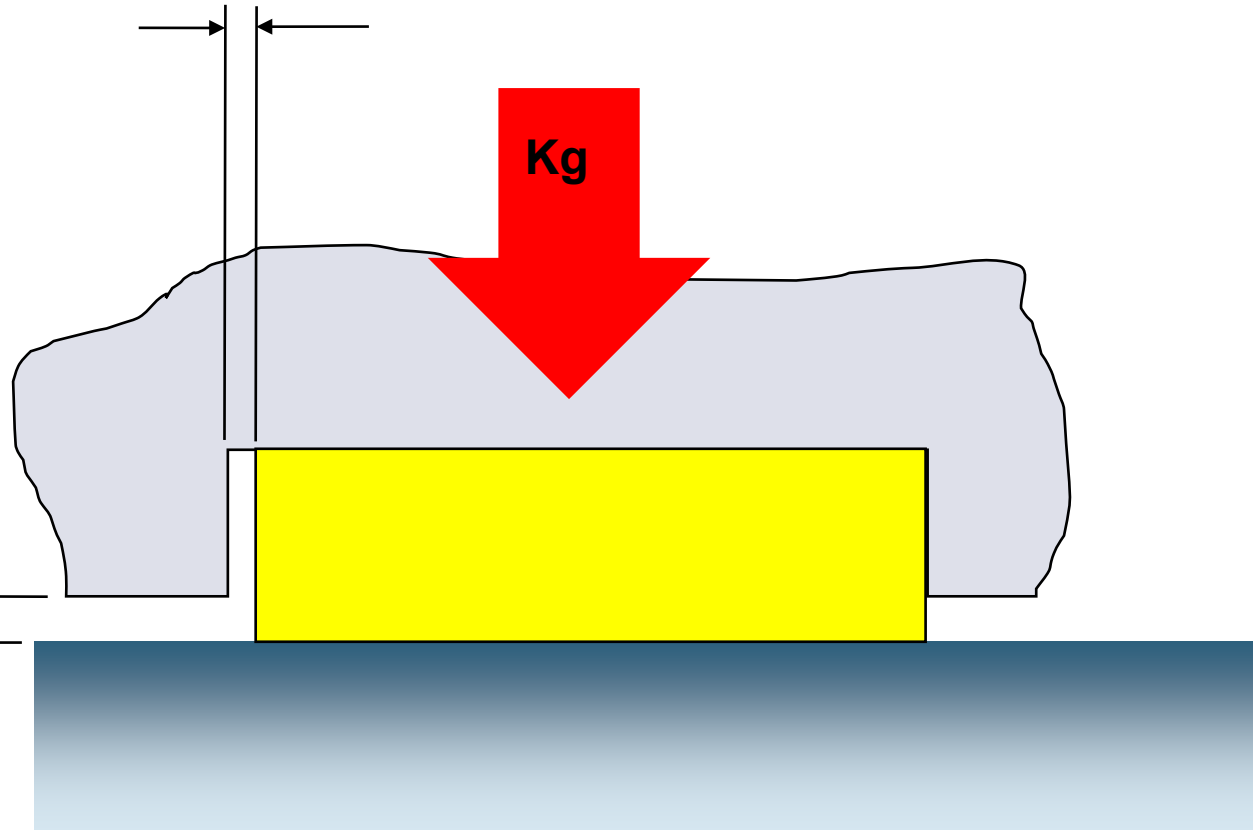
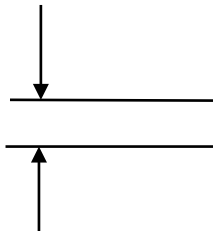
Ring axial clearance



