New Rotary Seal with bi-directional pressure-balancing

VDMA, Hannover 2017

TRELLEBORG

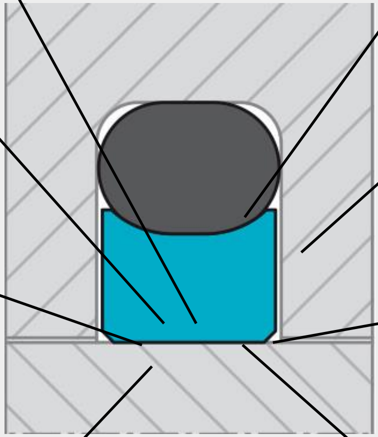
Rotary slipper seals, physical limitations

Temperature mainly limited by hardware heat dissipation

Potential rotation between seal parts

No fluid exchange in contact area

Potential seals rotation in housing groove



No removal of wear products

High power-density

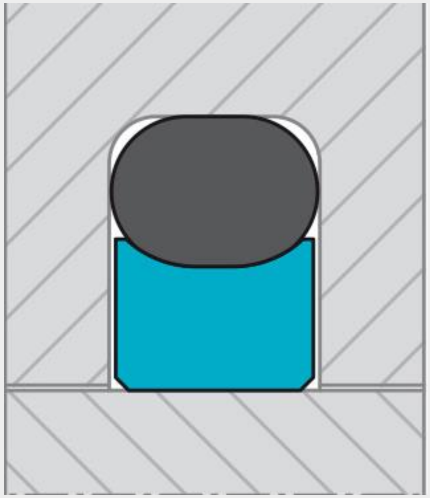
High mechanical loads on rotary part

Starved / non-existing lubrication

Practical considerations

Hardware

- Closed, symmetric housing groove
- Standard groove dimensions preferred
- Avoid back-to-back seals installation between channels
- Avoid internal drains between channels

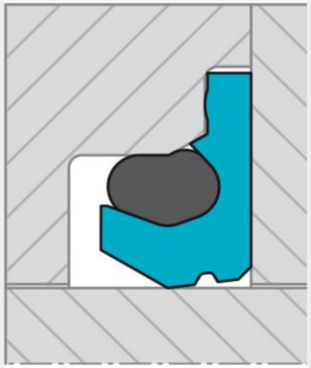


Seal

- Simple installation across wide diameter range
- Suitable for high temperature materials
- Suitable for fluid separation
- Symmetric, bi-directional design preferred
- Uni-directional seal should have poka-yoka features / or positioning should be verifiable

