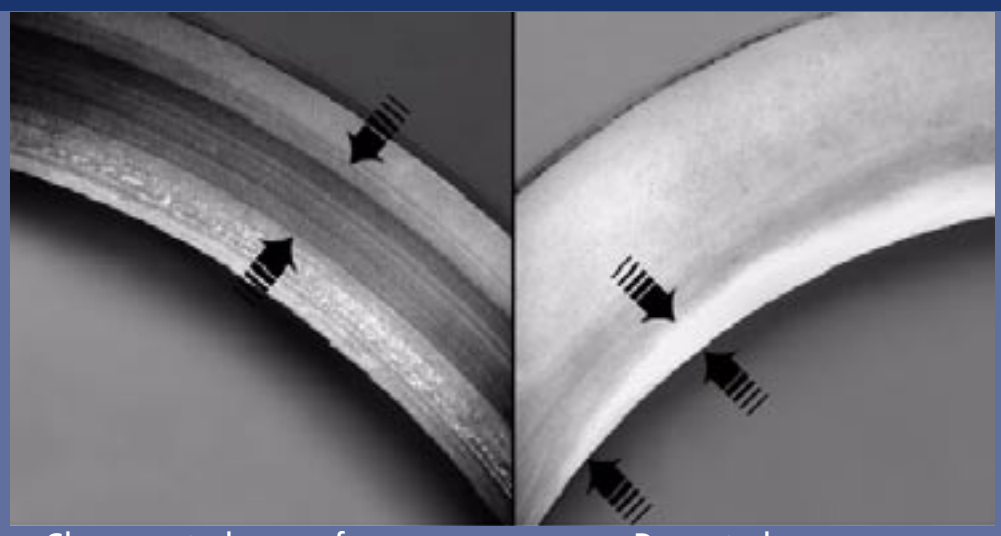
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Symptoms of wear marks:

Decentral wear mark

4a12



Clean central area of wear | Decentral wear

- Symptom
  - Decentral wear over the wide surface
- Causes
  - (Rotating) seal not centered correctly
  - Radial run-out
  - Operated outside of best degree of efficiency, vibration
- Types of failure
  - Incorrect installation
  - Condition of system
- Solutions
  - Check the bearings for run-out
  - Check installation technologies
  - Check the system for concentricity / adjustment between shafts and seal chamber

DR.PUMP
& ENGINEERING
CO., LTD

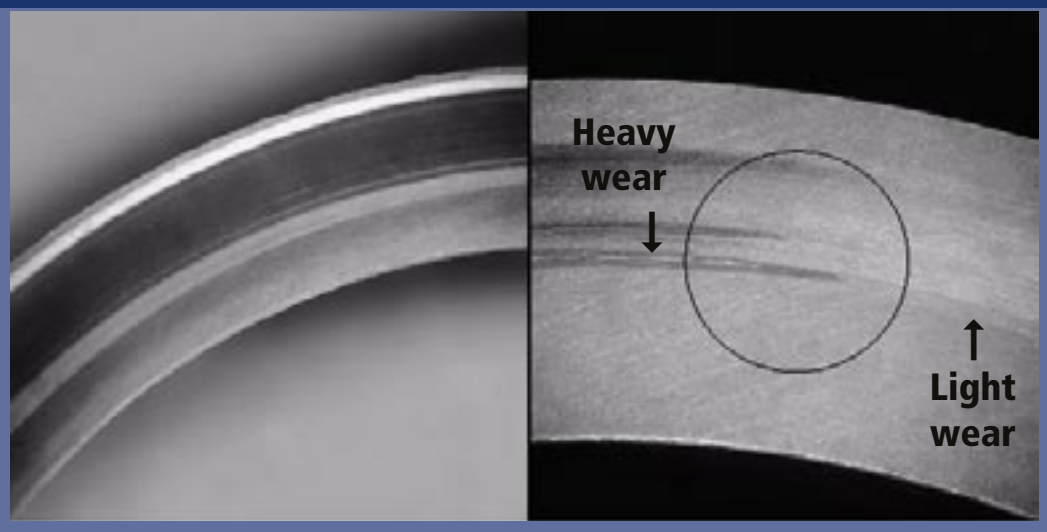
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Symptoms of wear marks:

