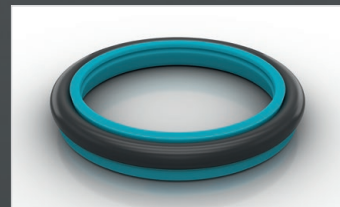
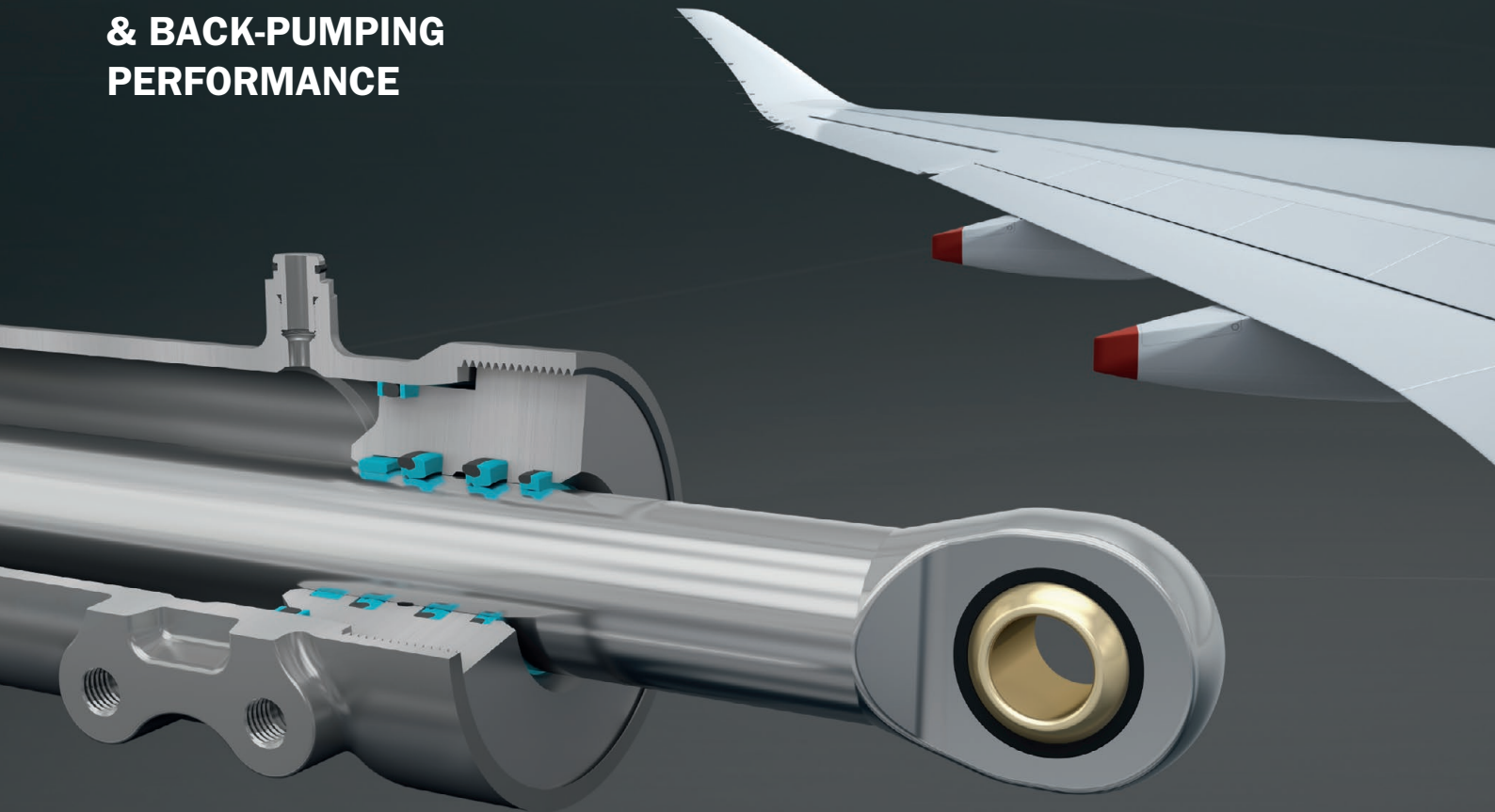