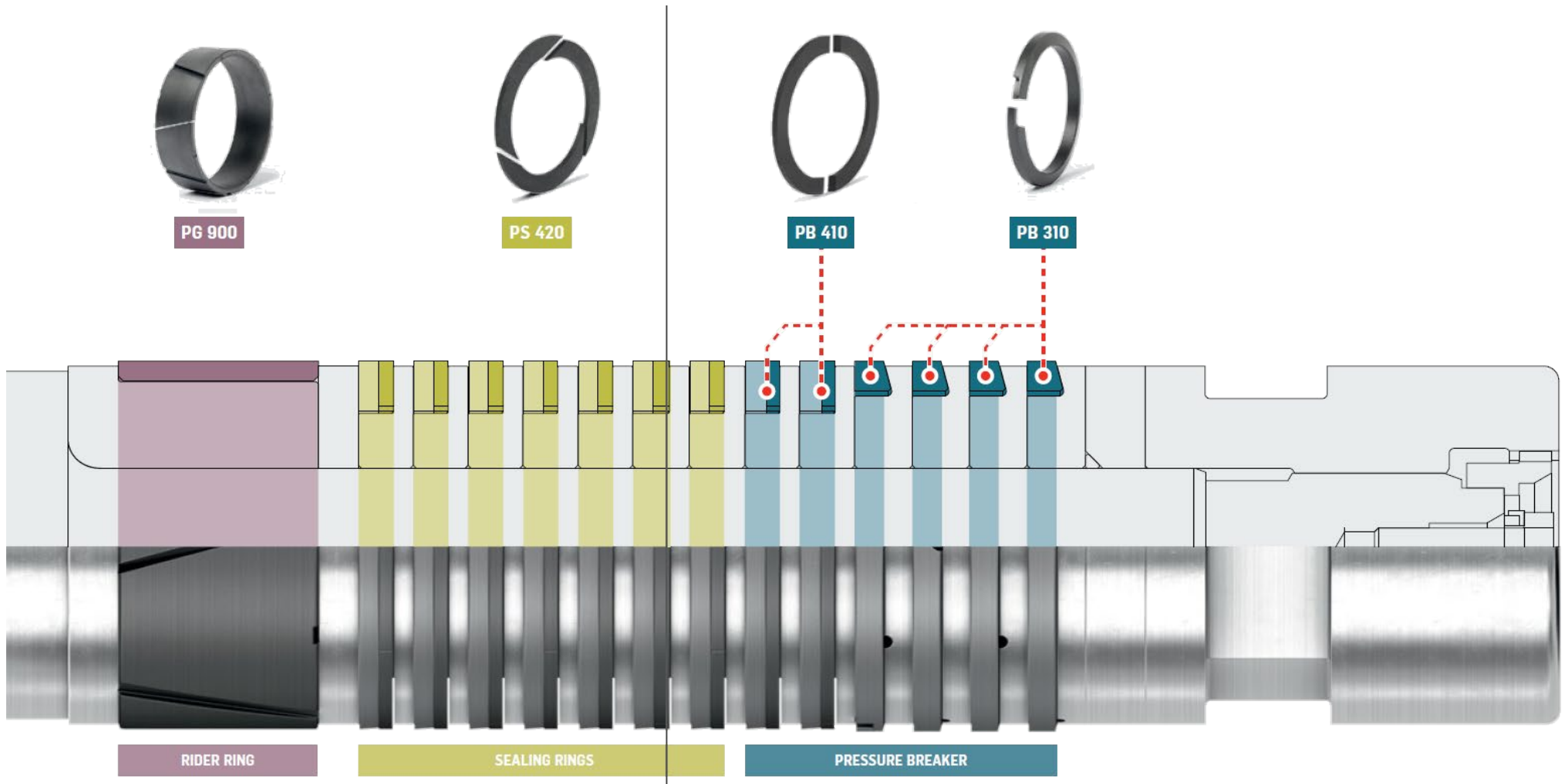
Kg



Piston  
cylinder  
clearance

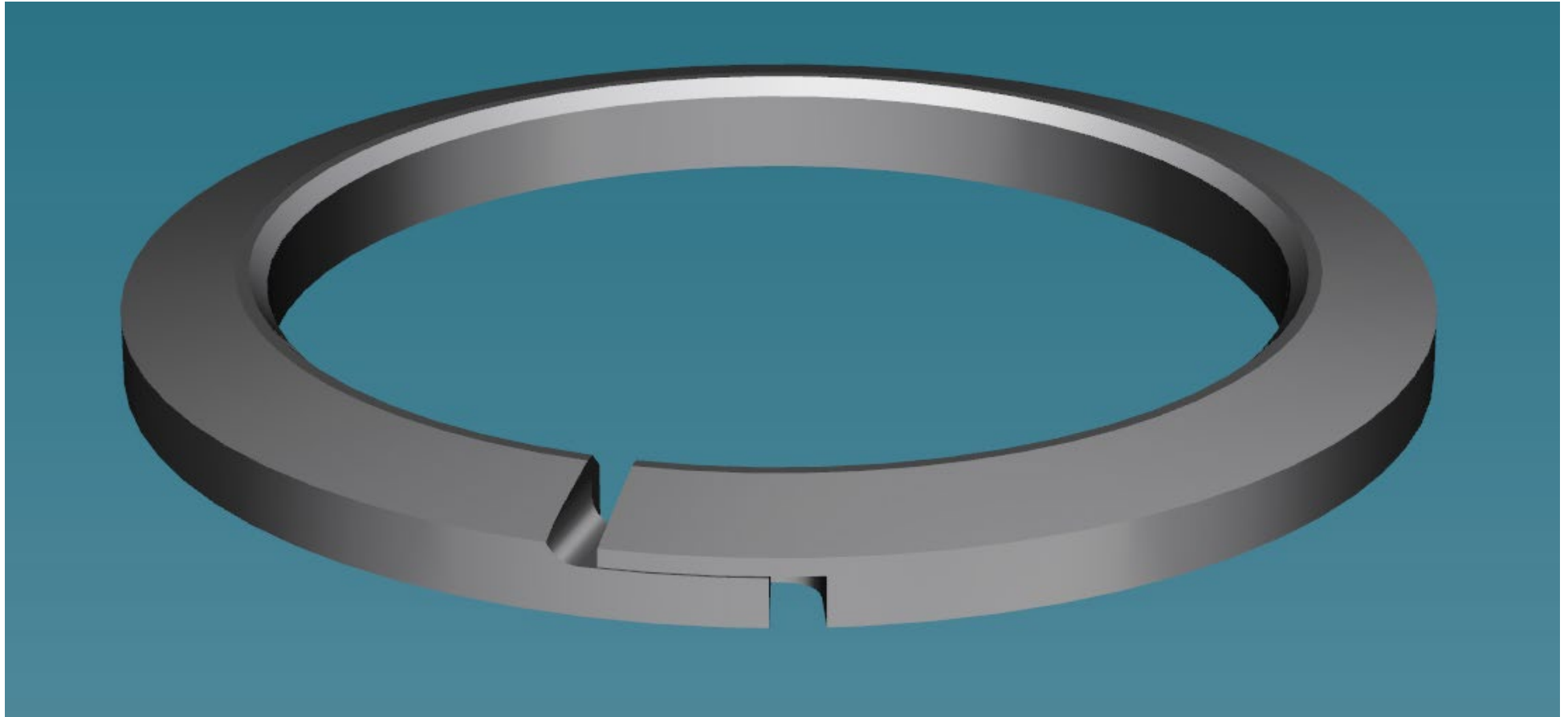


# Heterogeneous high pressure piston assembly



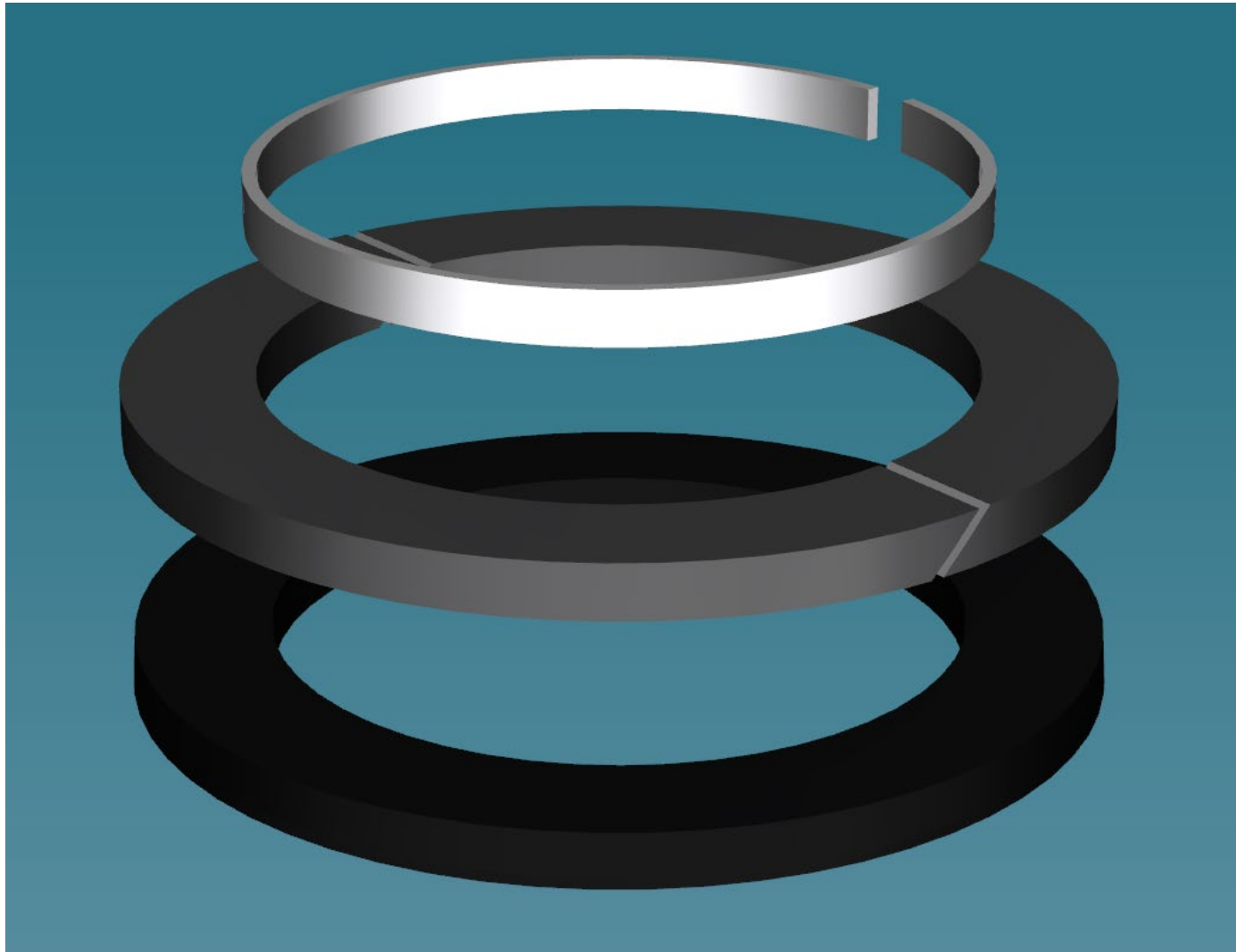