Prevention of seals rotation

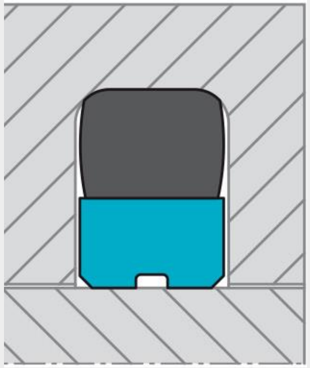
Mechanical
Retention



→ Clamping

- Unidirectional
- Complicated hardware

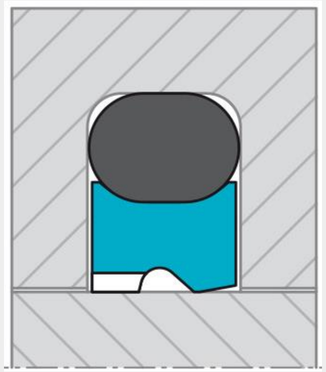
Lock seal
parts together



→ Bonding

- Poor installation
- Complicated manufacturing

Reduce friction

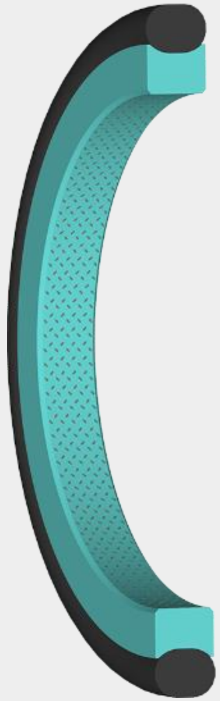


→ Pressure balancing

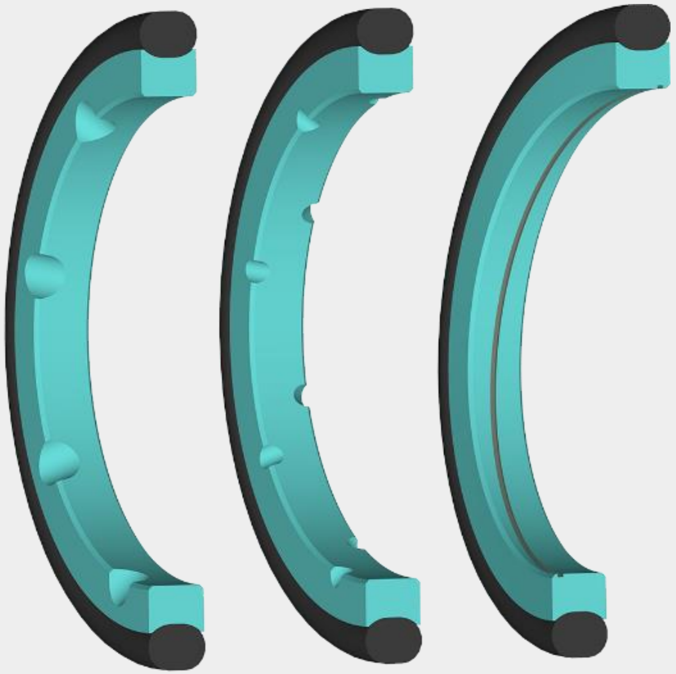
- Not generally bidirectional
- Assembly of unidirectional seals difficult to verify

Reduction of dynamic friction

By supporting fluid film formation in the contact area

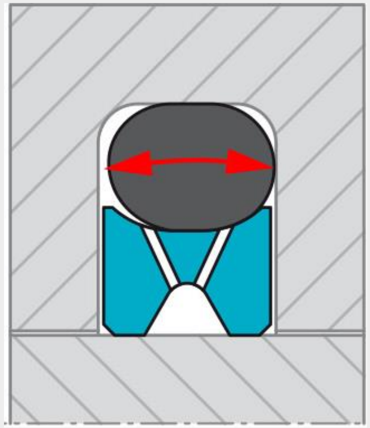


And/or by introducing pressure balancing



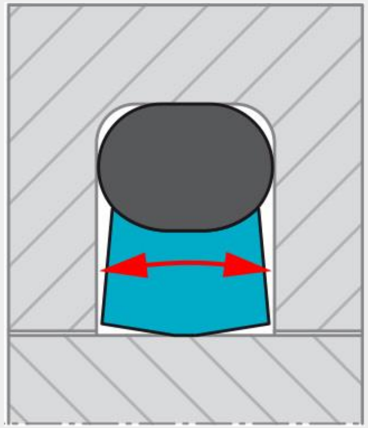
Bi-directional pressure-balancing

Existing concepts



+ O-ring automatically opens high-pressure port

- Valve function highly sensitive to tolerances
- Fundamentally less suited to standard housing grooves

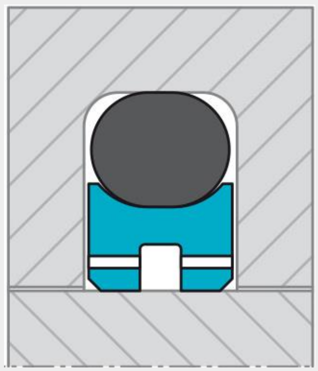


+ Pressure tilts seal body and reduces pressurized contact width
- Bi-directional function sensitive to deformation in service
- Less suited for material with low elasticity e.g. PTFE

Bi-directional pressure-balancing

Concept development

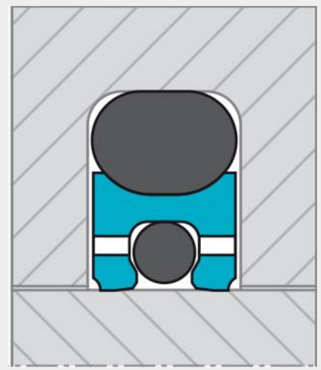
Design idea



Standard rotary seal design

Pressure ports close against groove wall

Development

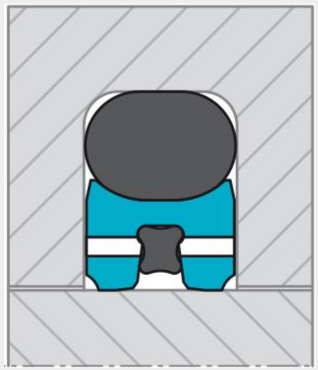


Bigger ports

Internal valve element (O-Ring)