Turcon[®] VL Seal[®] II

**OPTIMIZED SEALING
& BACK-PUMPING
PERFORMANCE**



Updating a Winning Formula

ROM 390

With the Turcon® VL Seal® II, Trelleborg Sealing Solutions Aerospace is leading the revolution in hydraulic sealing of actuators in flight controls and landing gear, and seals in landing gear shock absorbers. Based on the groundbreaking and well-proven Turcon® VL Seal®, this new generation offers enhanced sealing efficiency, easier installation, and even greater reliability. Extensive testing proves its outstanding 'zero' leakage performance, to extend service life and minimize planned maintenance.

The innovative design of Turcon® VL Seal® II combines the unique back-pumping capability of Turcon® VL Seal® with new patented features. An angled seal back allows seal width adjustment according to service pressure, improving leakage control, while a leading protective front lip safeguards the sealing edge during hardware assembly. In addition, the seal's FEA optimized design improves support for and containment of the O-Ring.

'Sealed for life' means the seal lasts as long as the actuator itself. In addition, negating the need for drain lines and with a profile that allows smaller hardware design, the seal can make a significant contribution to an aircraft manufacturer's goal of weight saving and fuel efficiency. Used in a tandem sealing system, flight safety is increased and back-pumping enhanced.

BER 900

Turcon® VL Seal® II is available in a range of Turcon® materials for use in a wide variety of extreme operating conditions. These are combined with O-Ring compounds suitable for use in all hydraulic fluids and service parameters.

Exceeding current aerospace standards, Turcon® VL Seal® II is designed for installation in AS4716 O-Ring housing grooves, enabling it to be used in place of other O-Ring-energized and Turcon® solutions, including the original Turcon® VL Seal®, Turcon® Plus Seal®, Turcon® Wedgpak® and Turcon® Variseal®.

ZPH 343

Contributes to aircraft weight reduction

Zero leak performance

Increases flight safety

Extends actuator service life



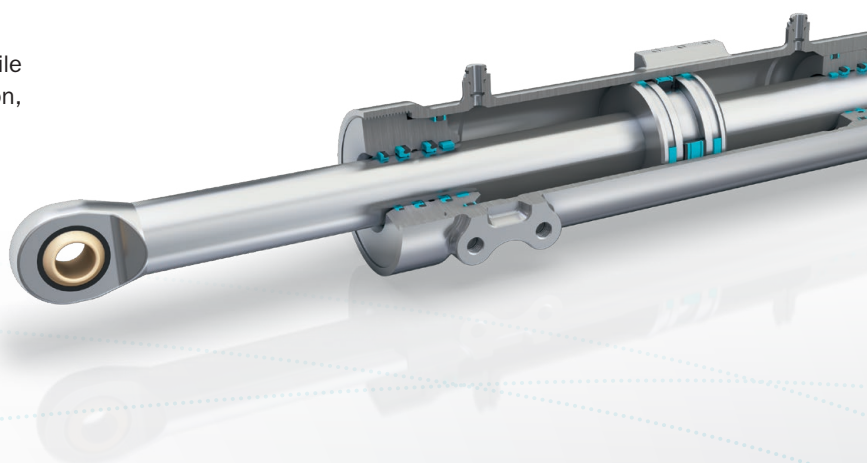
Turcon® VL Seal® Film

Visit the Films & Animations section on our website to see the Turcon® VL Seal® in action.

Applications

The Turcon® VL Seal® II is an extremely versatile seal. Because of its unique design and function, this seal is ideal for use in:

- Primary flight controls
- Secondary flight controls
- Landing gear actuation systems
- Helicopter flight controls
- Aircraft landing gear shock absorbers



Turcon® VL Seal® II is a unidirectional rod seal for reciprocating movements, consisting of an “L” shaped Turcon® jacket energized by an O-Ring.