# PB 310 Sealing Ring



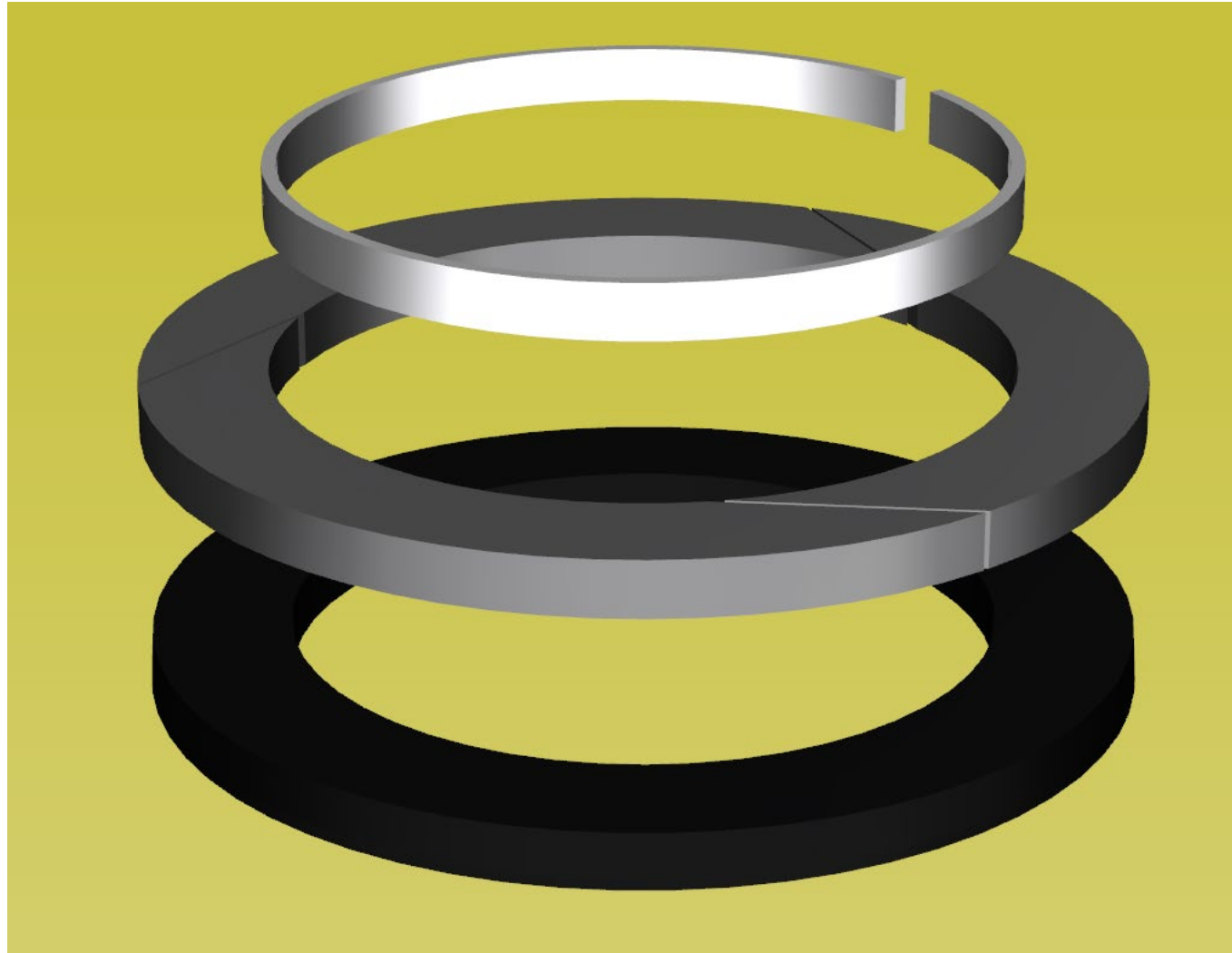


# PB 410 Sealing Ring





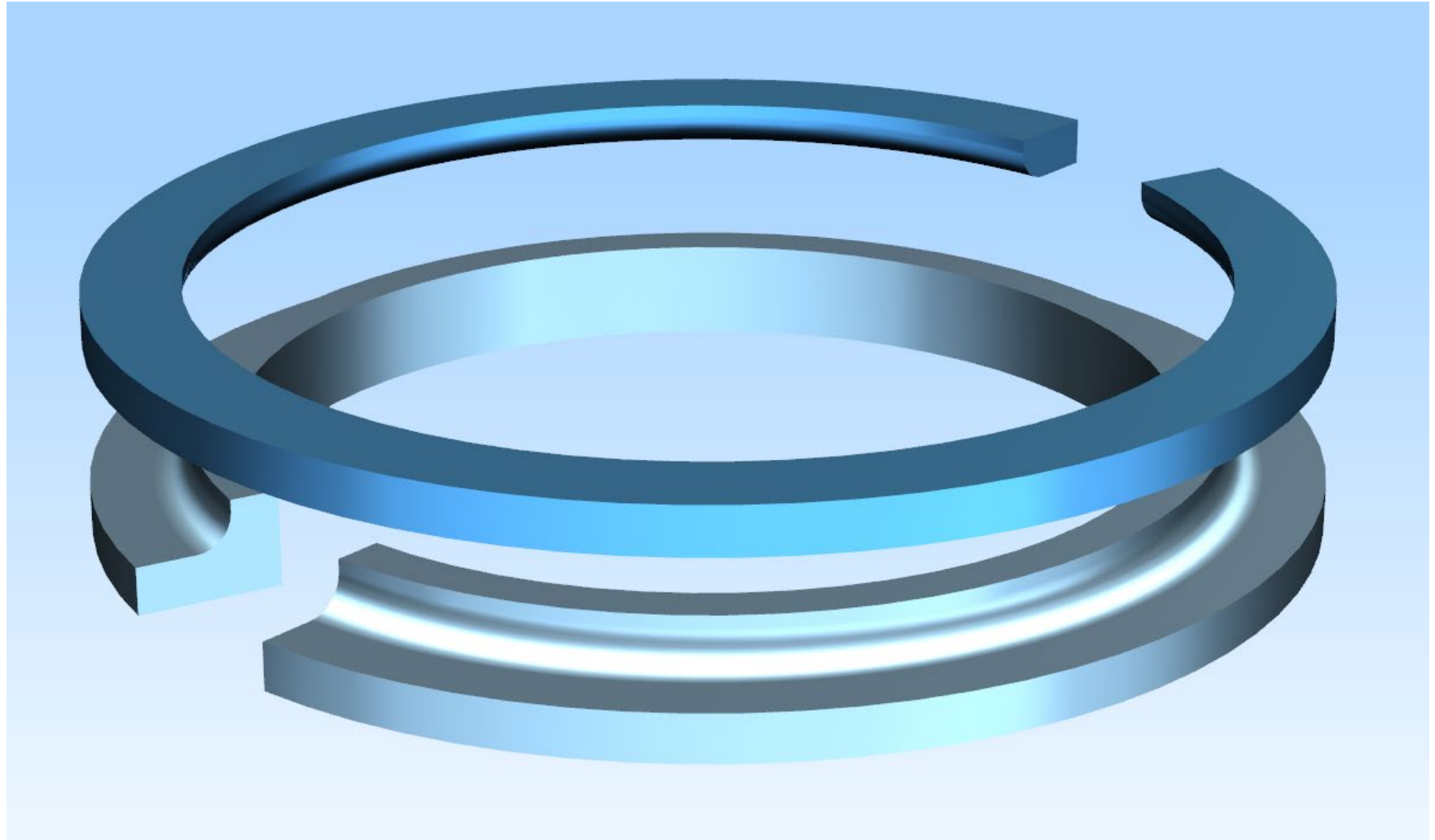
# PS 420 Sealing Ring





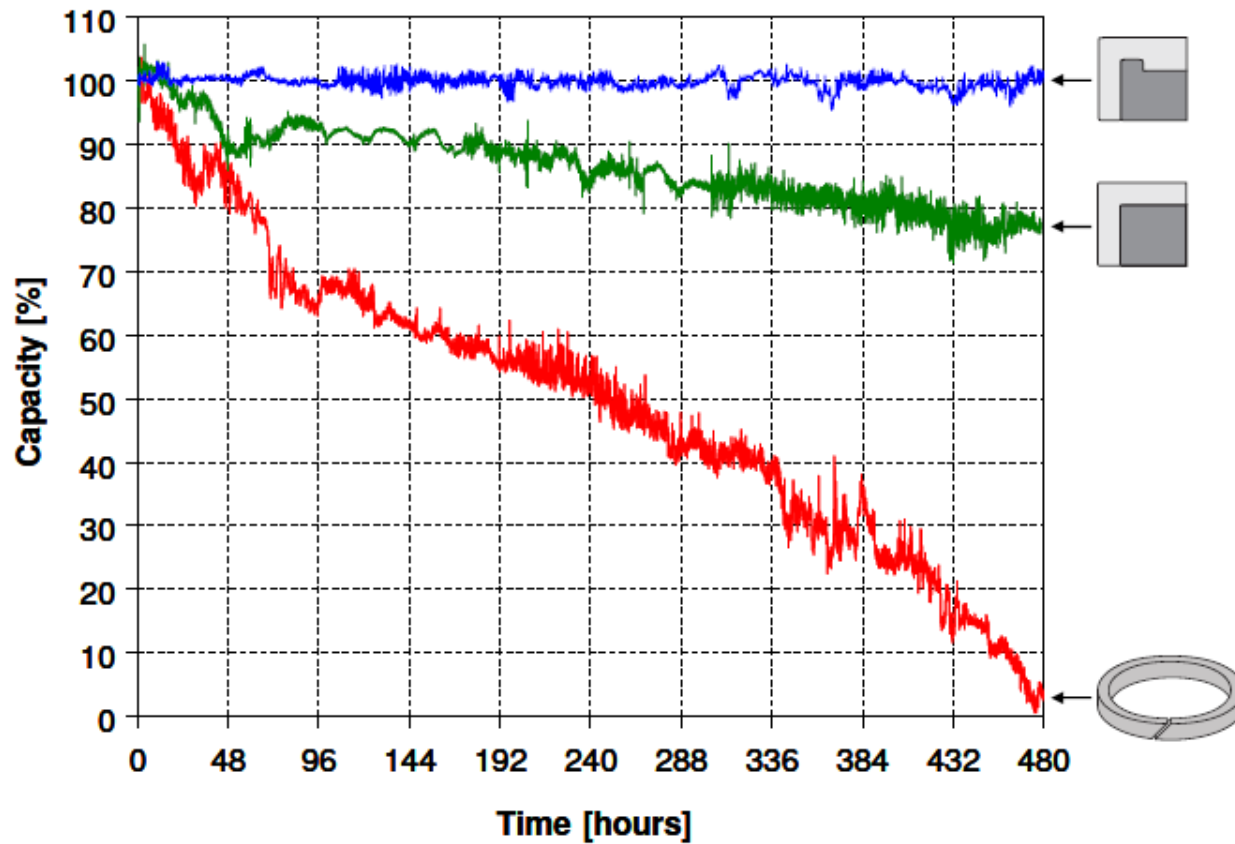


