



**43rd Turbomachinery
30th Pump SYMPOSIA**

GEORGE R. BROWN CONVENTION CENTER
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RTD FAILURE IN HYDRODYNAMIC THRUST BEARING

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Table of Content

1- Abstract

2- Problem statement

3-Equipment Overview

4- Root cause analysis

5-Corrective actions and results

6-Lessons learned

Abstract

The [Waukesha Bearing Corporation in 1997](#) introduced a researche about thrust pad flutter and mention that :-

Tilting pad thrust bearings are commonly used on both the active and inactive (loaded and unloaded) sides of thrust collars of turbo machinery rotors Fatigue failure of temperature sensor lead wires to the [inactive](#) thrust pads are due to abnormal wear at the pad contact points.

This case study will show how the repeated damage of RTD elements of hydrodynamic thrust bearings (JJ type) can occur in both the active and inactive side.

We try to determine the main reason causing this failure, many trials had been done, and all of it failed.

After deep analysis we discovered the main reason causing the failure, it was related to oil flow inside bearing housing.

We try to avoid this by modifying the RTD element shape to override the repeated failure.

Problem statement

The compressor type is a synthesis gas (gas mix) compressor barrel type that has been in service since 2008

There have been repeated thrust bearing RTD problems (both active and inactive). There have been many modifications to avoid the repeated problems.

Thrust bearing

Transmit the axial shaft loads with minimum power loss into the foundation or machine support of rotating apparatus

Equalizing thrust bearing

Transmit the load through a self-renewing film of oil during operation and a-unique force – balancing action distributes the load across the shoes, working surfaces are separated by the fluid film



Equipment Overview

Compressor barrel type driven by steam turbine , 17MW, 10600RPM

Synthesis gas (gas mix)

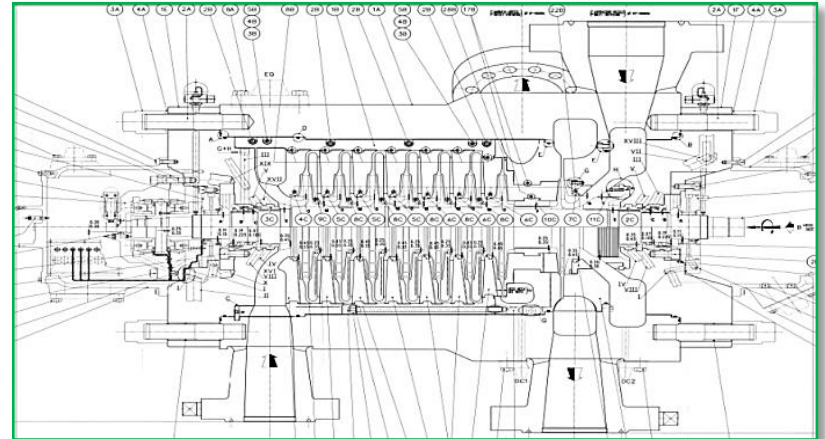
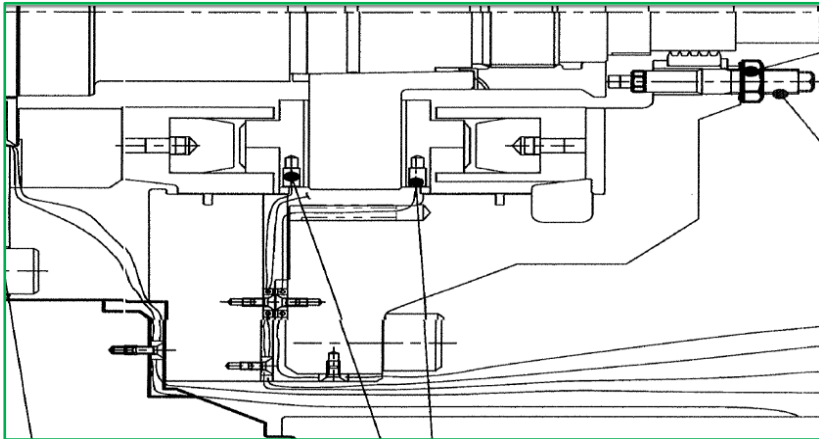
Suction pressure 25 barg