Refined contact faces

Final

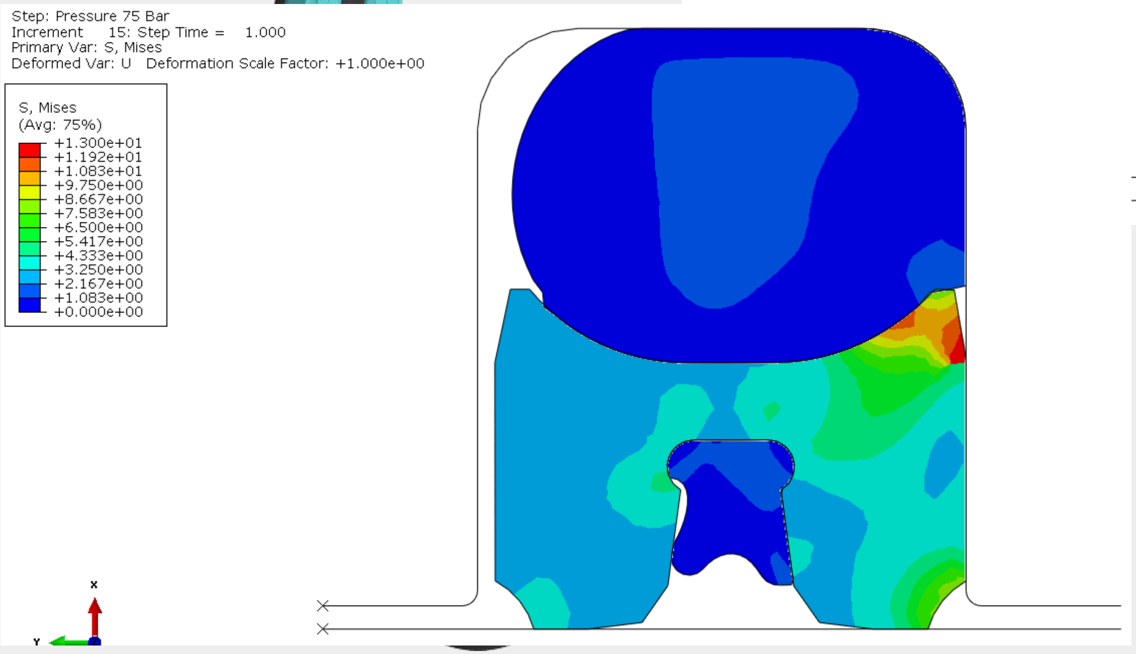


O-ring replaced by Quadring

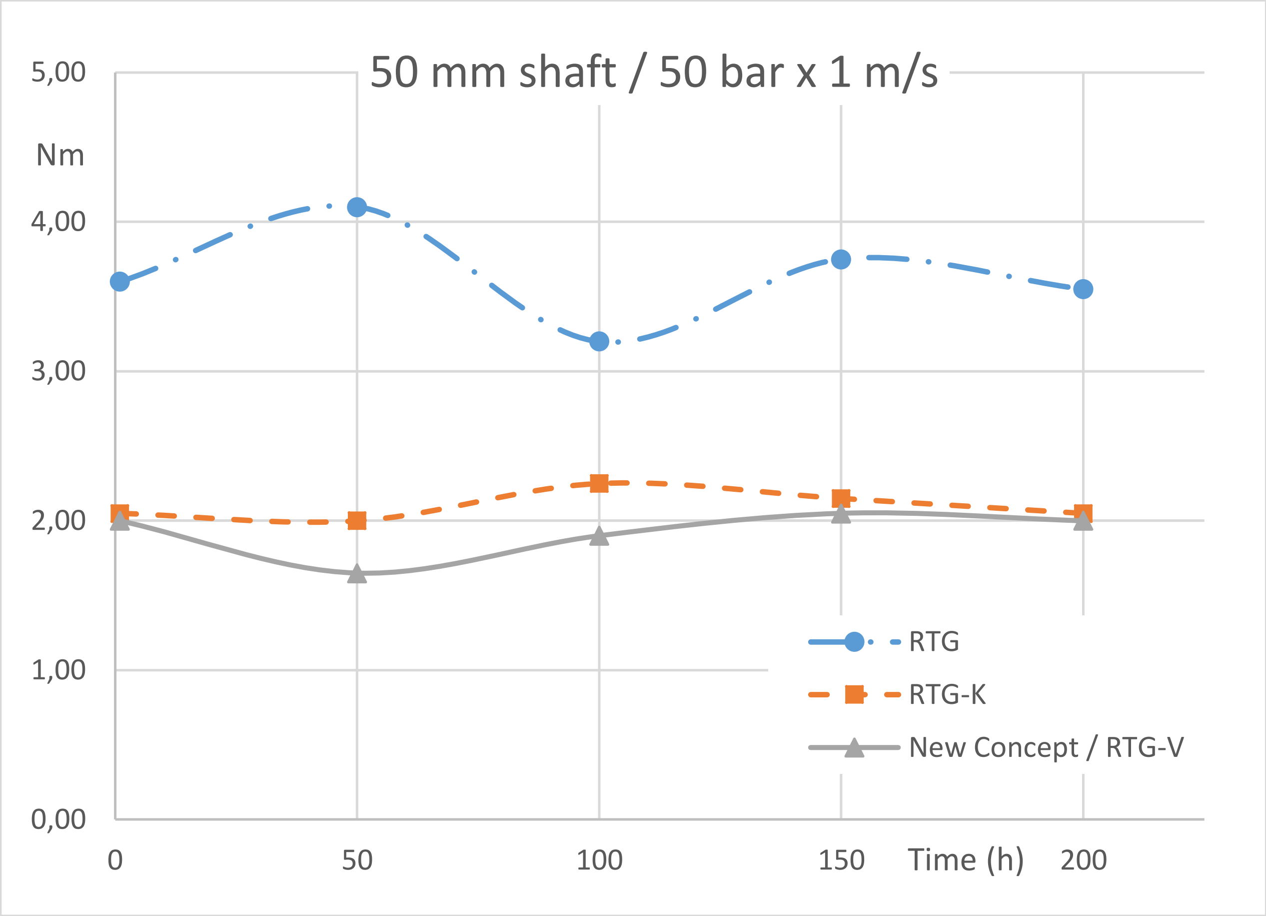
Further changes to seal body

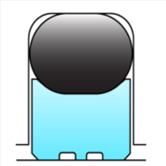
TRELLEBORG

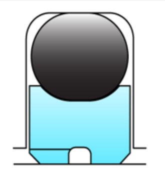
Finalized design

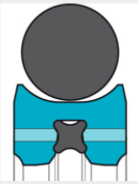