Uneven wear

4a13



Even wear Uneven wear

- Symptom
  - Uneven wear mark
- Causes
  - Sealing ring twisted due to overtightening or uneven tightening or overpressure
  - Misaligned sealing rings in case of a split seal
  - Incorrect tension-relieved component
- Types of failure
  - Incorrect installation
  - Quality / design-related problem
- Solutions
  - Check installation technologies
  - Check operating conditions
  - Reduce torque and tighten uniformly

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

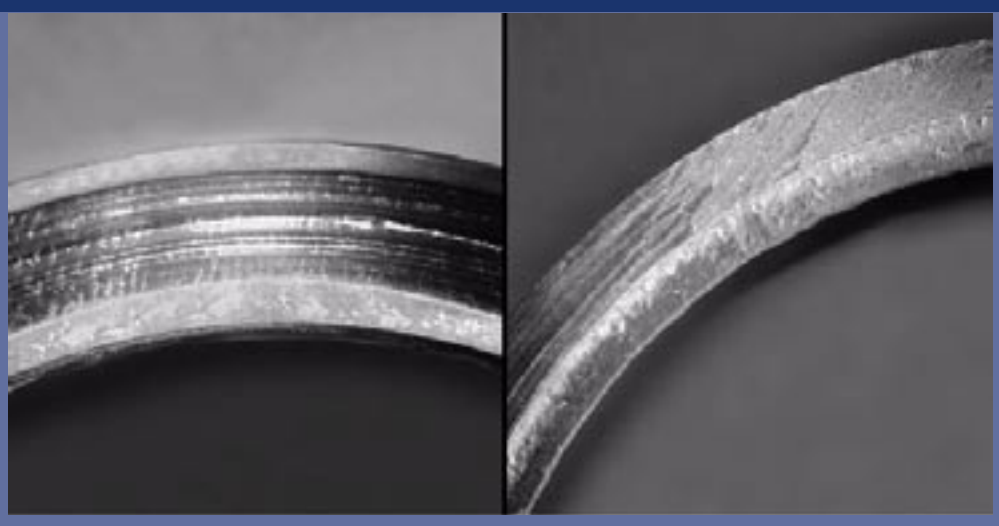
ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Sealing surfaces – Symptoms:

4a20

Scoring & erosion

4a21



Scoring (phonographic finish) Erosion

- Symptom
  - Scoring or erosion / chunking
- Causes
  - Seal assembled in unclean environment
  - Opening of surfaces / evaporation / vibration
  - Particles / solids found between the sealing surfaces
- Types of failure
  - Abrasion particles between the sealing surfaces
  - Insufficient lubrication of sealing surfaces
- Solutions
  - Make sure that the sealing surfaces remain even
  - Eliminate evaporation and vibration
  - Usage of harder surfaces
  - Use a clean flushing or return line to suction side