discharge pressure 160 barg

Interstage cooling , separators

Thrust bearing is JJ Style self-equalizing tilting pad bearing

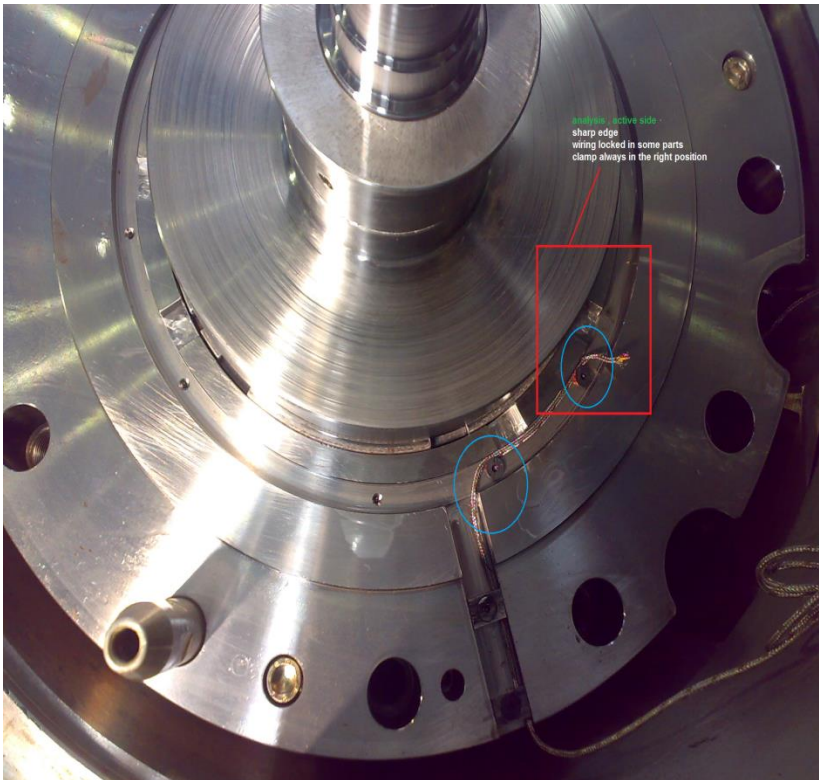
Thrust bearing RTD arrangement



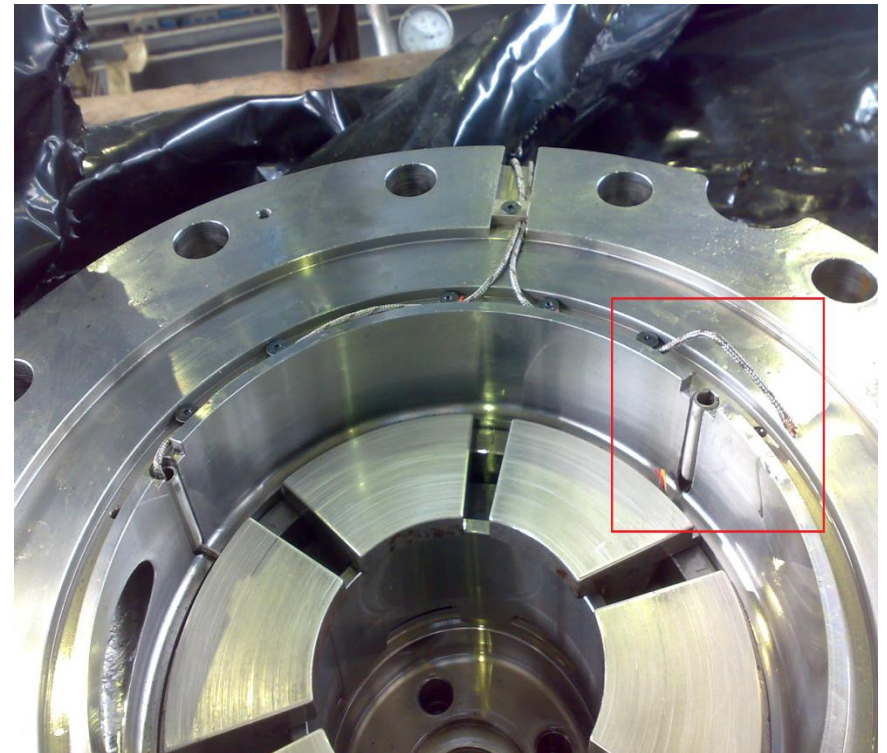
The analysis of 2BCL 408 Compressor thrust bearing RTD repeated failure during 4years analysis