Rotary seal performance, torque / time



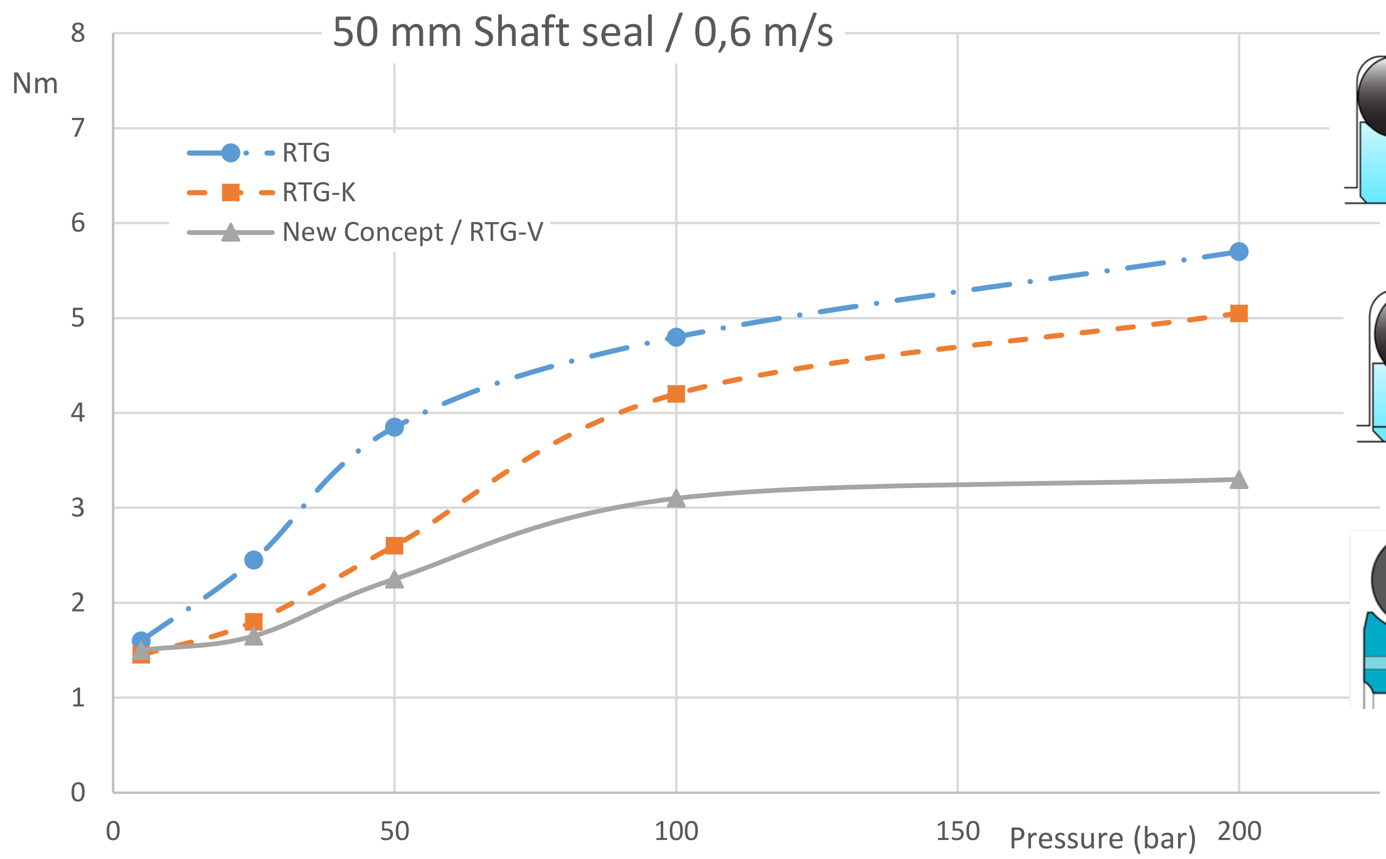


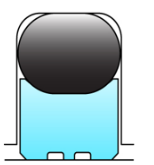


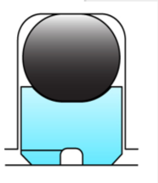


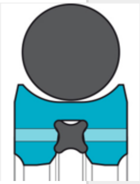
All test results with mineral oil HLP46 and seal material Turcon M15 unless otherwise noted