DR.PUMP
& ENGINEERING
CO., LTD

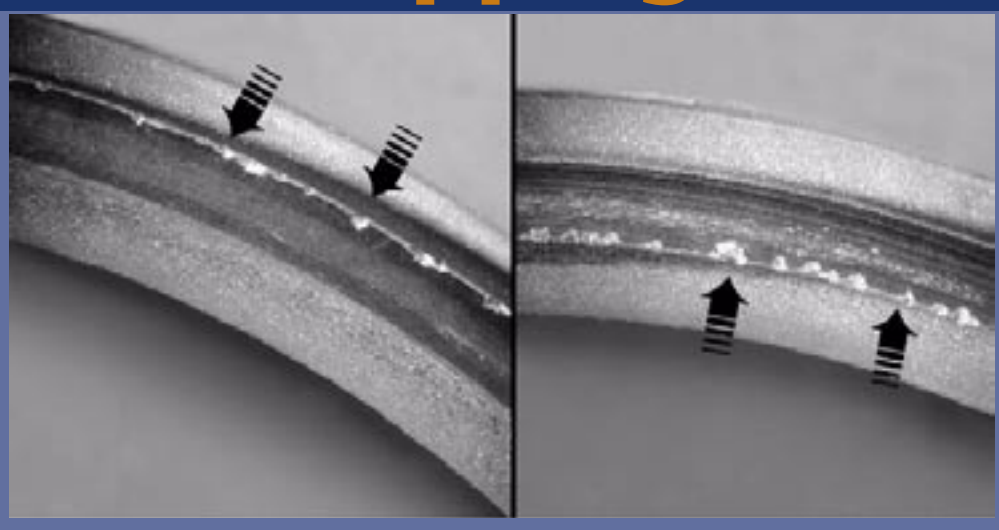
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Sealing surfaces – Symptoms:

Chipping

4a22



Chipping at the outer diameter Chipping at the inner diameter

- Symptom
  - Chipping at the outer / inner diameter
- Causes
  - Opening of area due to evaporation / vibration
  - Cavitation
  - Product hardening and saturation
  - Overpressure
- Types of failure
  - Insufficient environment control
  - Incorrect application
  - Product hardened and saturated
  - Surpassed PV* and temperature limits
  - Operating conditions
  - Insufficient lubrication of sealing surfaces
- Solutions
  - Appropriate environment controls
  - Check operating conditions
  - Consideration of evaporation curve
  - Operate within the permitted operating limits

* PV – Pressure characteristics of sliding surfaces

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

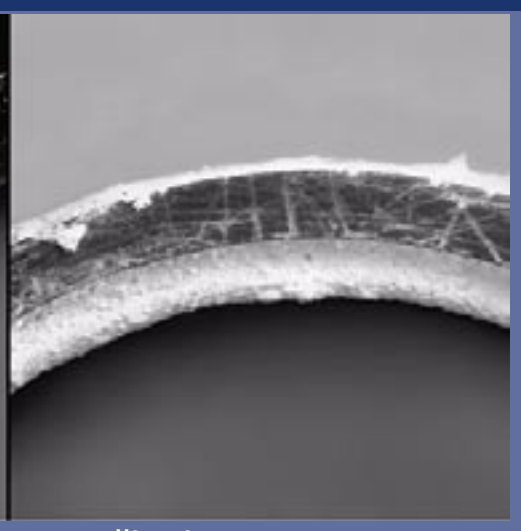
ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Sealing surfaces – Symptoms:

Carbonization & crystallization

4a23

Carbonization



Crystallization

- Symptom
  - Carbonization or crystallization of the product
- Causes
  - Excessive temperatures
  - Dirty product (carbonization)
  - Limited space in seal chamber
  - Pump cooling jacket not efficient
  - Product evaporation (crystallization)
- Causes of problems
  - Insufficient environment controls
  - Product hardened, saturated or carbonized
  - Surpassed RPM and temperature limits
- Solutions
  - Correct environment controls
  - Operate within the permitted operating limits
  - Understanding product behavior