- 1- Several sharp edges on both active and non- active sides
- 2- Possibility contact between bearing housing surface and wiring leading to friction and wiring reduced movement capability
- 3- Clamps not always in the right position
- 4- Signs of compression on the wiring
- 5- Wiring locked in some parts
- 6- Clamp sometimes far from pad

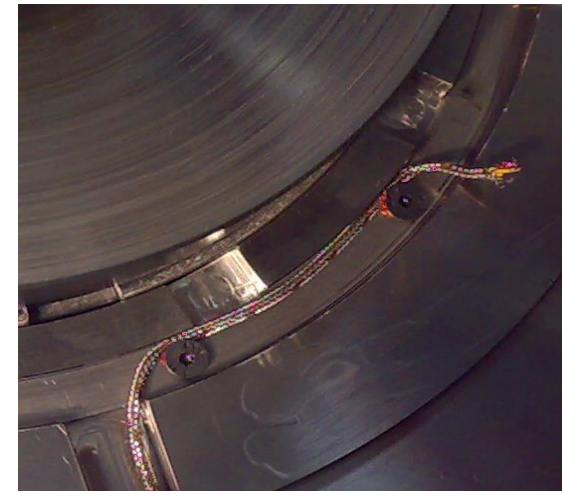
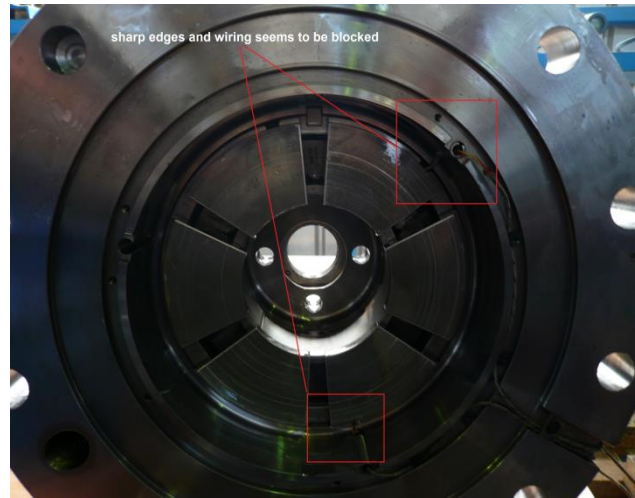
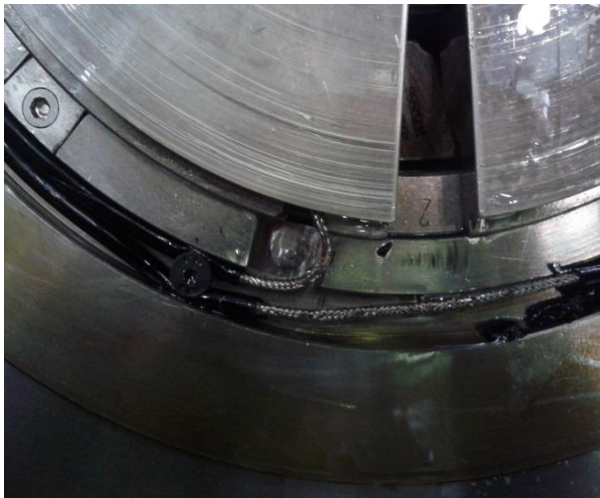
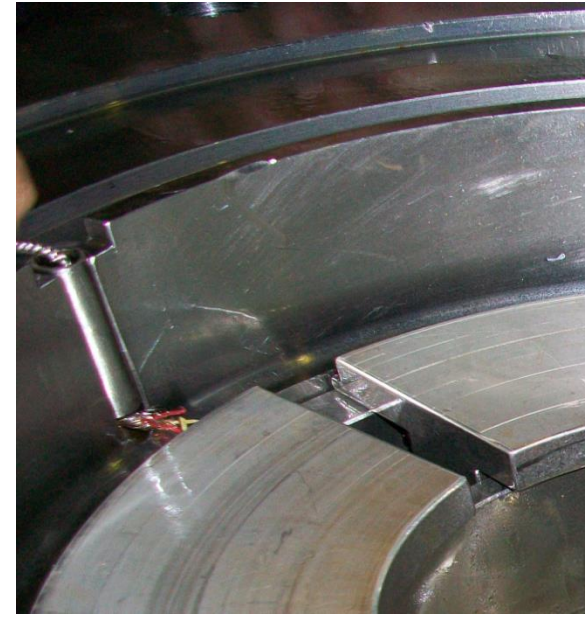
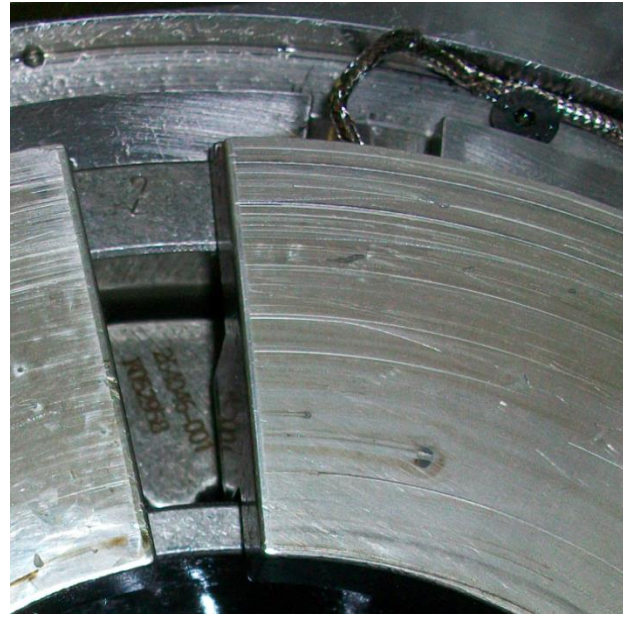
Active side