# PS 201 Sealing Ring

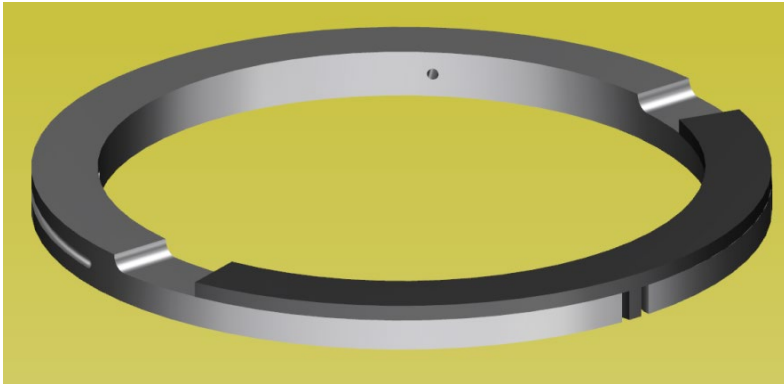




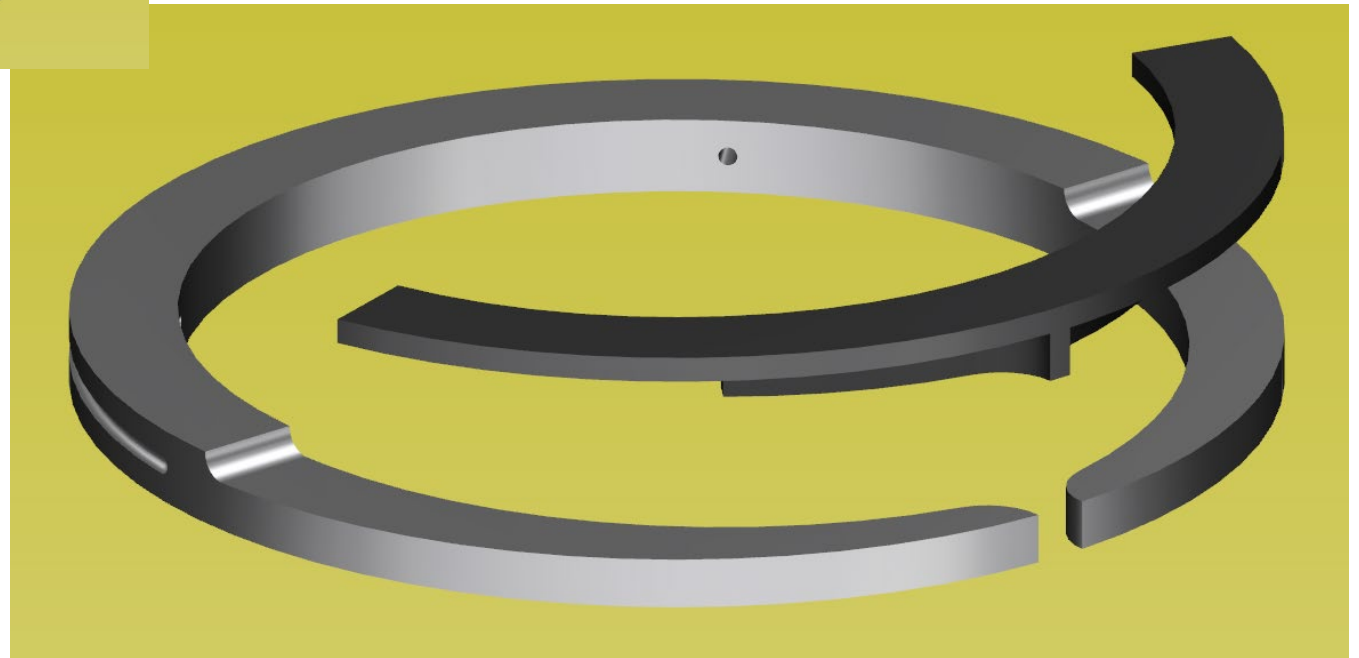
# PS 220 Sealing Ring - Capacity



# New ring design

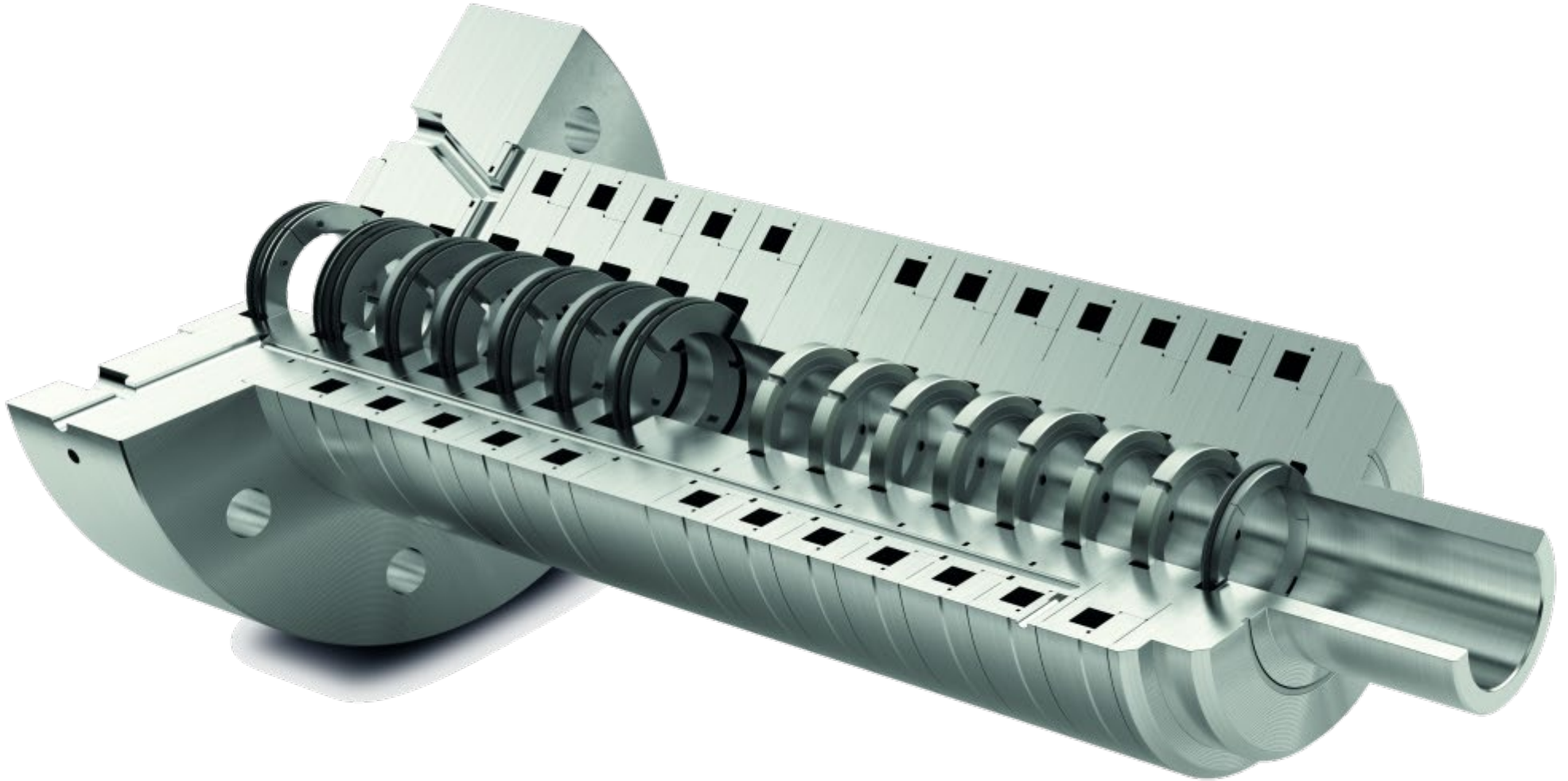