Rotary seal performance, torque / pressure

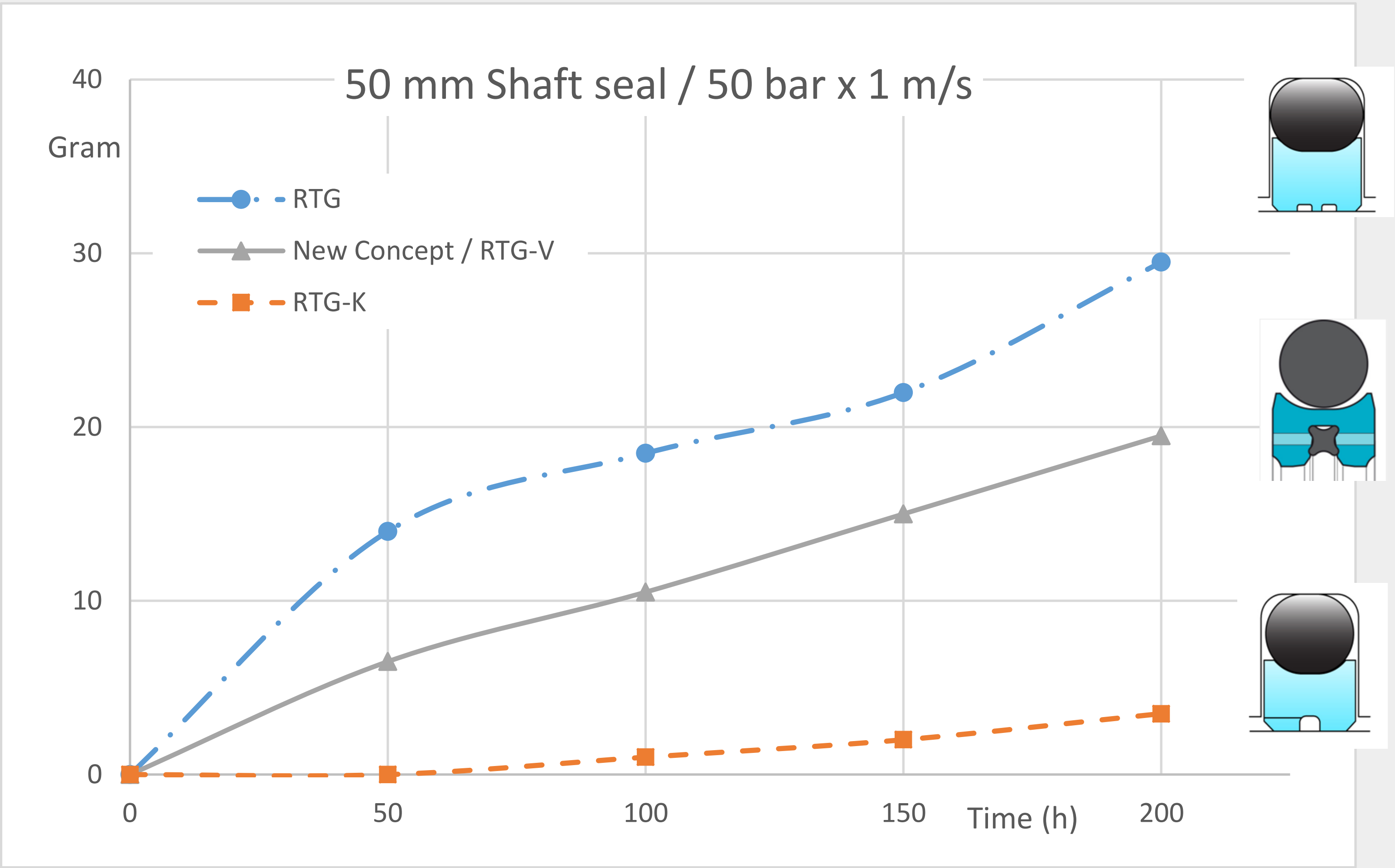






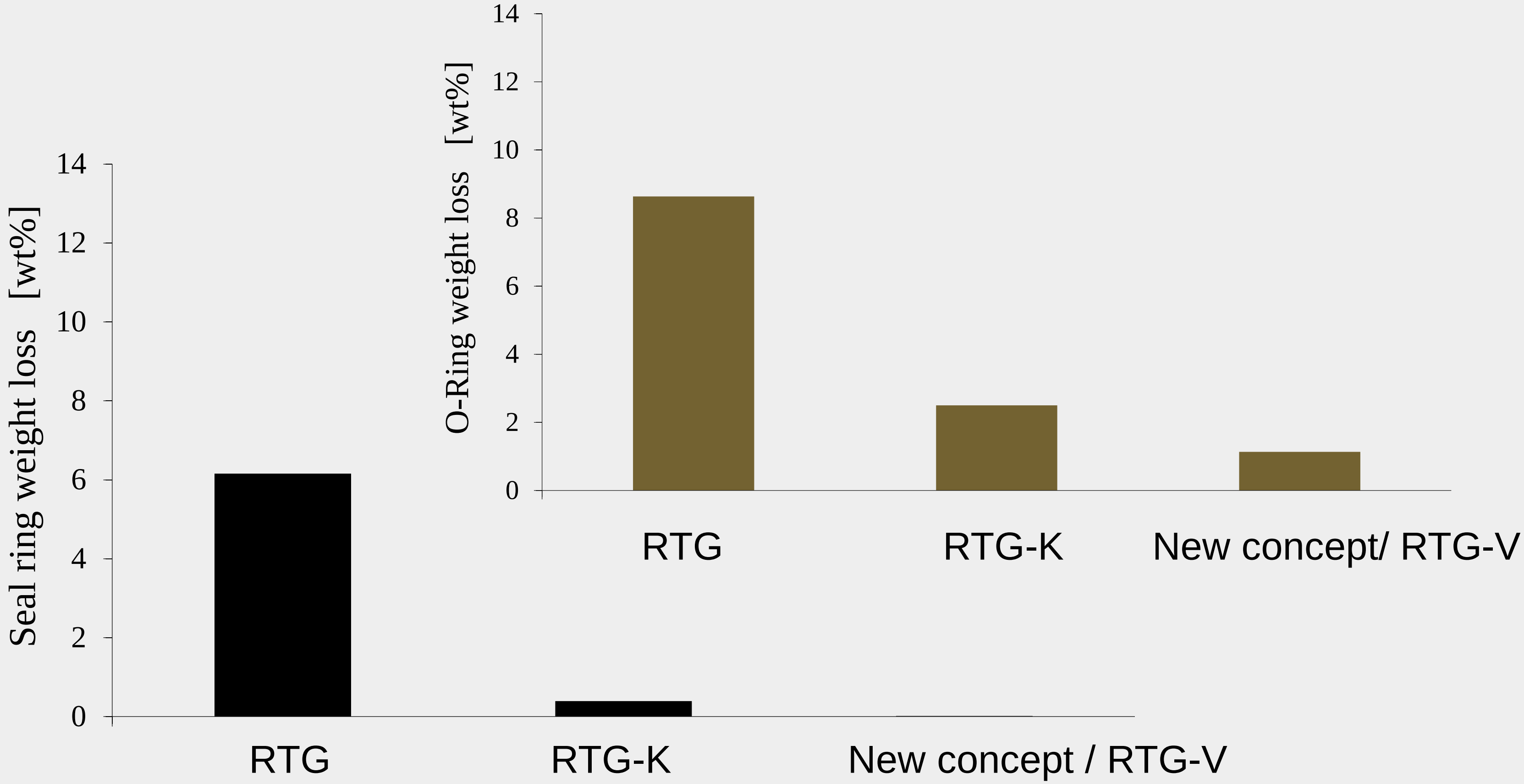


Rotary seal performance, Leakage / time



TRELLEBORG

