

# EXPERT KNOWLEDGE FAILURE ANALYSIS OF ELASTOMER COMPONENTS *SHORT VERSION*

An offer of

**O RING**  
**PRÜFLABOR**  
**RICHTER**

TESTING CONSULTING DEVELOPING

Source: [www.o-ring-prueflabor.de](http://www.o-ring-prueflabor.de)

Information as of 01/2019

## **Excessive Abrasion** **The Elastomer Seal: A Soft Partner in a Hard Environment**

Authors:

Dipl.-Ing. Bernhard Richter,  
Dipl.-Ing. (FH) Ulrich Blobner

In literature, the damage pattern "excessive abrasion" is also referred to as "excessive wear and tear" or "abrasion wear".

This type of damage mainly occurs with moving seals and can have many different causes.

Generally, rubber seals are many times softer than the components in which they are mounted and are therefore susceptible to damage and abrasion. Particular care must be taken with moving seals to ensure that the mating surface (**Fig. 1**) is as smooth as possible (up to approx.  $1\mu\text{m R}_z$ ) and has no sharp edges or transitions.

Due to abrasive solid particles (hydroabrasion, **Fig. 2**) dissolved in media, scoring usually occurs in the sealing surfaces, which are washed out and enlarged by erosion.

When machines are started up for the first time, dynamically used seals usually undergo a short dry run until they are supplied with lubricant. This is not problematic for short periods of time. However, if lubrication fails to occur during operation, the seal can be so severely abraded after a short time that it fails completely.

A frequent constructive error is an imprecisely defined surface condition of the mating surfaces. Not only the roughness should be specified, but also the machining process and the topology of the surfaces. Too little pre-compression of the seal (e.g. missing consideration of the diameter play) can lead to flow erosion.

In the event of hard pressure surges in hydraulic systems, seals used statically can also experience abrasion. If the seal bushing has too much axial play (**Fig. 3**), the "static" seal can still be severely damaged despite the small axial stroke (a few tenths of a millimeter) due to the frequent pressure surges.

Unsuitable seal formulations may cause excessive abrasion. Mixtures with active fillers are recommended. The base polymer and the cross-linking density of the finished seal are also important. Thermoplastic polyurethane rubbers are particularly suitable for extreme abrasion resistance requirements.

A change from lubricants can be critical. Sometimes these alternative lubricants have poorer tribological properties, if the mixed friction phase is considerably extended as a result.

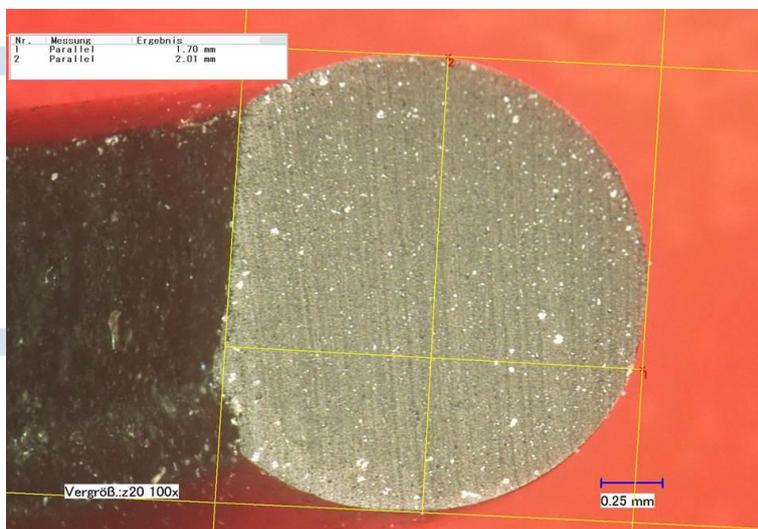
Excessive seal swelling (>10%) can also cause unwanted abrasion.

## Damage Pattern and Problematic Areas

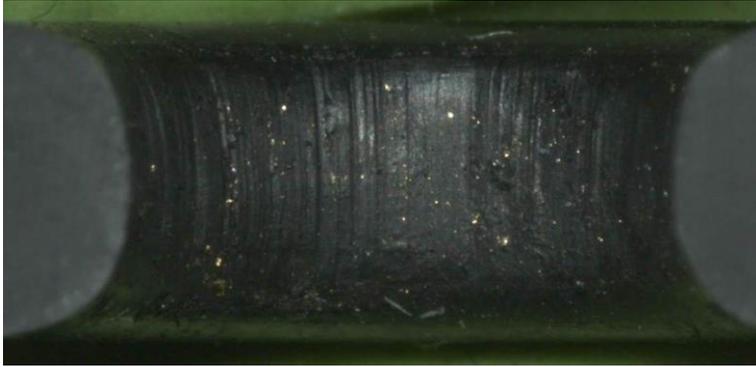
In general, after abrasion wear, the damaged seals show a verifiable loss of mass. Two types of damage are most evident in areas where material has been abraded:

Either the damaged surface is smooth and shiny (flat wear) or it shows scoring with or without particle residue.

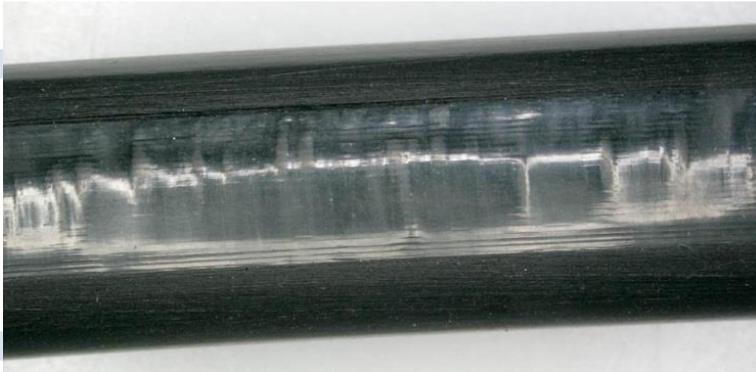
With abraded seals, the elasticity of the material is normally completely preserved, so there are no signs of ageing.



**Fig. 1:** Excessive abrasion caused by a poor mating surface



**Fig. 2:** Inside of a cut EPDM O-ring from a thermostatic valve: Metal particles are clearly visible in the grooves (hydroabrasion).



**Fig.3:** Abrasion of a "statically" used O-ring by axial stroke

## Differentiation from Similar Types of Damage

The damage "Permanent deformation" can at first glance resemble excessive abrasion. Erosion damage to seals caused by excess air or blowby effects can create score-like structures similar to hydroabrasion.

## Preventative Measures

An important preventive measure against hydroabrasion is regular oil maintenance and the use of suitable filters. In addition, wipers are recommended for rod seals, as well as the use of abrasion-resistant, high-quality seal formulations.

## Practical Tips (Testing Possibilities / Standard Recommendations)

Although there are abrasion test methods (e.g. DIN ISO 4649), these only facilitate the pre-selection of materials for sealing applications.

The suitability with regard to abrasion should be demonstrated in test rigs that are as realistic as possible.