## PJ Ring



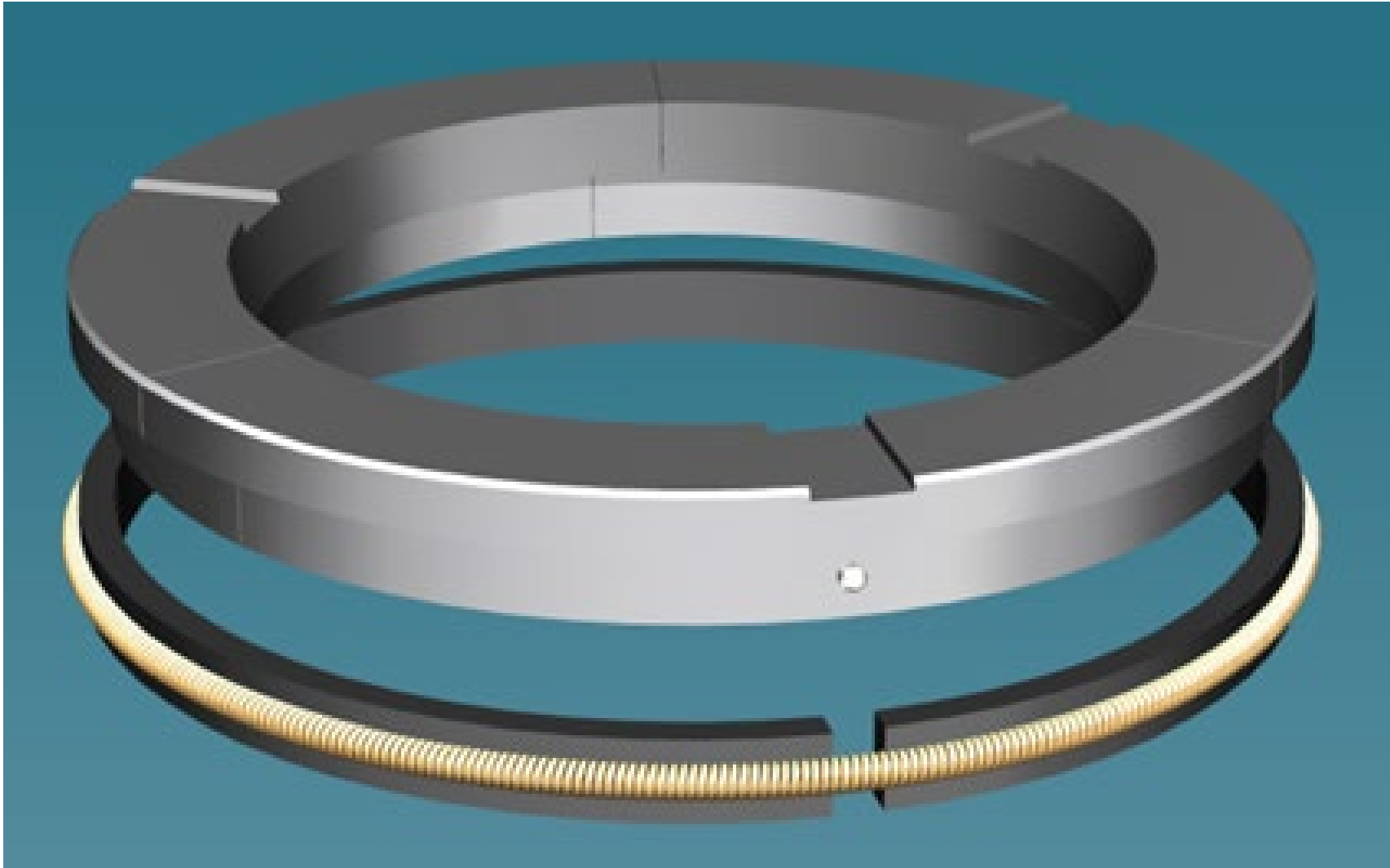
## Definition: - Heterogeneous

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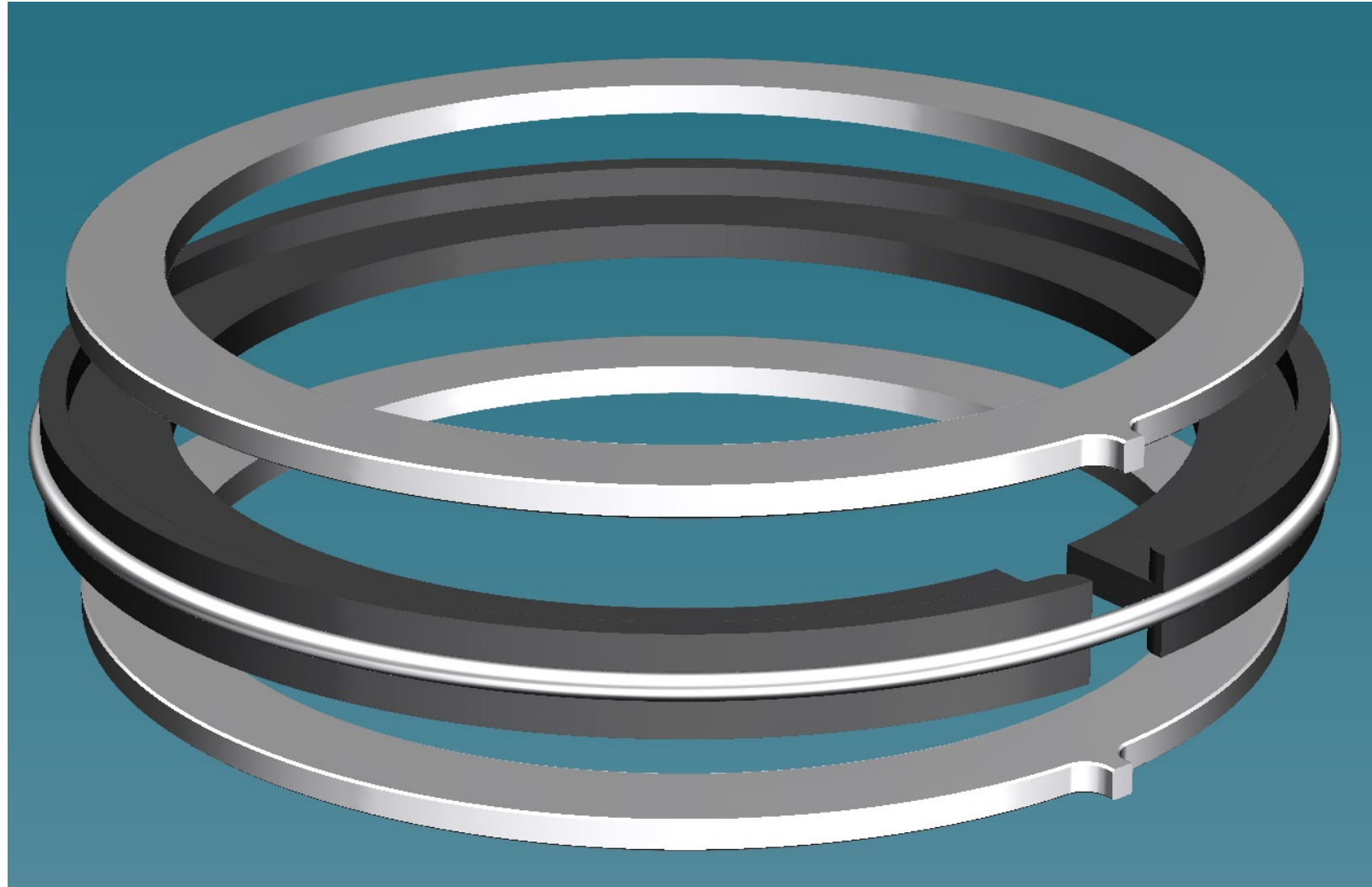
# RB 110 Pressure Breaker