Non- active side

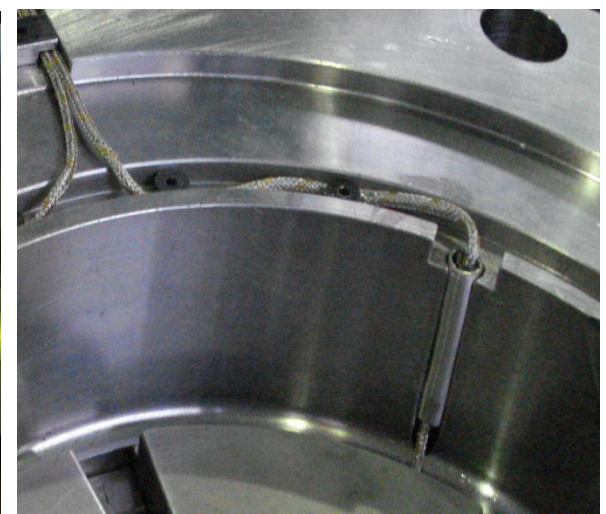
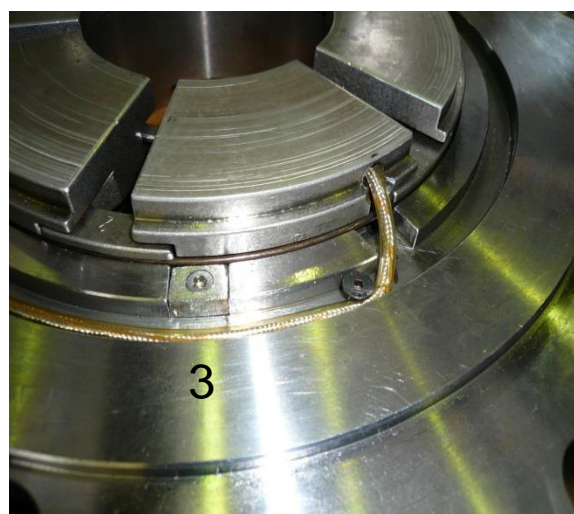
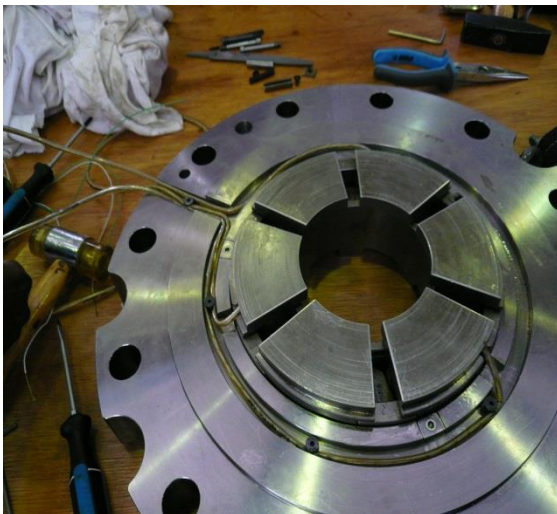
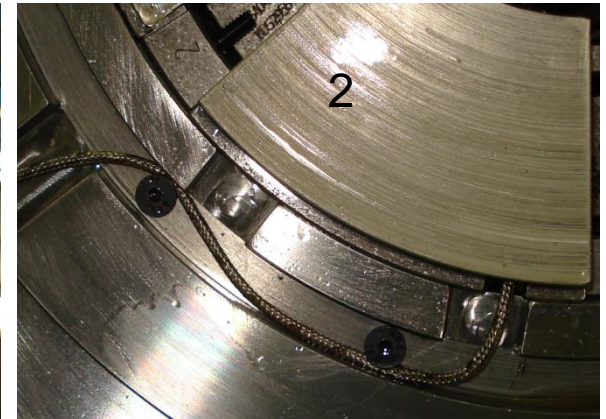
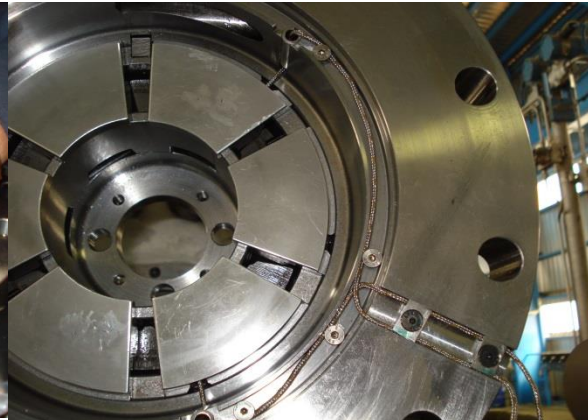