DR.PUMP
& ENGINEERING
CO., LTD

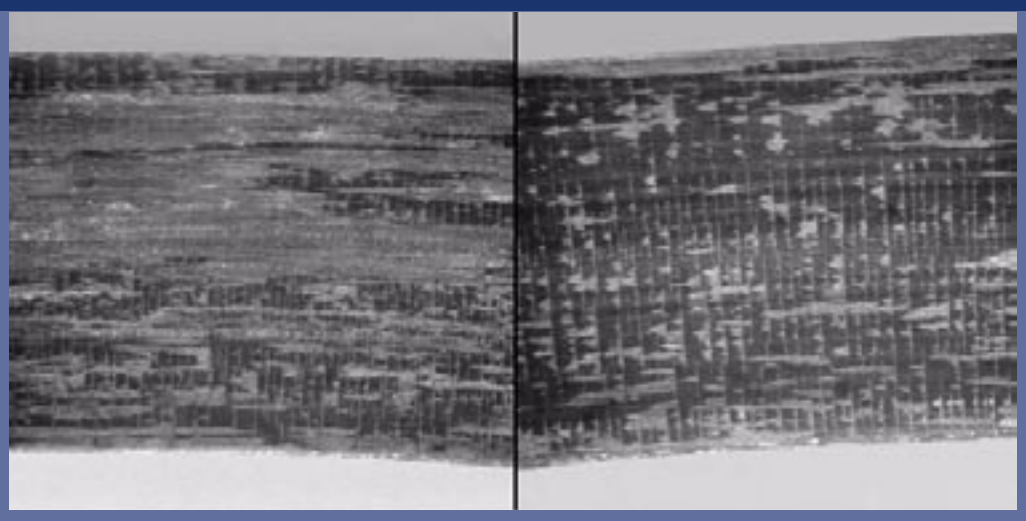
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Sealing surfaces – Symptoms:

Heat cracks

4a24



- Symptom
  - Temperature cracks
- Causes
  - Overstepping the PV* limits of the sealing surfaces
  - Dry running
  - Excess heat from product
- Types of failure
  - Insufficient lubrication of sealing surfaces
  - Surpassed PV* and temperature limits
  - Insufficient environment controls
- Solutions
  - Operate within the sealing limits
  - Eliminate dry running conditions
  - Appropriate environment controls

* PV – Pressure characteristics of sliding surfaces

DR.PUMP
& ENGINEERING
CO., LTD

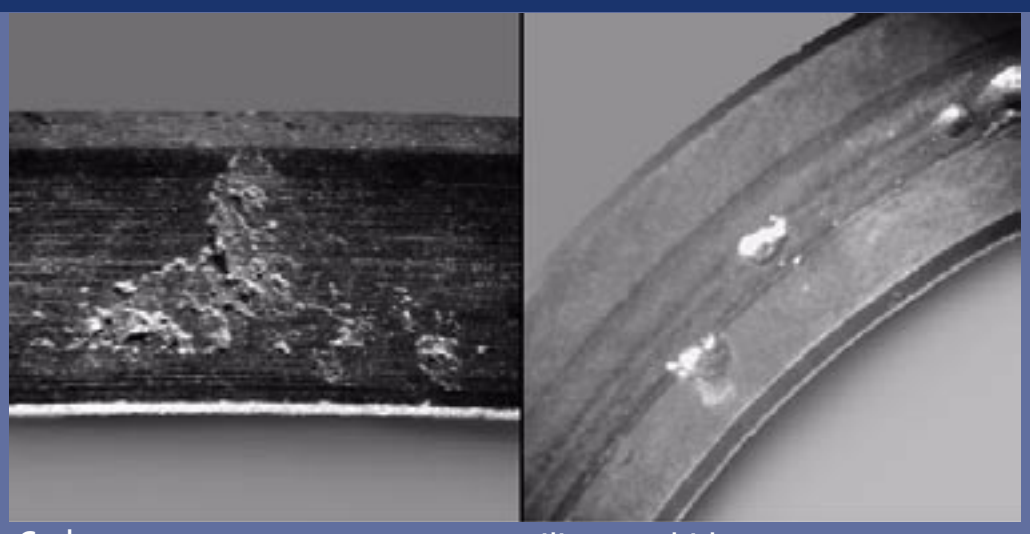
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Sealing surfaces – Symptoms:

Blistering

4a25



Carbon | Silicon carbide

- Symptom
  - Blistering on sealing surface
- Causes
  - Use of carbon surfaces in oil
  - Overstepping the PV* limits of the sealing surfaces
  - Evaporation
- Types of failure
  - Incompatibility of sealing surface
  - Surpassed PV* and temperature limits
  - Incorrect application
- Solutions
  - Use of SC / TC in oil
  - Operate within the sealing limits
  - Ensure that sealing surfaces are lubricated