Chamfered Seal Corner

Chamfer on outer diameter of seal permits rounded corners in the grooves, thereby reducing stress on the hardware

O-Ring Support

FEA optimized shape for efficient support of O-Ring

Extrusion Resistance

Eliminates extrusion with FEA optimized design

Turcon® Material

Meets demanding service conditions and provides low friction and stick-slip free operation

Elastomer O-Ring

Accommodates hardware tolerances and movements, material compounds available to meet application needs

Protective Front Lip

Safeguards against damage during hardware assembly

Sealing Edge

Reduces fluid transport during forward stroke

Back-Pumping

Sealing face enhanced to increase back-pumping during return stroke

Proven Performance

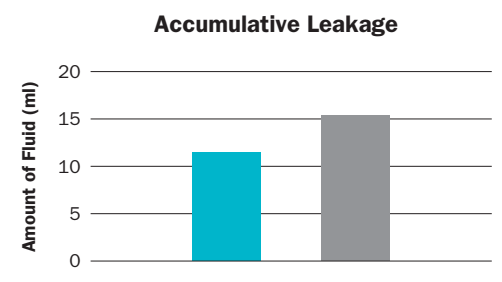
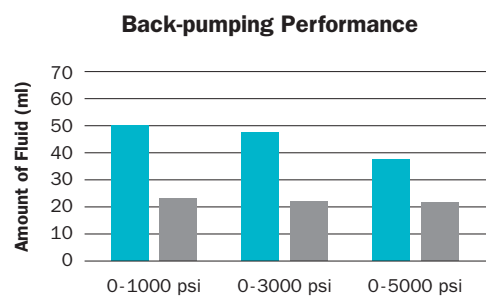
RIGOROUS TEST PROGRAM CONFIRMS ENHANCED LEAKAGE CONTROL AND EXTENDED SERVICE LIFE

Trelleborg Sealing Solutions global R&D facilities performed a series of tests, exceeding current aerospace standards, to compare the new Turcon® VL Seal® II to its predecessor, the Turcon® VL Seal®.

Tests were conducted, in aircraft operating conditions, to evaluate overall seal performance, in particular leakage control and the back-pumping effect.

Test Conditions	Back-pumping	Endurance
Cyclic Pressure	0-1,000 psi, 0-3,000 psi, 0-5,000 psi	0-5,000 psi
Cycles 1,000 psi = 7.9 MPa 3,000 psi = 20.7 MPa 5,000 psi = 34.5 MPa	Seal Break-in: 40,000, 60,000 @ 0-1,000 psi, 60,000 @ 0-3,000 psi, 60,000 @ 0-5,000 psi. 220,000 total	10,000,000
Speed	1 Hz	1 Hz
Stroke length	3" / 76.2 mm	3" / 76.2 mm
Fluid	Mil-PRF-83282	AS1241- Hyjet® V
Fluid temperature	+140 °F / +60 °C	+160 °F / +72 °C
Specimen size	50mm Rod, -3XX series cross section	AS4716-214 Rod, 2 BU Gland
Rod material	HVOF to Trelleborg Sealing Solutions Aerospace surface finish parameters	IHCP to Trelleborg Sealing Solutions Aerospace surface finish parameters
Results	Zero-leakage and enhanced back-pumping effect	Improved leakage control