Some figures for failure of RTD during 4 years in both active and non active side



Corrective actions done during the past 4 years

- 1-Rounded corners realize on the edges
- 2-Clamp position changes
- 3-Covering the elements by plastic hose



Root cause analysis

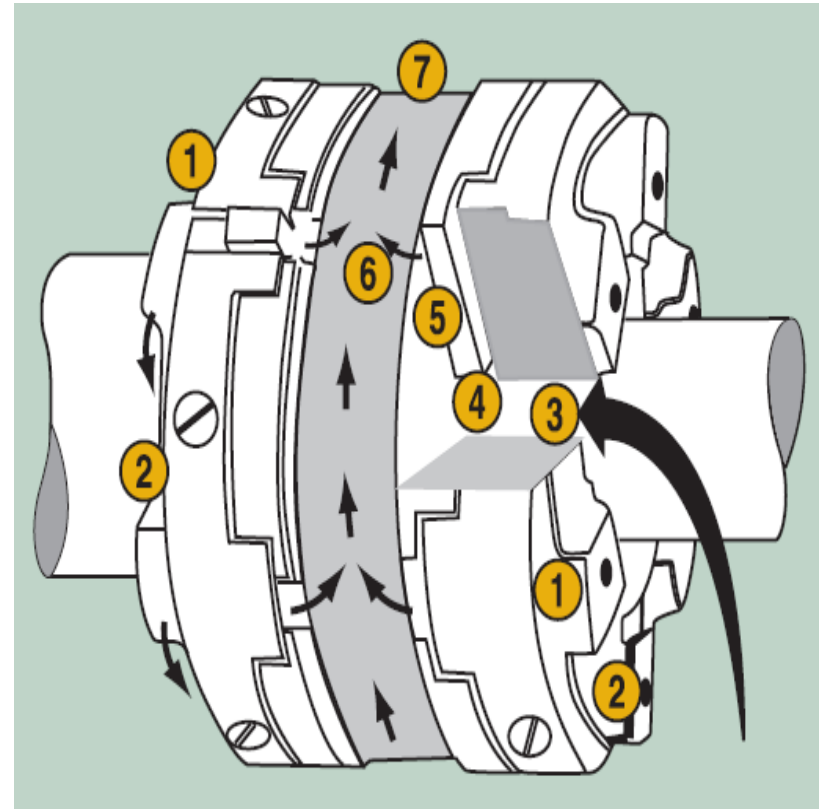
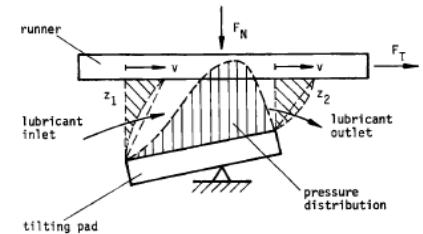
Previously mentioned corrective actions have not been successful to prevent failure reoccurrence

In 2012
a thorough analysis was conducted.