* PV – Pressure characteristics of sliding surfaces

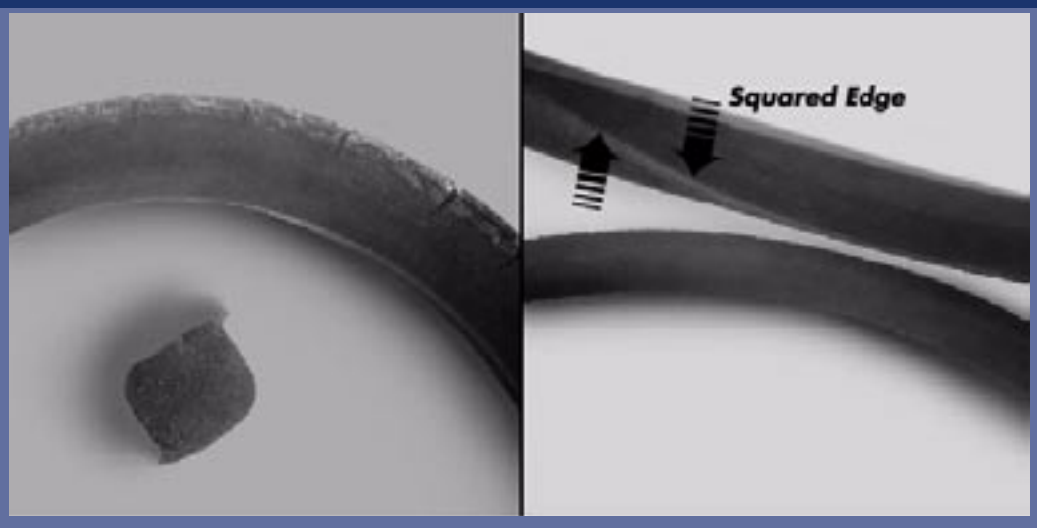
DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Elastomer – Symptoms:
030
Deformation under pressure

4a31



Substantial deformation under pressure

Minor deformation under pressure

- Symptom
  - Hard / deformation under pressure (squared edge)
- Causes
  - Elastomer temperature limit overstepped
  - Incompatibility with product
- Types of failure
  - Incorrect application
  - Temperature limit overstepped
  - Excess heat due to dry running
  - Insufficient environment controls
- Solutions
  - Use appropriate O-ring material
  - Prevent situations where dry running could occur
  - Suitable application / environment control

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Elastomer – Symptoms:

Extrusion & nibbling

4a32

Extrusion Nibbling

- Symptom
  - Extruded / nibbled O-rings
- Causes
  - Excessive tolerances / gap
  - Overpressure
  - O-ring material too soft for the application
- Types of failure
  - Incorrect application
  - Overpressure
  - Quality / design-related problem
  - Excessive material temperature limit
- Solutions
  - Appropriate selection of O-ring material
  - Suitable design of the O-ring groove
  - Sufficient cooling for the seal

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Elastomer – Symptoms:

Explosive decompression

4a33

- Symptoms
  - Explosive decompression (Dieseling)
- Causes
  - Gas contained in the liquid is pressed into the O-ring and embedded there. If the ambient pressure decreases, the included gas expands considerably and causes fractures in the elastomer material
- Types of failure
  - Incorrect application
  - Operation of system
- Solutions
  - Use firmer O-ring material
  - Knowledge about operating the system

