O-Ring Failure Chart

EXTRUSION OR NIBBLING

The seal develops ragged edges, generally on the low pressure side, which appear tattered. This condition is more common with high pressure



CONTRIBUTING FACTORS:

- Excessive clearances
- · Irregular clearance gaps due to eccentricity
- Sharp groove edges
 Low-modulus/low-hardness elastomer
- · Softening of elastomer due to fluid incompatibility
- Excessive gland fill
- . Expansion of cylinder wall due to pressure

SUGGESTED SOLUTIONS

- Decrease clearances
- Decrease system pressure if possible
- · Use back-up ring
- Increase rigidity and concentricity of metal components
 Break edges of groove to minimum of .004" (0.10mm)
- Use higher-modulus/higher-hardness elastomer
 Use more chemically compatible elastomer
 Increase groove width or change o-ring size

- · Stiffen cylinder wall to limit expansion

SPIRAL FAILURE

The seal surface exhibits a series of deep, spiral, 45° angle cuts. This failure is often seen with longstroke, hydraulic piston seals.



CONTRIBUTING FACTORS:

- Eccentric components
- · Wide clearances in combination with side locks
- Uneven surface finishes
 Inadequate lubrication

DESCRIPTION:

Elastomer is too soft
 Stroke speed too slow - dynamic reciprocating

Explosive decompression results when high-pressure gases are absorbed by the seal, and then, as the pressure is rapidly dropped, the expanding gases are

trapped in the micropores of the elastomer, causing surface blisters and ruptures as they escape. The effected seals will exhibit random short splits or ruptures

deep into the seal cross-section. When first removed the surface may also be covered with small blisters.

EXPLOSIVE DECOMPRESSION

- Increase rigidity and concentricity of metal components
- · Decrease clearances

SUGGESTED SOLUTIONS:

· Slow the release of system pressure

Specify a higher-modulus/higher-hardness material
 Specify a decompression-resistant material

Use a higher durometer material
 Increase stroke speed or use D-ring instead of 0-ring

- Machine metal surfaces to 10 to 20 pinch surface finish
 Specify an external lubricant or use an internally
- lubricated material

CHEMICAL DEGRADATION

including blisters, cracks, voids, or discolouration. However, in some cases the degradation is only detectable by measurement of physical properties.

CONTRIBUTING FACTORS:

· Incompatibility with chemical environment

SUGGESTED SOLUTIONS:

- · Use more chemically resistant elastomer
- temperatures accelerate chemical degradation

ABRASION

CONTRIBUTING FACTORS:

· Rapid pressure drop from high pressure

Low-modulus/low-hardness elastomer

DESCRIPTION:

Abrasion occurs only with dynamic seals - seals involved with a rotary, oscillating or reciprocating motion. The seal or parts of the seal exhibit a single flat surface parallel to the direction of motion. Loose particles and scrapes may be found on the seal surface.



CONTRIBUTING FACTORS:

- · Rough sealing surface
- · Sealing surfaces too smooth to allow for adequate
- · Process environment containing abrasive particles

SUGGESTED SOLUTIONS:

- · Use recommended gland surface finishes · Use recommended gland surface finishe
- · Eliminate abrasive components or protect seal from

CONTRIBUTING FACTORS:

- temperature properties or hardness

SUGGESTED SOLUTIONS

- Switch to elastomer with low-temperature properties so plasticizers aren't needed
- Change plasticizers used to ones less compatible with

INSTALLATION DAMAGE

DESCRIPTION:

The seal or parts of the seal may exhibit small cuts.



CONTRIBUTING FACTORS:

- · Sharp surfaces on glands or components
- · Inadequate lead-in chamfer
- . O-ring too large for gland
- SUGGESTED SOLUTIONS:
- . Break all sharp metal edges and cover threads with
- tubes or tape for installation Provides a 15º lead-in chamfer of adequate length so
- o-ring sees only chamfer

 Review gland and o-ring design per recommended
- design standards · Specify a higher-, odulus/higher-hardness material

- . Exposure to ozone, UV radiation or other
- Excessive seal stretch (>5% ID stretch)

SUGGESTED SOLUTIONS:

- Apply anti-ozonant or wax coating to seal
 - Modify the design to avoid the damaging exposure



OVER-COMPRESSION

DESCRIPTION:

The seal exhibits parallel flat surfaces corresponding to the sealing surfaces. May also develop circumferential splits within flattened



CONTRIBUTING FACTORS:

- Excessive compression squeeze
- · Elastomer with inadequate heat resistance
- · Elastomer that swells excessively in system fluid Improperly cured part used

CONTRIBUTING FACTORS:

· Thermal properties of elastomer

or temperature cycling

- Use smaller o-ring or adjust gland dimensions
 Use material with better compression set resistance
- Use more heat resistant elastomer
- Use more chemically resistant elastomer
 Check cure state of parts prior to installation

HEAT HARDENING/THERMAL DEGRADATION

The seal may exhibit radial cracking on the highest temperature surfaces, often accompanied by the flattening of the seal characteristics of over-compression. Certain elastomers may exhibit signs



of softening, such as a shiny surface.

Excessive temperatures, temperature excursions



SUGGESTED SOLUTIONS

- Select more heat-resistant elastomer
- · Select elastomer containing antioxidants
- Consider possibility of cooling sealing surfaces
 Increase thermal mass to dampen temperature cycling
- Change the position of the gland away from heat

DESCRIPTION:

The seal may exhibit many signs of degradation



Use PTFE encapsulated o-ring
 Decrease temperature that o-rings sees, as higher

PLASTICIZER EXTRACTION

DESCRIPTION:

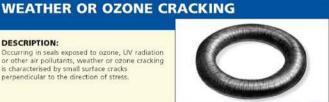
Seen primarily in fuel systems, plasticizer extraction is characterised by a loss of volume or weight of the seal. It is often difficult to detect with only a visual inspection.



- Heavy use of plasticizers to achieve low-

DESCRIPTION:

Occurring in seals exposed to ozone. UV radiation or other air pollutants, weather or ozone cracking is characterised by small surface cracks perpendicular to the direction of stress



CONTRIBUTING FACTORS:

- · Select more ozone and UV-resistant elastomer
- . Modify design to reduce stretch to less than 5%

· Low-modulus/low-hardness elastomer