

Observation:

During seal face inspection, the mating ring exhibits **two dominant high-contact zones**, typically positioned approximately **180° apart**, while the remaining circumferential regions show reduced or negligible contact. The seal ring generally shows full **360° contact**. Typical visual indicators include:

- Two distinct, heavily worn contact spots on the mating ring surface, diametrically opposed to each other. While contact intensity gradually fades away between the two high-contact regions.
- Seal ring shows full circumferential contact.
- Possible scoring on the mating ring surface, cross-hatched or circular scratches due to particles entered in gaps of the out-of-flat mating surface.
- Seal faces fail flatness verification during optical inspection.

These observations indicate that the sealing faces did not remain parallel during operation. Instead, the mating ring adopted a globally distorted shape, resulting in two dominant contact zones, commonly referred to as **Two-Spot Contact**. Scoring is secondary manifestations that support diagnosis but are not critical to the failure mechanism itself.

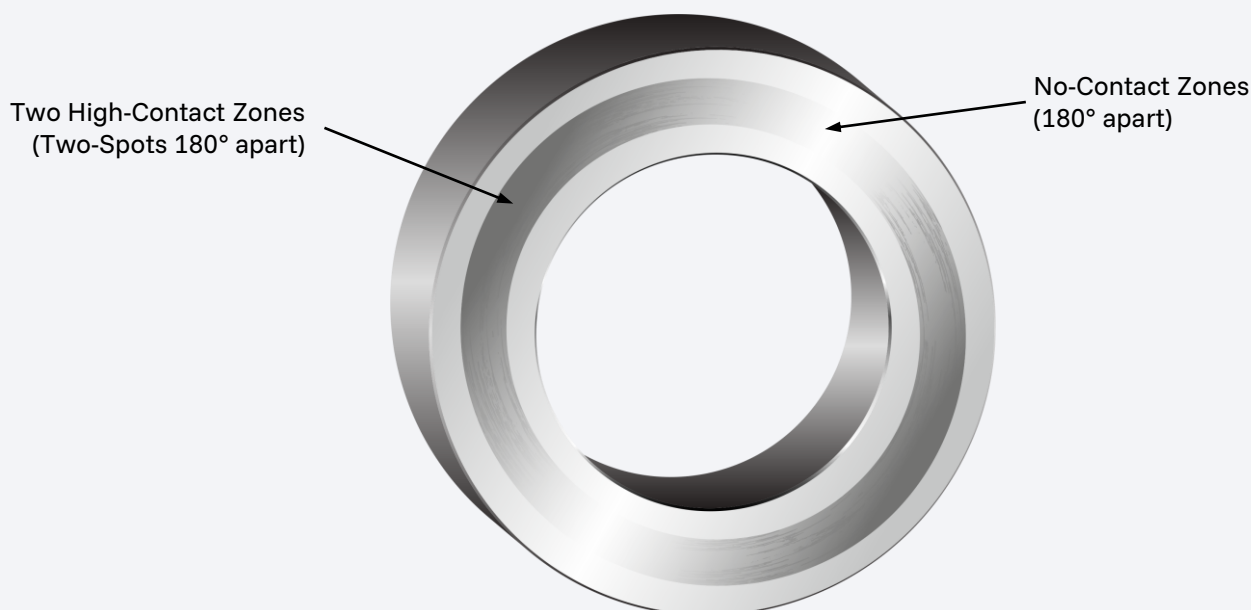


Figure 1: Illustration of a Mating Ring with Two-Spot Contact

Symptom:

- Seal leaks steadily when the shaft is **rotating** or **stationary**, due to loss of uniform face contact.

Root Cause

Two-Spot Contact occurs due to **global distortion of the gland or seal plate**, which prevents the mating ring from remaining flat and parallel to the seal ring during operation. This distortion causes the mating ring to develop two dominant high-contact zones, typically located approximately 180° apart.

The distortion is mostly introduced during installation and assembly. Excessive or uneven tightening of gland bolts, improper bolt tightening sequence, or over-torquing can elastically or plastically deform the gland or seal plate. When the distorted gland or seal plate **clamps the mating ring**, the mating surface adopts a **non-flat geometry**, leading to **localized contact** rather than uniform face loading.

Additional contributing factors include:

- **Inadequate stiffness of the gland or seal plate**, making it susceptible to bending under normal bolt loads, operating pressure, or non-uniform gasket compression, which can amplify plate distortion when bolt loads are uneven.
- **Improper seating or support of the mating ring**, allowing distortion from the plate to be directly transferred to the seal face.

As a result, the sealing faces fail to maintain parallelism. Instead of achieving uniform circumferential contact, **sealing occurs primarily at two localized regions**. This condition leads to unstable sealing performance and promotes secondary effects such as **localized wear and scoring**, but the fundamental root cause remains structural distortion of the gland or seal plate induced during installation or assembly.

Corrective Actions for Possible Root Causes:

Sr	Possible Cause	Corrective Action
1	Gland / Seal Plate Distortion	<ol style="list-style-type: none"> 1) Verify Gland / Seal Plate bolt torque against manufacturer recommendations; If bolt loading is suspected to be excessive or non-uniform: <ol style="list-style-type: none"> a) Use calibrated torque tools and follow a cross-pattern tightening sequence to achieve uniform bolt loading. b) Avoid reusing overstressed, stretched, or damaged bolts, which can lead to uneven clamping forces. c) Train installation personnel on correct bolt torque and tightening sequences. 2) Review Gland / Seal Plate thickness and material selection for adequate rigidity; If distortion is suspected under operating or assembly loads: <ol style="list-style-type: none"> a) Upgrade to a thicker, stiffer, or reinforced plate. 3) Verify gasket selection and installation for uniform support; If non-uniform gasket compression is suspected: <ol style="list-style-type: none"> a) Use gaskets with appropriate thickness and hardness to minimize excessive compression. b) Replace gaskets showing signs of uneven compression, damage, or permanent set.
2	Lack of Flatness or Squareness	<ol style="list-style-type: none"> 1) Inspect flatness at the respective mating surfaces of the <i>Gland / Seal Plate–Seal Chamber</i> and <i>Gland / Seal Plate–Mating Ring</i> using bluing or optical methods. Correct surface errors by re-machining or replacing parts if required. 2) Ensure the mating surfaces are free of nicks, burrs, or damage before installation. 3) Ensure Gland / Seal Plate squareness to the shaft centerline during installation to prevent angular misalignment.