DR.PUMP
& ENGINEERING
CO., LTD

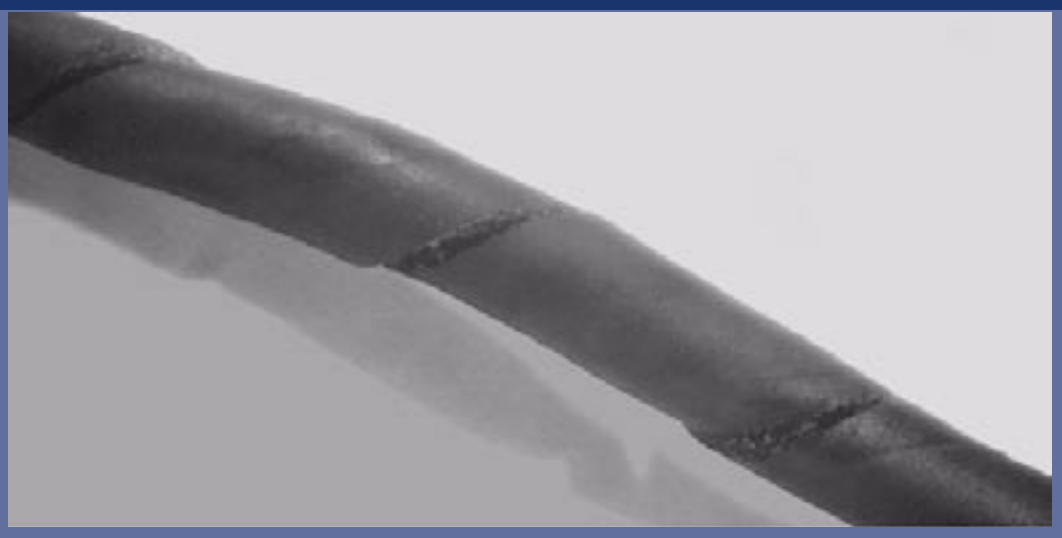
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Elastomer – Symptoms:

Distorted elastomers

4a34



- Symptom
  - Soft / mushy, swollen or twisted
- Causes
  - Chemical attack
  - Temperature limit of material surpassed
- Types of failure
  - Incorrect application
  - Maximum temperature limit surpassed
  - Chemical attack on the elastomers
- Solutions
  - Use O-ring material compatible with the liquid

When the pump fails!

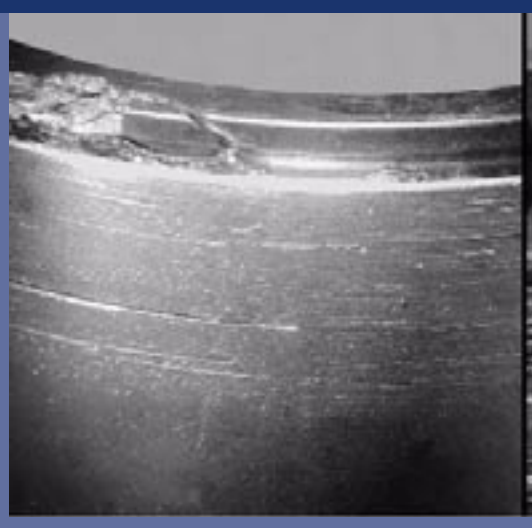
ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Parts testing:

4a40

Mechanical damages

4a41



Notches and scoring OD

Notches and scoring on the sleeve

- Symptom
  - Scoring on inner / outer diameter of sealing surfaces and metal parts
- Causes
  - Incorrect centering of the seal
  - Shaft run-out or deflection
  - Product build-up in seal chamber
  - Contact between seal and borehole wall
  - Shaft runs untrue
- Types of failure
  - Incorrect installation
  - Condition of system
  - Insufficient environment controls
- Solutions
  - Suitable installation technologies
  - Check system for radial run-out & end clearance
  - Suitable application of environment controls
  - Open (radially) seal chamber

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Parts testing:

Corrosion

4a42

- Symptom
  - Corroded / eroded parts
- Causes
  - Chemical attack
  - Excessive temperature
  - Leaching of binding agent (RSC / DC / TC)
- Types of failure
  - Incorrect application
  - Chemical attack
- Solutions
  - Use of suitable type of metal
  - Selection of suitable sealing surface material
  - Understanding influence of temperature on the medium's corrosion characteristics

