EXPERT KNOWLEDGE

FAILURE ANALYSIS

OF ELASTOMER COMPONENTS

SHORT VERSION

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Assembly Damages –
An Often-Underestimated Cause of Damage

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The risk of assembly damage to gaskets can be largely ruled out by means of an assembly-friendly design of installation spaces, the use of assembly greases and coatings and the use of assembly aids. 10% of all failures are caused assembly damage, which shows that this topic is often underestimated. In practice, it is important to interpret the failure patterns correctly in order to identify the real cause.

Damage Pattern and Problematic Areas

The typical feature of a mounting error is the short operating time (usually <100 h) until failure. Since this is also characteristic of manufacturing faults, it is often necessary to distinguish between these two fault patterns. Occasionally, the damage pattern of gap extrusion also resembles that of assembly damage (over-compression).

Damage Pattern "Partial Shearing During the Joining Process"

If a piston part is not guided when it is inserted into the cylinder part, there is danger that the oblique insertion will displace the sealing material and move it in a circumferential direction (instead of in an axial direction). In this case, material accumulates in the area not yet inserted and the seal is lifted out of the groove. During automatic assembly or during "dynamic" manual assembly, some material may be sheared off at the outer diameter when this side is inserted (see **Fig. 1**).

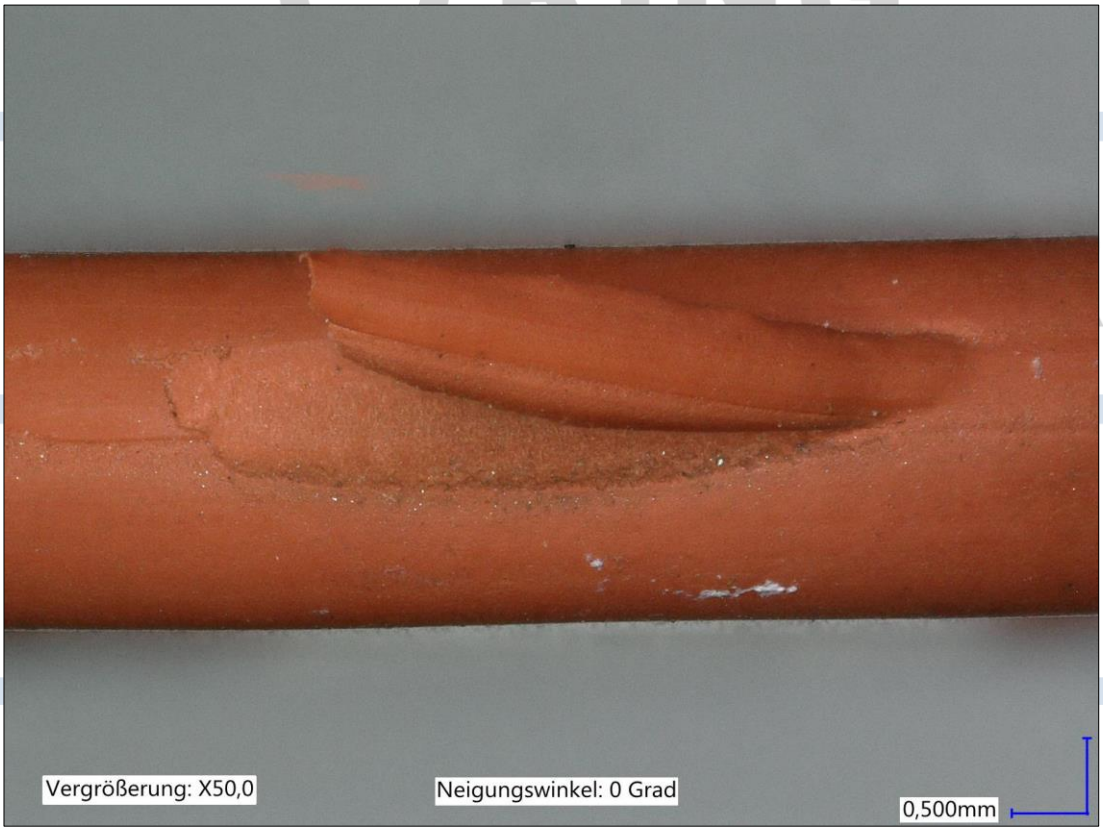

Fig.1: Material shearing due to non-centric insertion of a piston

Damage Pattern "Over-Compression Due to Misalignment"

Over-compression (see **Fig. 2**) is relatively easy to recognize as assembly damage because it's caused by incorrect positioning during assembly. The over-compressed areas can either be connected to the rest of the seal or completely separated from it. They differ from

operational gap extrusion tags in that they are significantly thicker than these. In addition, over-compressed areas can sometimes show impressions of the housing.

Fig. 2: Crushed due to incorrect positioning of the seal

Damage Pattern "Tear Due to Sharp Edges in the Installation Space"

Since rubber seals have to be deformed considerably during the assembly process, the high assembly forces required can lead to high line pressures at the edges when mounting, especially when not lubricated. If these edges are not cleanly rounded or chamfered, this can lead to a cut during assembly (see **Fig. 3**).

Fig. 3: Installation-related crack due to the effect of a sharp edge in the installation space

Differentiation from Similar Types of Damage

As mentioned above, the challenge for the Sealing Specialist is to clearly differentiate between the assembly fault and the manufacturing fault, and in some cases, assembly-related overstressing (e.g. excessive expansion), which causes violent fractures. However, the differentiation from other damage mechanisms can often be made solely on the basis of the time to failure, which is very small in the case of assembly errors.

Preventative Measures

In order to avoid assembly errors with O-rings, see ISO 3601-2, for more information on the design of insertion chamfers and edge radii. These specifications may also apply to other seals as guide values. In addition, it is advisable to study manufacturer information and attend specialist seminars.

Practical Tips

If in the event of a failure, the cause of the damage cannot be clearly traced back to an assembly fault, it is advisable to consult an independent specialist in order to be able to reliably rule out manufacturing defects as the cause of failure or, if necessary, to be able to represent the defect pattern confidently in dealings with the seal supplier.