Rotary seal performance, Seal wear

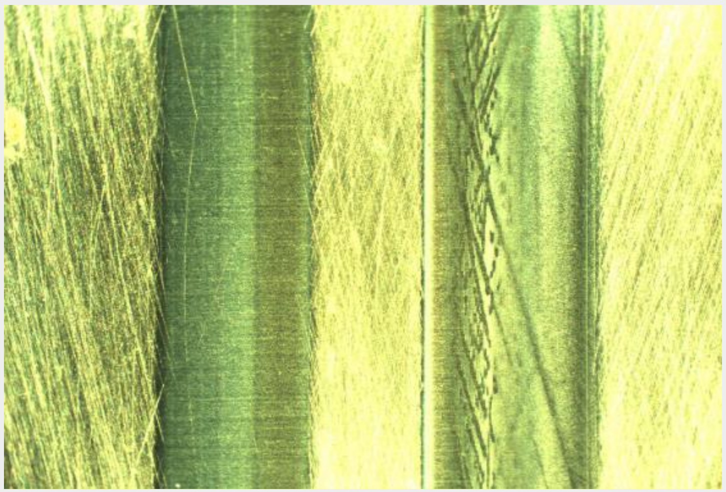


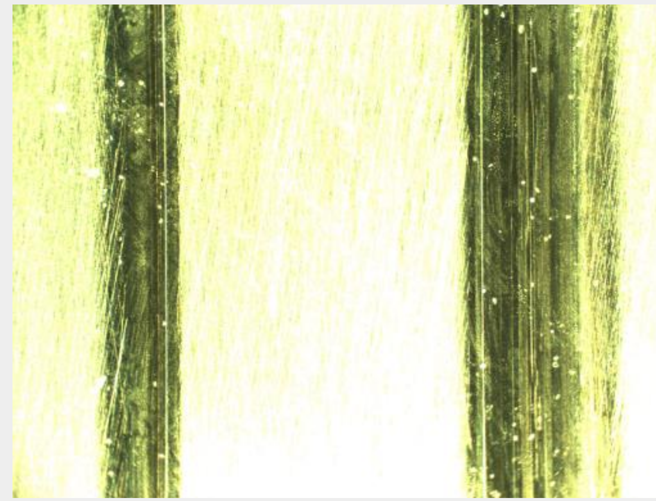
50 mm shaft, 50 bar x 1 m/s, 200 hours

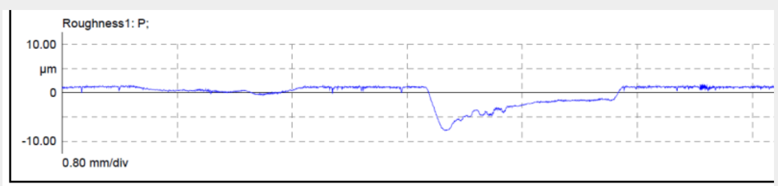
Rotary seal performance, hardware wear

Existing single-acting (RTG-K)

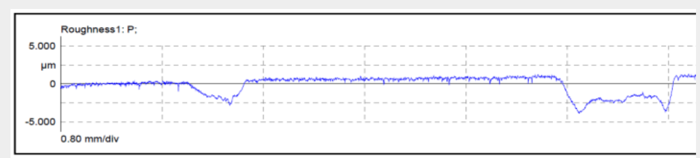
New Concept / RTG-V







P-profile parameters - Roughness1: P;				
Pt	9,5953 µm	0,0000		
Pv	1,6722 µm	0,0000		