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Parts testing:

Clamping screws

4a43

- Symptom
  - Flattened set screws / compression rings
- Causes
  - Rotation of seal on shaft
  - Overpressure
  - Use of stainless steel screws on hardened shafts
  - Pressure surges in system
- Types of failure
  - Incorrect installation
  - Maximum pressure limit surpassed
- Solutions
  - Use of hardened set screws
  - Testing of pump shaft material (hardness)
  - Check pressure curve

DR.PUMP
& ENGINEERING
CO., LTD

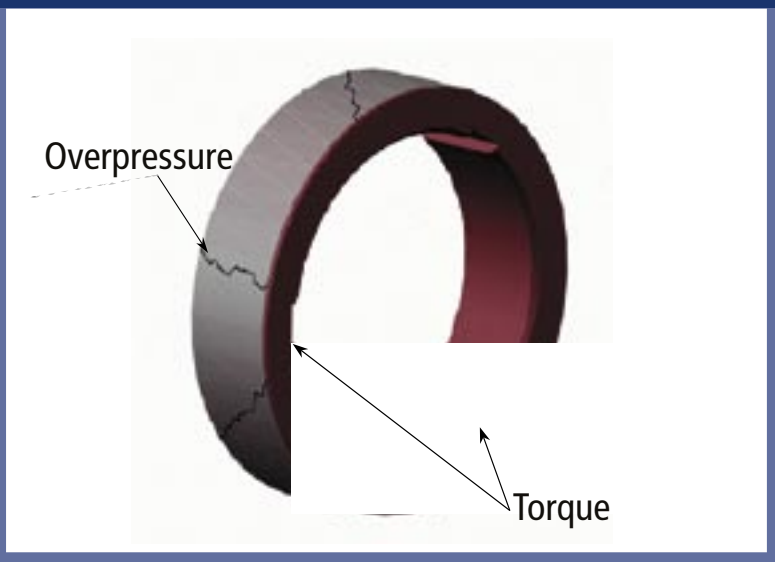
When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Parts testing:

Surface breakage

4a44



- Symptom
  - Sealing ring broken
- Causes
  - "Misusage" during installation
  - Overpressure on inner diameter (back seat)
  - Swollen O-ring on the inner diameter
  - High torque due to hardened product
- Types of failure
  - Insufficient environment controls
  - Surpassed pressure and temperature limits
  - Chemical attack
- Solutions
  - Operate within the sealing limits
  - Appropriate environment controls
  - More suitable O-ring materials

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Bellows – Symptoms:

4a50

Bellows symptoms

4a51

Crack

Bellows – Symptoms: Cracks

- Symptom
  - Crack at or close to the weld
- Causes
  - Overpressure
  - High torque due to deposited product
  - Dry running or non-lubricating liquid
  - Quality / design-related problem
  - Corrosion / erossion
  - Increased vibration/movement of the machine
- Types of failure
  - Incorrect application
  - Insufficient environment controls
  - Product hardening and saturation
  - Increased maximum pressure limit
  - Insufficient lubrication of sealing surfaces
  - Chemical attack on bellows unit
  - Condition of system
- Solutions
  - Correct application of bellow seals
  - Correct application of steam quench
  - Ensure that sealing surfaces are lubricated
  - Use only in clean liquids
  - Minimizing vibration

DR.PUMP
& ENGINEERING
CO., LTD

When the pump fails!

ROTATING MECHANICAL SEAL FAILURE SYMPTOMS

Bellows – Symptoms:

Clogged bellows

4a52

Clogged

- Symptom
  - Bellows coated or clogged with product
- Causes
  - Product hardening due to temperature
  - Unclean or contaminated media
  - Insufficient space in seal chamber
- Types of failure
  - Insufficient environment controls
  - Product hardening and saturation
- Solutions
  - More space in seal chamber
  - Correct application of steam quench
  - Use of a clean flushing, compatible with product
  - Knowledge of the medium