More Common Reasons For O-Ring Failure | 1

A few weeks ago on this blog, we discussed a few of the common reasons for O-Ring failure.

Typically, O-Rings fail due to adverse effects of a number of factors, from improper installation and lubrication to incorrect size and design.

Today we’ll continue that discussion by looking at three more reasons why O-Rings fail, along with ways to identify and correct these failures.

1. **Installation Damage**

   The O-Ring may have a simple appearance, but it is a precise device that needs care during installation. Improper installation can cause O-Rings to fail.

   Damage to an O-Ring during installation can occur when:

   - There are sharp corners on mating metal components over which the O-Ring must pass during assembly.
   - Insufficient lead-in chamfer.
   - Blind grooves on multi-port valves.
   - Oversize or undersize O-Rings on pistol seal applications.
   - O-Ring pinched or twisted during installation.
   - O-Ring dirty or not properly lubricated during installation.
   - O-Ring gland or other surfaces over which the ring needs to pass during assembly contaminated by metal particles.
• General carelessness.

The best way to avoid O-Ring damage during installation is simple common sense, applied to these specific solutions:

• Break sharp edges on all metal components.
• Provide a 20 degree lead-in chamfer.
• Be sure all components are clean before installation.
• Tape all threads the O-Ring will pass over.
• Provided it won’t contaminate the system, use an O-Ring lubricant such as Parker O-Lube or Parker Super O-Lube.
• Double check O-Rings to be sure you’ve got the right size and material.

And finally, there’s one more step, one that applies to any work you do: BE CAREFUL.

2. **Spiral Failure**

This type of O-Ring failure is found on long-stroke hydraulic piston seals and – to a lesser degree – on rod seals. Spiral failure happens when the seal gets “hung up” at one point on its diameter (against the cylinder wall) and slides and rolls at the same time. This twists the O-Ring as the sealed device is cycled and finally causes a series of deep spiral cuts (typically at a 45 degree angle) on the surface of the seal.

Conditions that may cause this damage to occur are:

• Eccentric components.
• Wide clearance combined with side loads.
• Uneven surface finishes.
• Improper/inadequate lubrication.
• O-Ring too soft.
• Stroke speed (usually too slow).
• Improper installation causing the O-Ring to become rolled or pinched.

Solutions to spiral failure are:

• Improve surface finish of sealed assembly at dynamic interface (cylinder bore, piston...
More Common Reasons For O-Ring Failure | 3

- Look for out-of-rod components (cylinder bores particularly).
- Provide proper lubrication, and consider using internally lubed O-Rings.
- Use a harder O-Ring.
- Consider using alternate seal shapes. For example, the Parker T-Seal is designed specifically to avert spiral failure. Using it will allow for increased tolerances thanks to its built-in anti-extrusion back-up rings. Parker T-Seals will fit a number of standard AS568 O-Ring grooves and may directly interchange with O-Rings in most cases.

We should also mention that you can spot spiral failure simply by looking for the cuts that give this type of O-Ring failure its name.

3. **Explosive Decompression**

This type of O-Ring failure is one we see more frequently as system pressures increase. It could be called “O-Ring embolism,” in that after a period of service under high pressure gas, when the pressure is reduced too quickly, the gas trapped within the O-Ring expands rapidly, causing small ruptures on the O-Ring surface.

Explosive decompression, also called gas expansion rupture, is caused by high pressure gas trapped inside the elastomeric seal element. Rapid drop in system pressure causes the gas to expand to match the external pressure. This expansion causes blisters and ruptures on the surface of the seal.

If the volume of trapped gas is small, the blisters could recede as the pressure equalizes, without effecting the integrity of the seal. But too much trapped gas could lead to total destruction of the seal.

Solutions to explosive decompression are:

- Increasing the decompression time to allow trapped gas to leave the seal.
- Choosing a seal material that has a good resistance to explosive decompression.
- If the problem persists and pressures are very high, consider switching to a Parker Metal Seal.

A seal subjected to explosive decompression will often show small pits or blisters on the
surface. In more severe cases, an examination of the inside of the O-Ring will show other splits or fissures.

For more information on O-Ring failure, and uses for O-Rings, be sure to download Gallagher Seals’ complete O-Ring Design Guide.