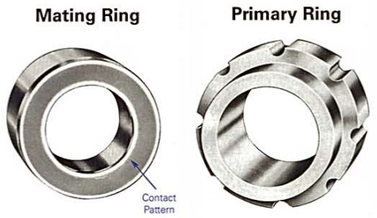
John Crane IDENTIFYING CAUSES OF SEAL LEAKAGE

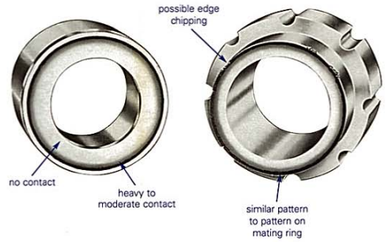
1 Full Contact Pattern



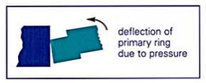
Observation:
Typical contact pattern for a non-leaking seal. Full contact on the mating ring surface through 360°. Little or no measurable wear on either seal ring. If leakage is present with this type face pattern, the secondary seals must be examined.

SYMPTOM OF SECONDARY SEAL LEAKAGE	CAUSES	CORRECTIONS
Seal drips steadily. Shaft rotating or stationary.	1. Secondary seals nicked or scratched on installation. 2. Damaged or porous secondary seal surfaces. 3. Compression set of O-rings. 4. Chemical attack of secondary seals.	1. Replace secondary seals. 2. Check secondary sealing surfaces. 3. Check for proper materials with seal manufacturers. 4. Check for proper lead in chamfers, burrs, etc.

2 Coning (Negative Rotation)

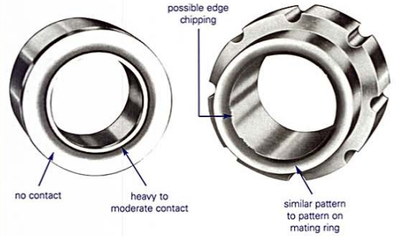


Observation:
Heavy contact on the mating ring pattern at the outside diameter of the seal. Fades away to no visible contact at the inside diameter of contact pattern. Possible edge chipping on the outside diameter of primary ring. May not leak initially, but may after weeks, months, etc.



SYMPTOMS	CAUSES	CORRECTIONS
Little or no leakage when new. After running, leaks steadily.	1. Faces not flat due to pressure. 2. Faces not flat. Incorrect lapping.	1. Check for over pressurization of seal. 2. Check flatness of lapped parts.

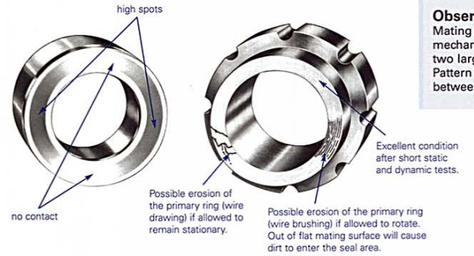
3 Thermal Distortion (Positive Rotation)



Observation:
Heavy contact on the mating ring pattern at the inside diameter of the seal. Fades away to no visible contact at the outside diameter of contact pattern. Possible edge chipping on the inside diameter of the primary ring.

SYMPTOMS	CAUSES	CORRECTIONS
Seal should leak initially when shaft is rotating. Usually no leakage when shaft is stationary.	1. Thermal distortion of seal faces. 2. Faces not flat. Incorrect lapping.	1. Improve cooling to seal. 2. Consult seal manufacturer for proper materials. 3. Check flatness of lapped parts.

4 Mechanical Distortion



Observation:
Mating ring is distorted mechanically, creating two large contact spots. Pattern fades away between contact areas.

SYMPTOM	CAUSE	CORRECTIONS
Seal leaks steadily when shaft is rotating or stationary.	Faces not flat.	1. Check for gland distortion due to over torquing of bolts. 2. Check squareness of parts used to clamp mating ring in place. 3. Check seal chamber face flatness of split case pumps. 4. Check the gland surface in contact with the mating ring. Must be free of nicks and burrs. Surface must show full pattern when blued with mating ring.

5 Mechanical Distortion

Observation:
Mating ring is being distorted mechanically, creating contact through approximately 270°. Pattern faces away at the low spot.

SYMPTOM	CAUSES	CORRECTIONS
Seal leaks steadily when shaft is rotating or stationary	Faces not flat.	1. Check for gland plate distortion due to over torquing of bolts. 2. Check for high seal chamber pressure. 3. Check for squareness of parts used to clamp mating ring in place. 4. Check seal chamber face flatness. 5. Check the gland surface in contact with the mating ring. Must be free of nicks and burrs. Surface must show full pattern when blued with mating ring.

6 Mechanical Distortion

Observation:
Mating ring is being distorted mechanically, creating contact at bolts. High spots are at each bolt location.