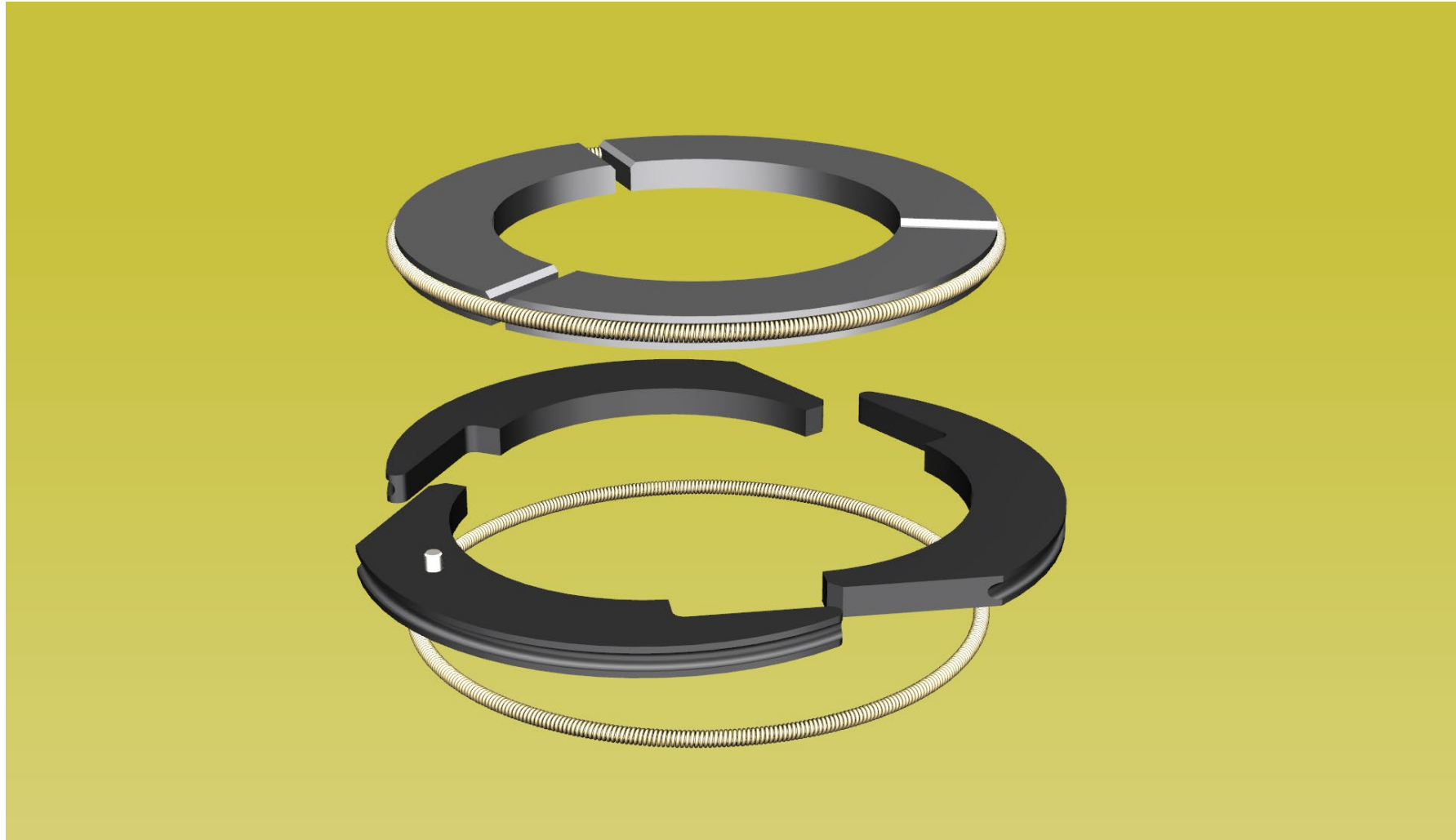


# RB 220 Pressure Breaker



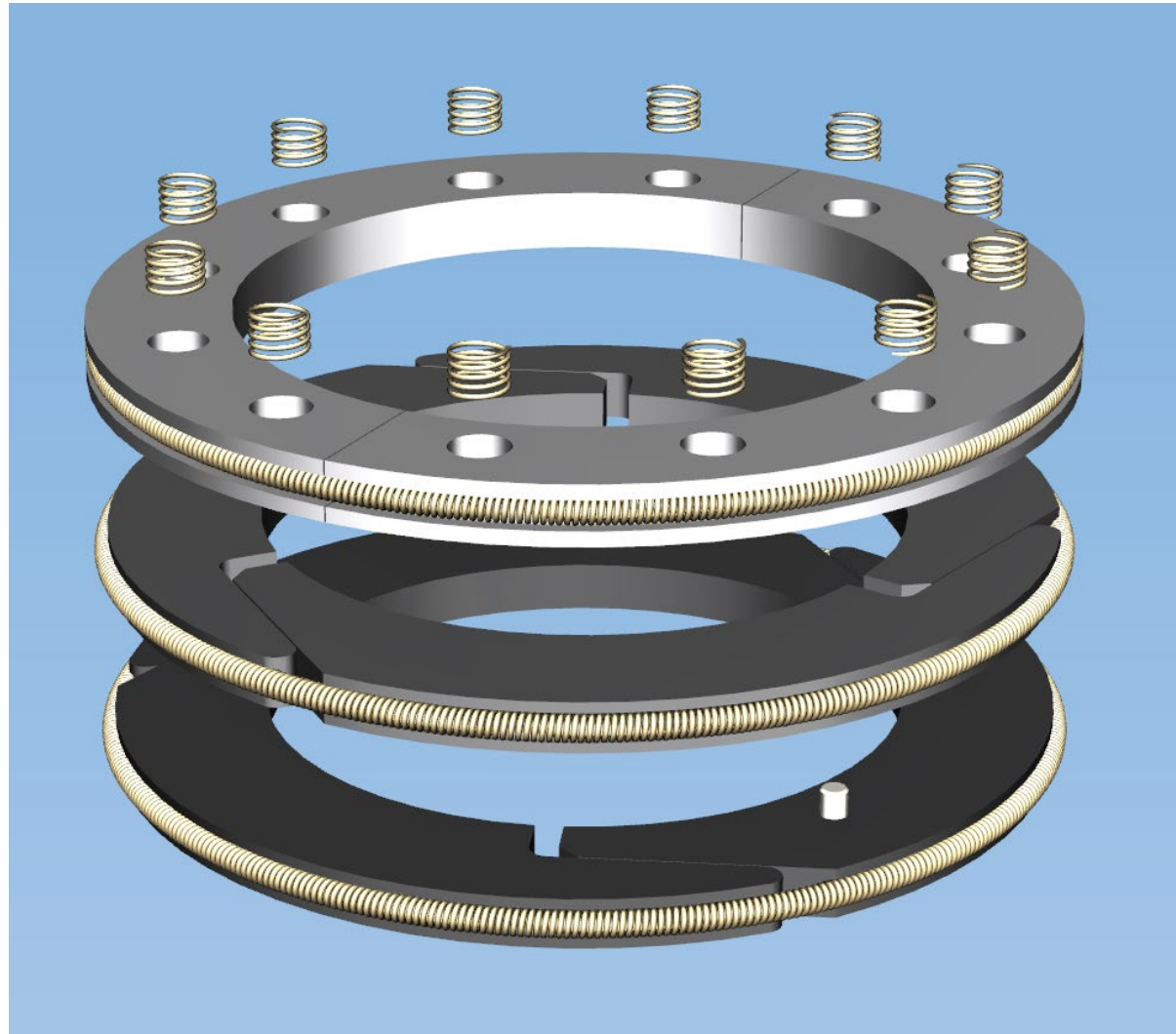


# RS 310 Sealing Ring



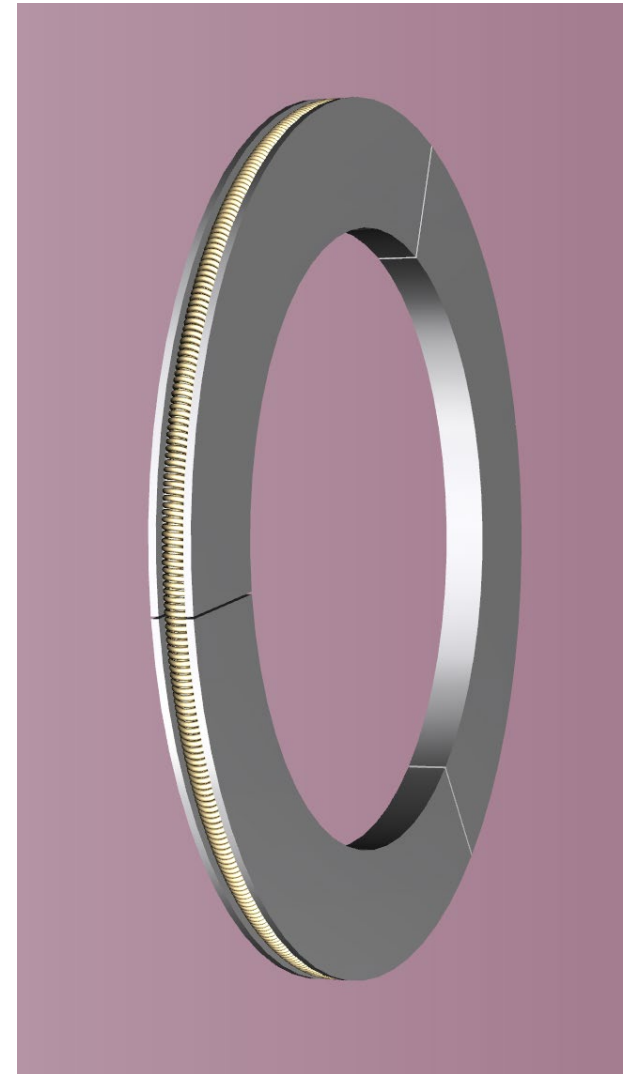
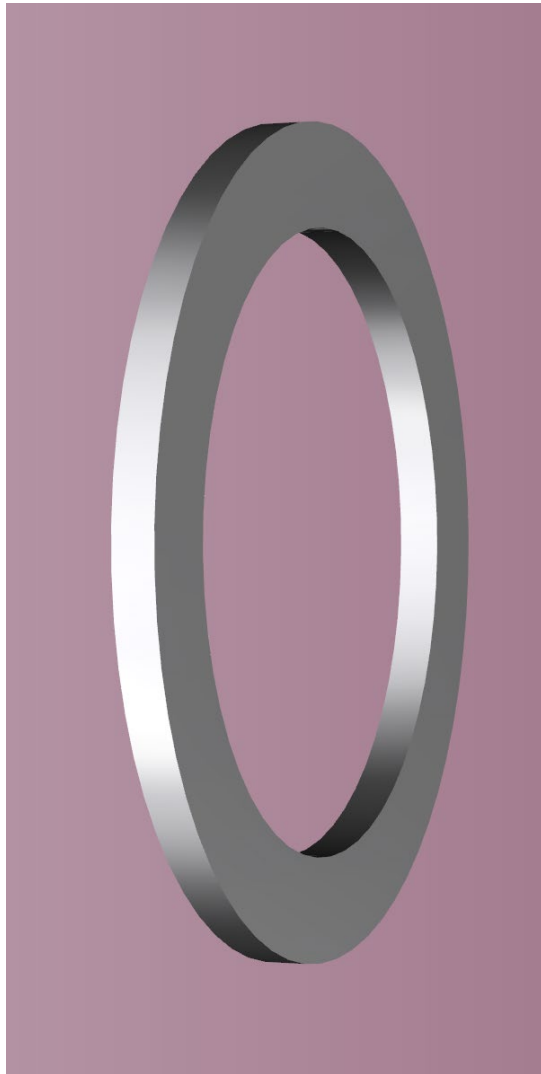