■ VL Seal® II
■ VL Seal®





Primary flight control seal test bench

0-5,000 psi

1,872,000

various

various

AS1241- Hyjet® V

various

AS4716-329 Rod, 2 BU Gland

IHCP to Trelleborg Sealing Solutions Aerospace surface finish parameters

Improved leakage control and zero interstage pressure

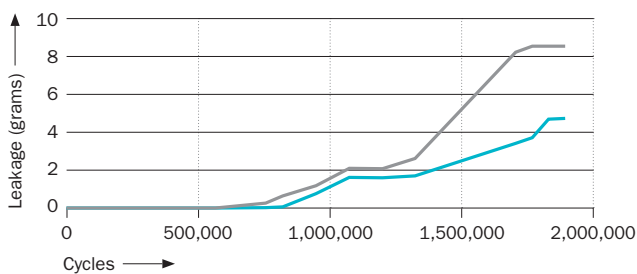
Trelleborg Sealing Solutions primary flight control seal test bench simulates extreme operating conditions:

- static or cyclic pressures up to 5,000 psi/ 345 bar
- dynamic operation across the entire phosphate ester fluid operating temperature range, -80 °F to +325 °F / -62 °C to +163 °C

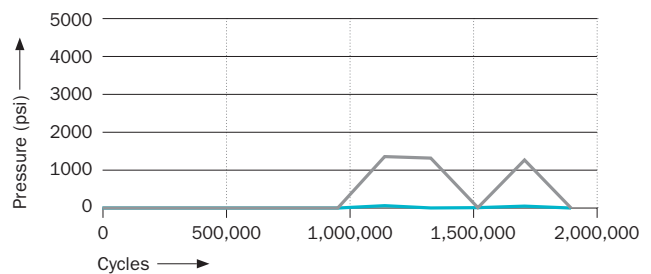
Expedited Testing

The test bench achieves pressure rise rates of up to 360,000 psi/second / 24,800 bar/second, enabling accelerated high frequency cycling up to 5 Hz, even under maximum pressure or extreme temperature conditions. This rapid multi-million cycle capability allows testing to occur in just weeks rather than months, considerably shortening the proving time of flight control applications.

Accumulative Leakage



Interstage Pressure

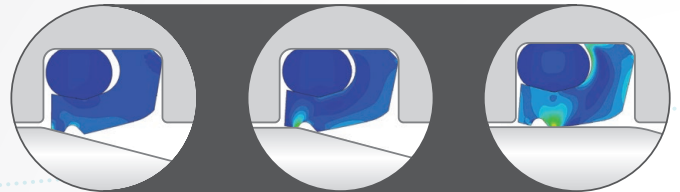


Seal Features

Protective Front Lip

The Turcon® VL Seal® II is equipped with an all new protective front lip, which shields the seal from damage during installation. During rod insertion, the protective front lip safeguards the sealing edge by lifting it off and away from the rod inlet and improving concentricity. This reduces the risk of accidental damage during assembly and improves system reliability.

When the rod is fully inserted, the protective front lip is lifted away from the rod, preventing contact between the rod and lip, thereby ensuring uninhibited sealing performance.



Rod insertion

Rod fully inserted

Hydrodynamic Properties

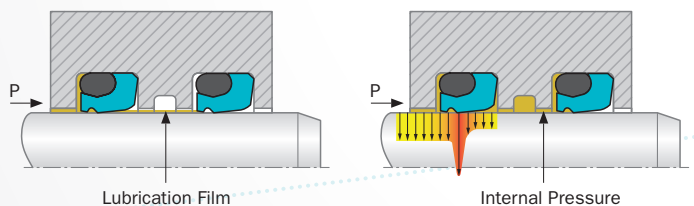
Turcon® VL Seal® II provides efficient static sealing through high prestress and contact pressure against the rod or bore, and direct elastomer contact in the housing groove. The extended contact face with the O-Ring, and the seal's concave back, protect the O-Ring from damage by keeping it in position and limiting movement under all working conditions.

Enhanced Back-pumping Performance

The Turcon® VL Seal® II offers reliable dynamic sealing, with an optimized back-pumping effect. The shape of the seal edge reduces the amount of fluid travelling out with the rod during the forward stroke, while the seal face works together with the angled seal back to support fluid transport back into the system, during the return stroke.