SYMPTOM	CAUSE	CORRECTIONS
Seal leaks steadily when shaft is rotating or stationary.	Faces not flat.	1. Check for gland plate distortion due to over torquing of bolts. 2. Change to softer gasket materials between seal chamber and gland plate. 3. Provide full face gasket contact or contact above centerline of bolts to prevent bending of gland plate.

7 High Wear or Thermally Distressed Surface

Observation:
High wear of mating ring or thermally distressed surface (heat checking) through 360°. High primary ring wear with carbon deposits on atmosphere side of seal. Possible edge chipping of primary ring due to opening and closing of seal faces. For dry-running, contact pressure may be too high. A mating ring of Silicon Carbide may exhibit a single stress crack.

SYMPTOMS	CAUSE	CORRECTIONS
Seal leaks steadily. Shaft rotating or stationary. Sound from flashing or face popping.	Sealed liquid vaporizing at seal interface.	1. Check pressure and temperature of fluid at pump suction and compare to vapor pressure of fluid at suction temperature. Suction pressure should be significantly above vapor pressure. 2. For multiple stage pumps check to be sure that seal chamber pressure taken off one of the stages is high enough to prevent flashing. 3. Check if seal is set at working height (not solid height). 4. Check for proper running clearances between shaft and primary ring at operating temperature. 5. Increase cooling to seal faces. 6. Improve distribution of flush (cooling) around the seal faces.

8 Section of Thermally Distressed Surface

Observation:
Thermally distressed area approximately 1/3 of the contact pattern. Distressed area 180° from inlet of seal flush. High primary ring wear with possible carbon deposits on atmosphere side of seal.

SYMPTOMS	CAUSE	CORRECTIONS
Seal drips steadily when shaft is rotating or stationary. Possible sound from flashing or face popping.	Sealed liquid vaporizing 180° from seal flush.	1. Check pressure and temperature of fluid at pump suction and compare to vapor pressure of fluid at suction temperature. Suction pressure should be significantly above vapor pressure. 2. Check for proper bushing clearances at the bottom of the seal chamber. 3. Increase cooling to seal faces. 4. Check gland plate for proper flush arrangement. 5. Improve distribution of flush (cooling) around the seal faces.

9 Patches of Thermally Distressed Surface

Observation:
Patches of thermally distressed surface (heat checking). 2, 3, 4, 5, or 6 hot spots are possible. High primary ring wear with possible carbon deposits on atmosphere side of seal. Failure due to hot spots (thermal asperities) is likely to occur on light specific gravity liquids at high speeds and pressures

SYMPTOMS	CAUSE	CORRECTIONS
Seal leaks steadily when shaft rotating or stationary. Leakage may be in the form of vapor. Sound from flashing or face popping.	Sealed liquid vaporizing at seal interface.	1. Increase cooling of seal faces. 2. Check for mating ring distortion. 3. Check for seal interface cooling with seal manufacturer. 4. Improve distribution of flush (cooling) around the seal faces.

10 High Wear and Grooving

Observation:
High wear of the mating ring. Primary ring has grooved the mating ring evenly through 360°.

SYMPTOMS	CAUSES	CORRECTIONS
Seal drips steadily when shaft is rotating or stationary.	1. Poor lubrication from liquid being sealed. Common when both seal faces are made of hard materials. 2. Abrasives are imbedded in softer primary ring material.	1. Increase cooling of seal faces. 2. Check procedures for lapping carbon primary ring. Do not use abrasives for lapping hard mating ring. 3. Check for abrasive particles in the pumpage. 4. Check for dead ended seal chamber.

11 Out-of-Square Mating Ring

Observation:
Contact pattern through 360° slightly larger than primary ring face width. High spot may be present on the mating ring opposite a drive pin hole. Mating ring without static seals will rock or move in gland plate or holder.

SYMPTOMS	CAUSE	CORRECTIONS
Seal does not leak when shaft is stationary. Leaks steadily when rotating.	Mating surface is not square to shaft.	1. Check the gland surface in contact with the mating ring. Must be free of nicks and burrs. Surface must show full pattern when blued with mating ring. 2. Check for proper drive pin extension from gland. 3. Check shaft for proper alignment to be sure that it is not passing through seal chamber at an angle. 4. Check for piping strain on pump casing.

12 Wide Contact Pattern

Observation:
Contact pattern considerably wider on the mating ring than the face width of the primary ring. Seal running eccentrically.

SYMPTOMS	CAUSE	CORRECTIONS
Seal does not leak when shaft is stationary. Leaks steadily when rotating.	1. Equipment bearing failure. 2. High shaft deflection whirl.	1. Check and/or replace bearing. 2. Check and determine if equipment is being operated within specification. 3. Check and determine if shaft is bent. 4. Check and determine if coupling has been properly aligned. 5. Check for piping strain on pump casing.