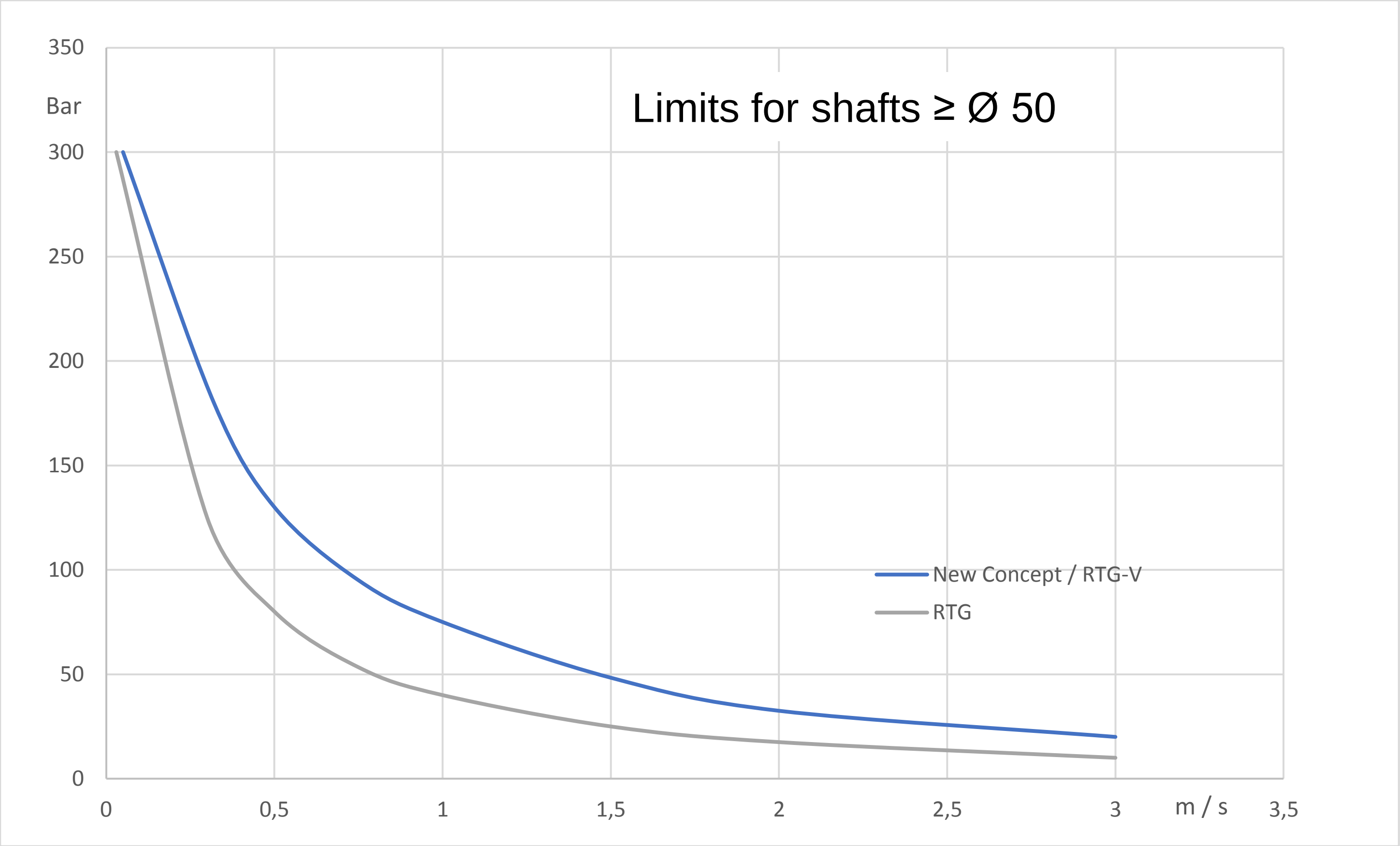


P-profile parameters - Roughness1: P;				
Pt	5,2146 µm	0,0000		
Pv	1,6756 µm	0,0000		

50 mm shaft, 50 bar x 1 m/s, 200 hours, pressure from left

TRELLEBORG

Rotary seal performance, Limits



Thank you for your attention

TRELLEBORG