# RS 900 Seal Element

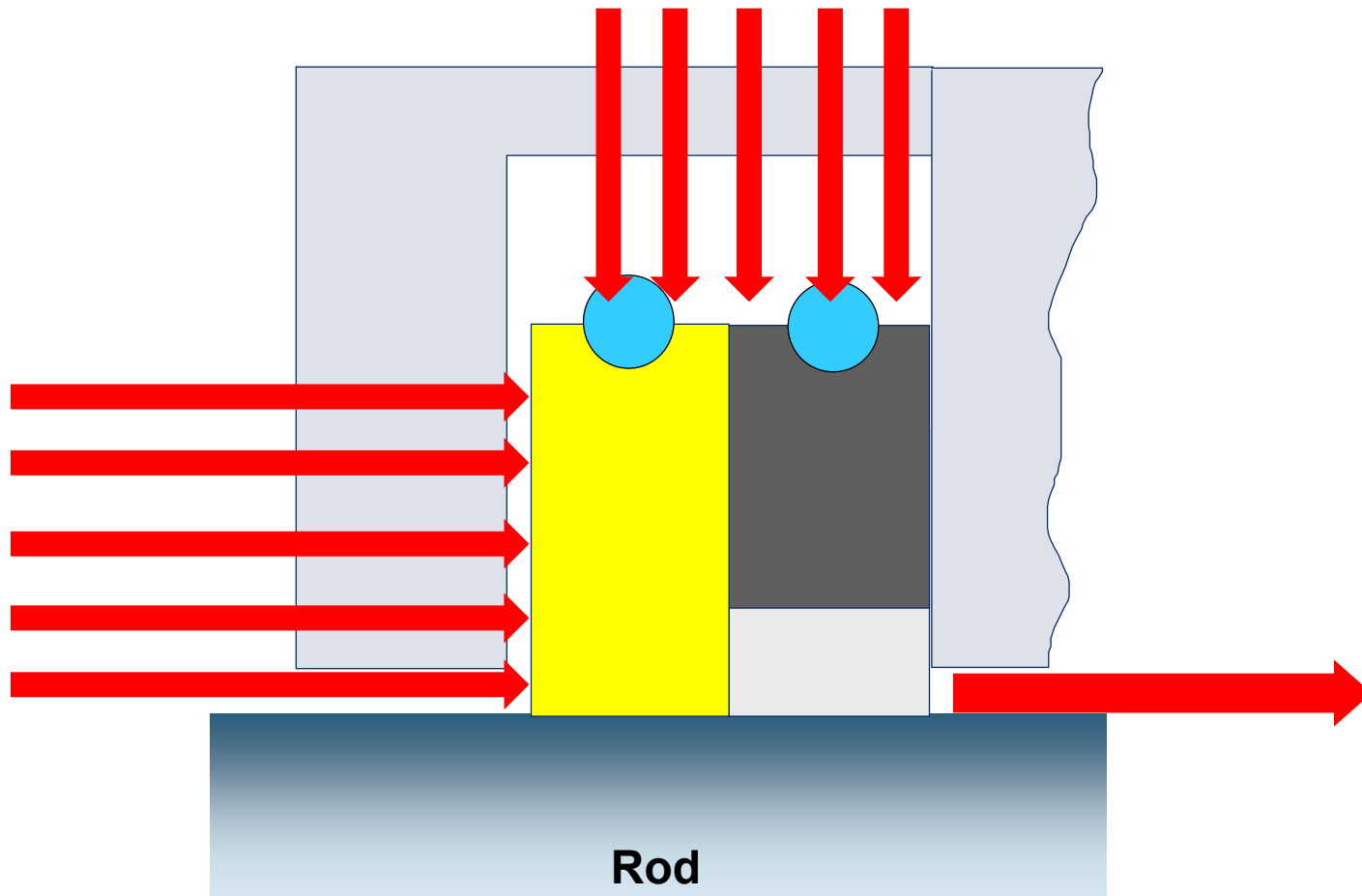




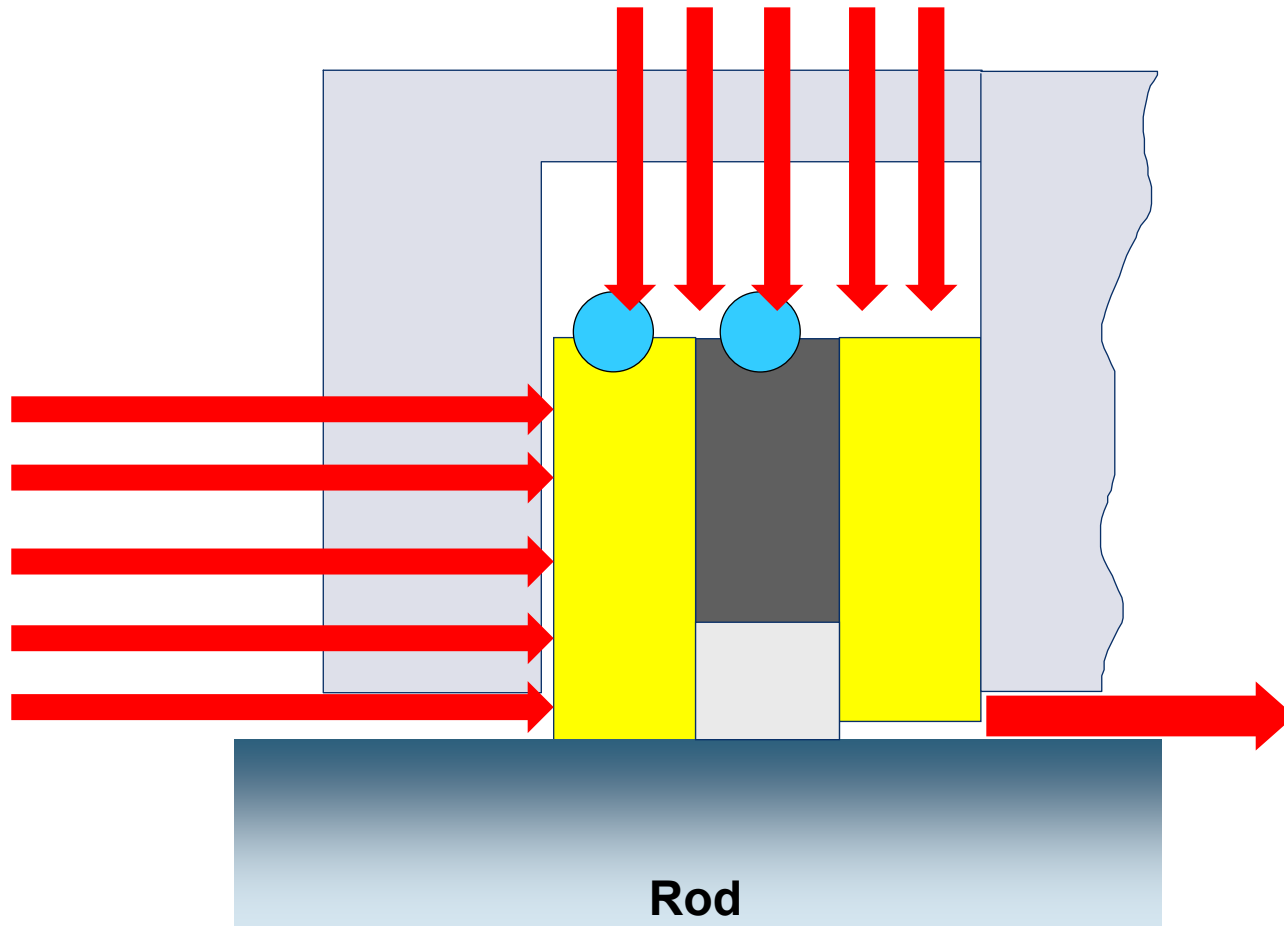
# Anti-extrusion rings (AER) / Back-up rings