Pressure Distribution in Tandem Installation

The design of the Turcon® VL Seal® II, combined with the friction and wear performance of Turcon® material, minimizes friction in the system at all operating pressures. When the Turcon® VL Seal® II is installed together with another Turcon® VL Seal® II as the secondary seal and with double-acting scrapers, drain lines are not required to eliminate pressure being trapped between the seals. The tandem installation enhances the back-pumping effect, thereby ensuring high sealing efficiency.



Back-up Rings for Lubrication Management

Typically, Back-up Rings serve to protect a seal from extrusion, but they also potentially contribute to increased friction and wear.

However, the Back-up Rings supplied with the Turcon® VL Seal® II, uniquely combine seal protection with Lubrication Management technology. The Back-up Ring allows just enough fluid to pass and lubricate the entire system, thereby

decreasing friction and wear and extending hardware and seal life. The symmetric design of the Back-up Ring supports easy installation.

A Lubrication Management Back-up Ring will always be supplied alongside the Turcon® VL Seal® II, when it is requested for use in G1 and G2 grooves.

Part Number Guide

Turcon® VL Seal® II is available as a rod seal for AS4716 sizes, in 100, 200, 300 and 400 series and G0 (zero Back-up Ring), G1 (one Back-up Ring) and G2 (two Back-up Ring) groove widths for aerospace applications.

Installation Limits

Trelleborg Sealing Solutions Aerospace conducted installation testing to determine the sizes that can be installed into a closed groove.

Recommended Materials

Turcon® M12: Versatile material for light to heavy hydraulic applications with linear, short stroke or helical movements in mineral oils, flame retardant hydraulic fluids, phosphate ester, bio-oils or fluids having lubricating properties.

Turcon® M30: Designed for hard ceramic mating surfaces, it offers unrivalled performance at the higher hydraulic pressures of modern aircraft, up to 5,000 psi, and meets the extended expected working life of actuators of up to 60,000+ flight hours.

The O-Ring component is available in a wide range of elastomer materials to meet chemical compatibility requirements and operating parameter needs.

Series No.	Dash Size per AS4716
RE20	Not Available
RE21	110 - 149
RE22	210 - 247
RE23	325 - 349
RE24	425 - 460

Note that size 110 to 115 can only be installed in open grooves.

Ordering Example:

RE2 2 0 G 214 A M30 EP

Part number is incomplete without material suffixes

Cross Section
1 = 100 series
2 = 200 series
3 = 300 series
4 = 400 series

Quality index
A = Certificate of conformance

Turel® O-Ring material code

Execution mark

G0 Groove

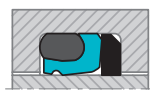
Zero Back-up Ring Width



0 Standard

G1 Groove

One Back-up Ring Width



Back-up Ring material:

- A** Zurcon® Z43
- B** Same as Seal Ring
- C** Turcon® T29

G2 Groove

Two Back-up Ring Width



Back-up Ring material:

- D** Zurcon® Z43
- E** Same as Seal Ring
- F** Turcon® T29

General guide to use of Back-up Rings:

Back-up Rings should be used at higher pressures and when the gap behind the seal exceeds the recommendations in AS4716.

Working pressure	Recommended configuration	Part number series*
0-3,000 psi	0-20 MPa	Turcon® VL Seal® II RE2X0
0- < 5,000 psi	0- <34 MPa	Turcon® VL Seal® II + Turcon® Back-up Ring RE2XB, RE2XC, RE2XE, RE2XF
0- < 5,000 psi	0- <34 MPa	Turcon® VL Seal® II + Zurcon® Z43 Back-up Ring RE2XA
≥ 5,000 psi	≥ 34 MPa	Turcon® VL Seal® II + Zurcon® Z43 Back-up Ring RE2XD

* X designates the series, e.g. „2“ = „200“ series

Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

Trelleborg Sealing Solutions is a leading developer, manufacturer and supplier of precision seals, bearings and custom-molded polymer components. It focuses on meeting the most demanding needs of aerospace, automotive and general industrial customers with innovative solutions.

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