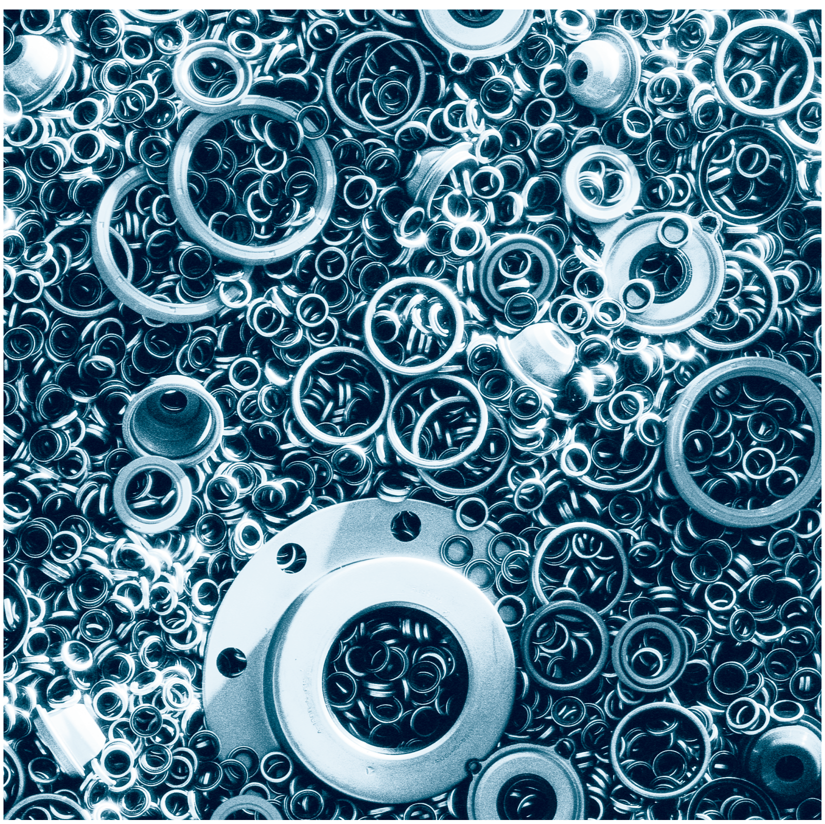
SEALING SYSTEM ANALYSIS

Sealing systems that have been properly designed and tested will prove to be extremely reliable and provide long service life. To optimize a seal design, it is recommended to involve deVries engineering in the original design development. For maximum sealing system efficiency and performance the seal and its adjacent components should be considered as a single unit in the design failure mode effects and analysis (FMEA) phase. It is our aim to help you minimize the number of components, simplify assembly, and reduce the need for costly manufacturing tolerances and procedures to create the best system results.

On occasions, sealing systems do fail and this section is designed to help you isolate the root cause of any failure. When an assembly leaks, the natural response is that the seal is bad. A thorough investigation is needed to correctly identify the root cause. It is necessary to review potential variations in system function and environmental conditions. In addition, shaft condition and function, bore condition and any wear or physical variation in the seal must also be examined.

This section is divided into three parts: a list of common reasons sealing systems fail and variables that lead to those failures, a preliminary guide to failure analysis, and a copy of the deVries International system failure analysis report. (See pages 44 and 45.) It is the goal of deVries International to provide immediate and thorough technical assistance in helping you evaluate any seal related failure. For best results, technical support is available by contacting deVries International's headquarters at 949-252-1212 or a regional sales office near you at the first sign of a problem.



SEALING SYSTEM ANALYSIS

COMMON REASONS FOR SEALING SYSTEM FAILURES

- Burrs on bore
- Cocked seal
- Corrosion on shaft
- Cracking of seal lip
- Deterioration of compound
- Dry start up
- Excessive shaft run out
- Excessive softening of compound
- Excessive stiffening of compound
- Extruded lip
- Inverted lip
- Lip wear
- Lubrication breakdown
- Missing spring
- Nicks or pits on shaft
- No bore lead-in chamfer
- Seal installed backward
- Seal slip-stick
- Shaft to bore misalignment
- Shaft wear
- Thermal expansion of bore
- Vibration
- Wrong seal designation

SEALING SYSTEM VARIABLES THAT CAN BE ROOT CAUSES OF SYSTEM FAILURE

ENVIRONMENTAL VARIATIONS

- Aggressive chemicals
- Dust and mud
- Ozone
- Paint
- Power washers
- Temperature
- Windings, grass or wire

HOUSING VARIATIONS

- Concentricity
- Diameter
- Finish
- Lead-in chamfer
- Material
- Roundness

OPERATIONAL VARIATIONS

- Cycle time
- Down time
- Pressure spikes
- Run hours
- Run time at maximum RPM
- Run time at maximum pressure

FLUID VARIATIONS

- Chemical activity
- Chemical breakdown
- Contamination
- Pressure
- Temperature
- Viscosity

SEAL ELASTOMER VARIATIONS

- Abrasion resistance
- Chemical stability
- Creep
- Cross-linking
- Crystallization
- Elastic vibration and dampening
- Frictional properties
- Hardness
- Resilience
- Stress relaxation
- Strain rate
- Thermal reversion
- Temperature hardening
- Volume change

SHAFT VARIATIONS

- Axial movement
- Chamfer
- Diameter
- Eccentricity
- Finish
- Hardness
- Roundness
- Speed
- Wear

SEAL CONFIGURATION VARIATIONS

- Barrel angle
- Case size
- Lip hoop load
- Lip beam hoop load
- Lip contact area
- Lip edge geometry
- Lip height
- Lip interference
- R-value
- Scraper angle
- Seal to bore interference
- Spring radial load

GUIDE TO PRELIMINARY SEAL SYSTEM FAILURE MODE ANALYSIS

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Early seal leakage	Nicks, tears or cuts on seal lip	Remove burrs or sharp edges from shaft. Use assembly bullet to protect seal from splines, keyways and shoulders.
	Rough shaft	Finish should be 10 to 20 Ra.
	Scratched or nicked shaft	Protect shaft at assembly.
	Machine lead on shaft	Plunge grind shaft.
	Shaft run out	Locate seal closer to bearing.
	Seal cocked in bore	Design proper installation tool.
	Paint on seal or shaft	Mask assembly before painting.
	Inverted lip	Lead-in chamfer should be no greater than 30 degrees and 32 Ra.
		Use tapered assembly bullet.
		Protect against power wash.
	Dislodged spring	Use tapered bullet and installation tool. Apply even installation force.
	Deformed case	Use correct assembly tool, apply even force. Protect seals prior to assembly.
Mid-life seal	Lip wear	Correct shaft finish, vent system leakage pressure, grease lips to prevent dry start up. Add internal lube to compound.
	Lip hardening or cracking	Check for elevated temperature or lack of lubrication. Use higher temperature compound or add internal lubrication.
	Lip softening	Check fluid/compound compatibility.
	Offset lip wear	Correct shaft to bore misalignment. Prevent cocked seal.
	Grooved shaft	Shaft hardness minimum 30 Rc. Reduce lip load. Add internal lubrication to compound. Check for contamination.
Outside diameter leakage	Damaged seal OD	Prevent scored or burred bore. Bore finish 125 Ra. Correct chamfer. Installation tool to prevent cocked seal.
	Deformed seal case	Use proper assembly tools and apply even load. Possible damage during seal transit or storage.
	Tool marks on bore	Use proper machining techniques.
	Oversize bore	Make to diameter recommendations in bore section of this handbook.