# Packing Rings – Leakage rates

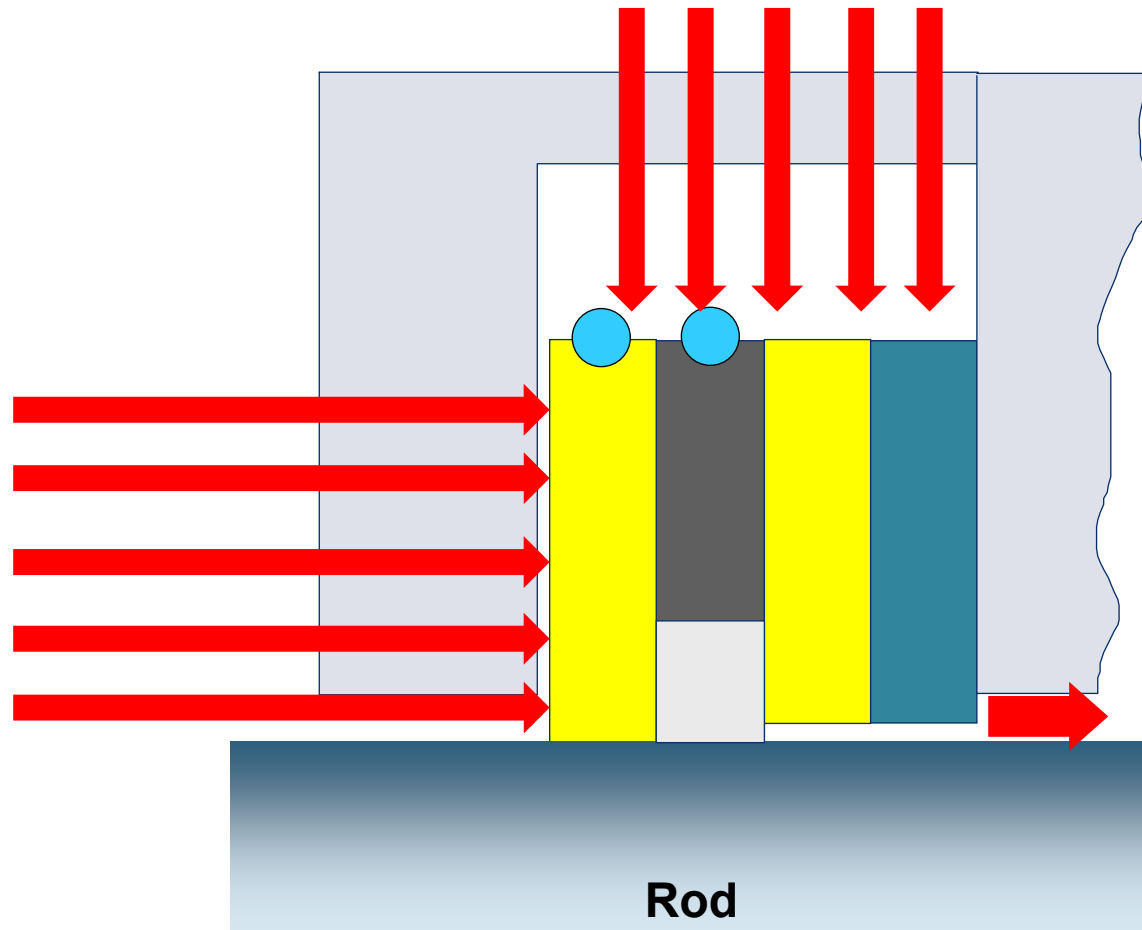


# Packing Rings – Leakage rates





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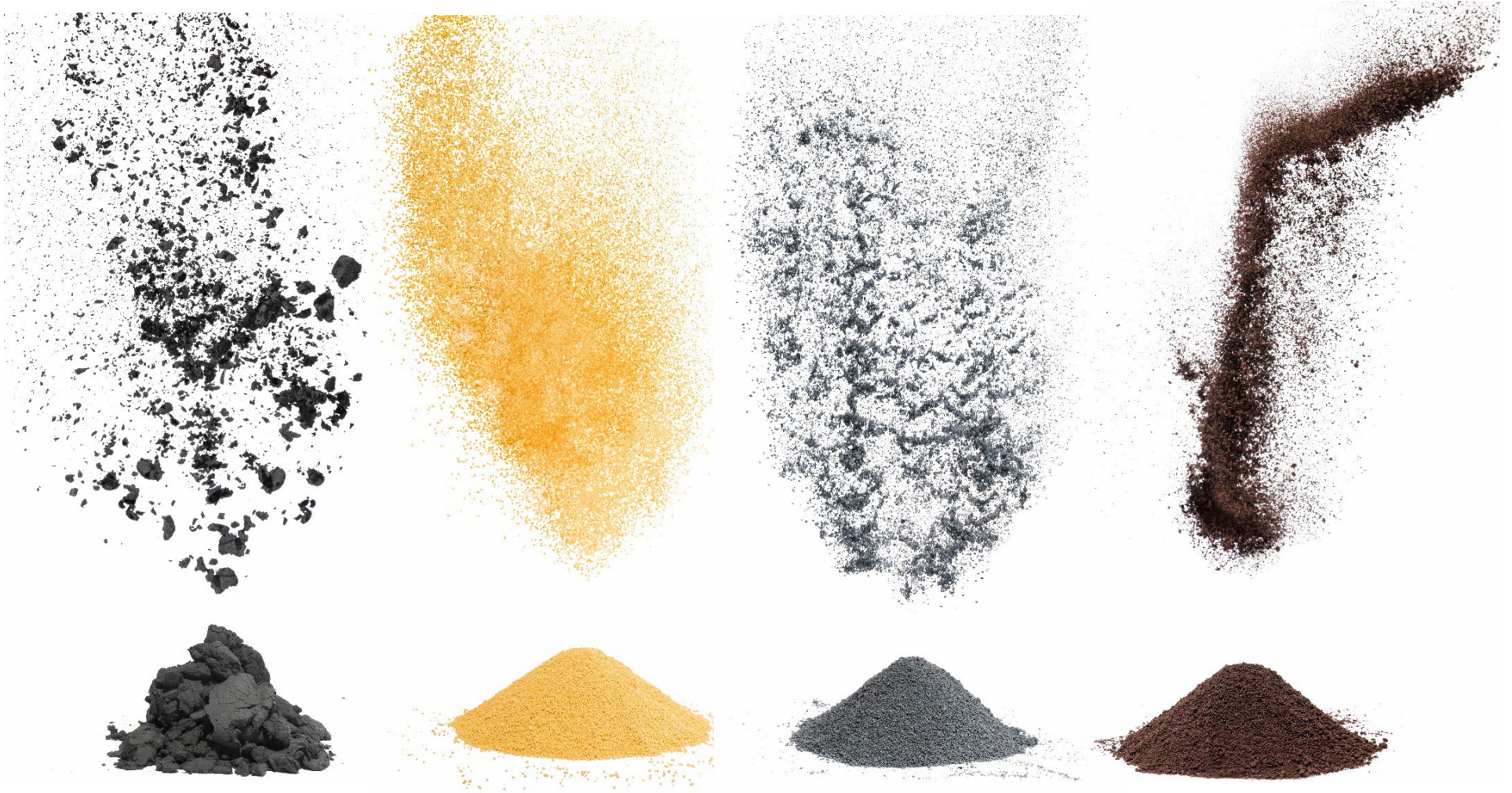


**HETEROGENEOUSLY DESIGNED  
SEALING SYSTEMS BASED  
ON THE REDURA® PRINCIPLE**

Dr. Norbert Feistel

[www.burckhardtcompression.com/media/downloads/technical-article/](http://www.burckhardtcompression.com/media/downloads/technical-article/)

# Material Family







# Material





# Premium Plastic Ring Materials - Differentiating

- **Newest available polymers**

- **Optimized fillers...**

...what

...size

...shape

...percentage



- **Strictly controlled processing...**

...mixing

...compacting (hot pressing)

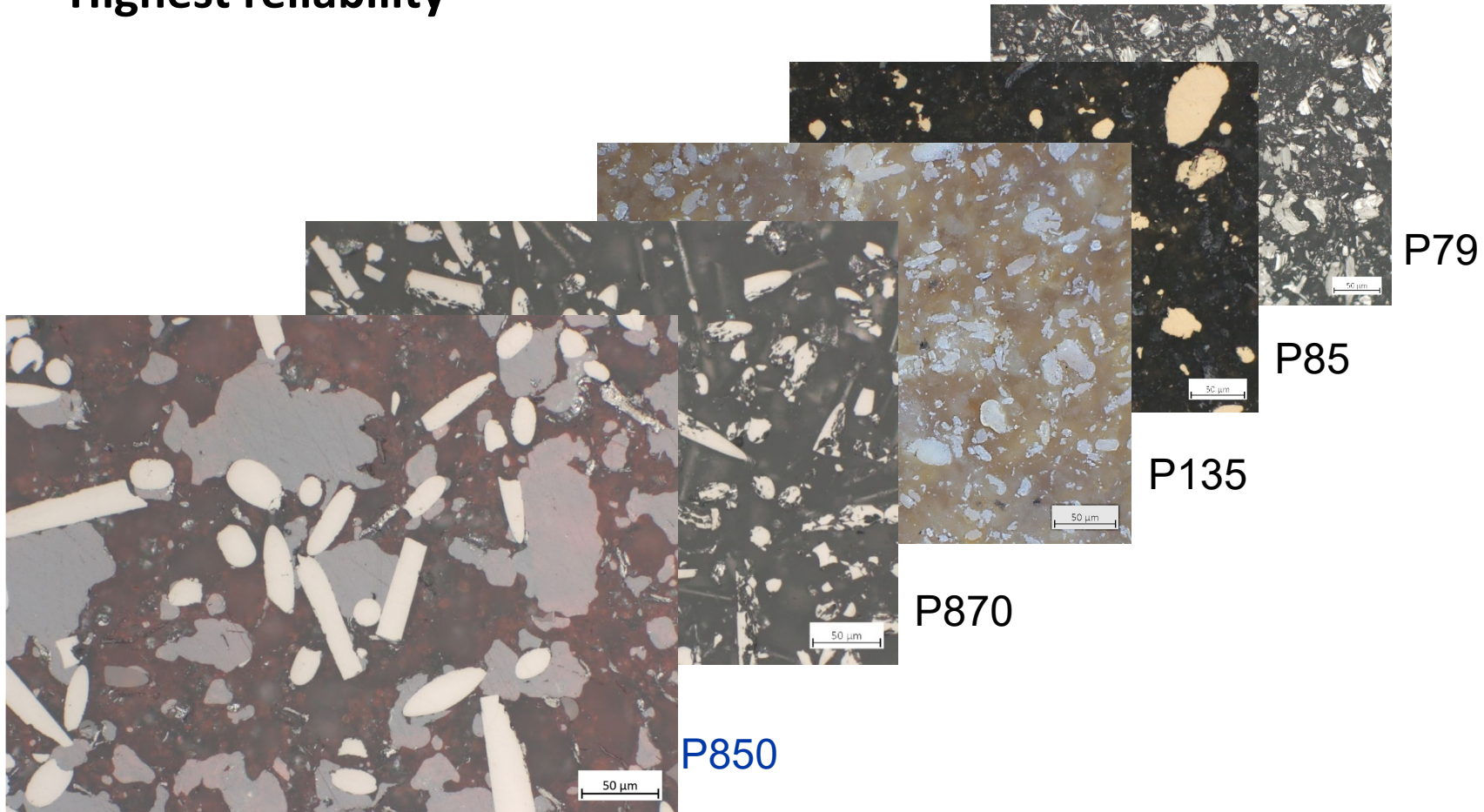
...sintering





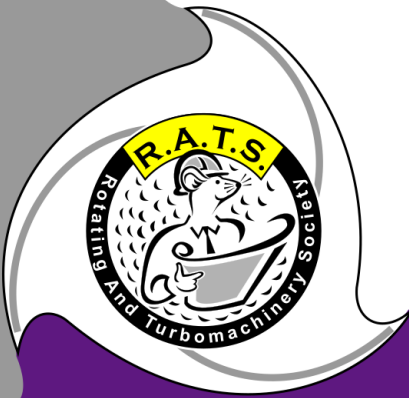
# Sealing Material Family

- Highest persistence against wear –for longest lifetime
- Highest reliability



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- Please fill in **feedback form** to help us plan for 2020
- All presentations will be available for **download from MRO website**
- A portion of the MRO proceeds will go towards an **Educational Grant** and our selected charities:



2018 - MRO Technical Conference and Workshops