Self-equalizing thrust bearing flooded type lubrication theory

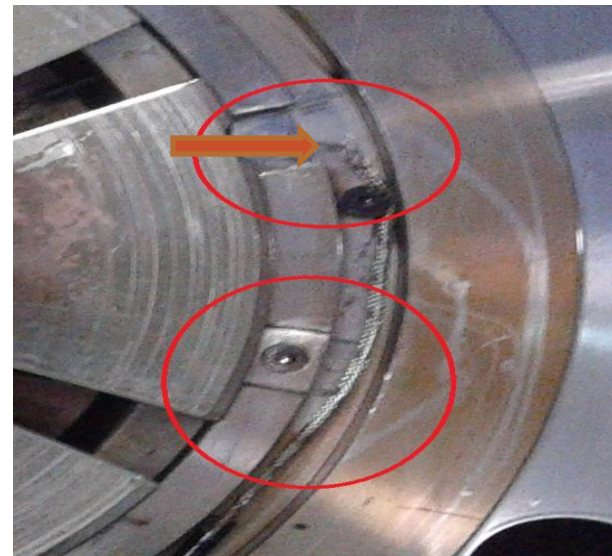
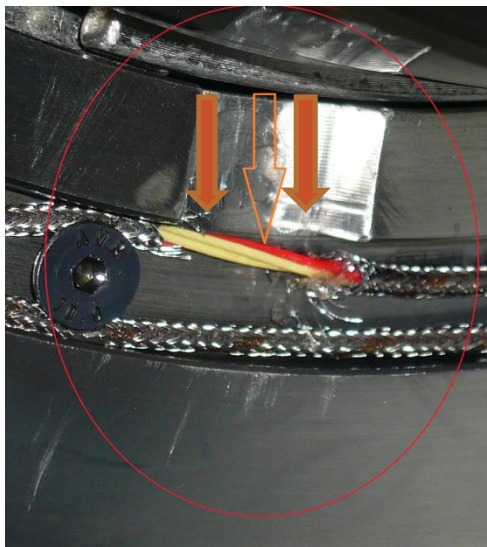
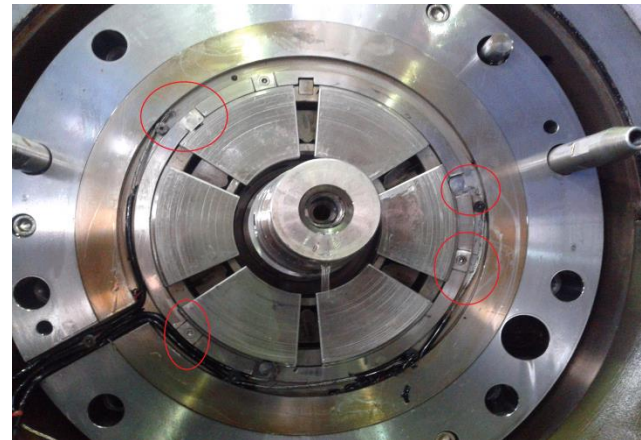
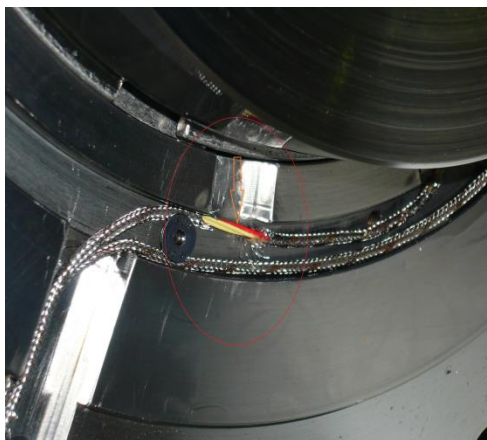
The oil velocity and profile pressure inside the thrust bearing differ according to the size and oil viscosity and speed of collar mainly

1. Oil enters the annulus in the base ring
2. Oil passes through radial slots in the back face of the base ring.
3. Oil flows through the clearance between the base ring bore and shaft.
4. Oil flows to the inner diameter of the rotating thrust collar.
5. Oil flows between the shoes and into the films.
6. At the collar rim, oil is thrown off into the space around the collar.
7. Oil exits tangentially through the discharge opening.
8. Oil enters the sump and is pumped through a filter and cooler.
9. Oil passes through the inlet orifice, which controls flow rate.



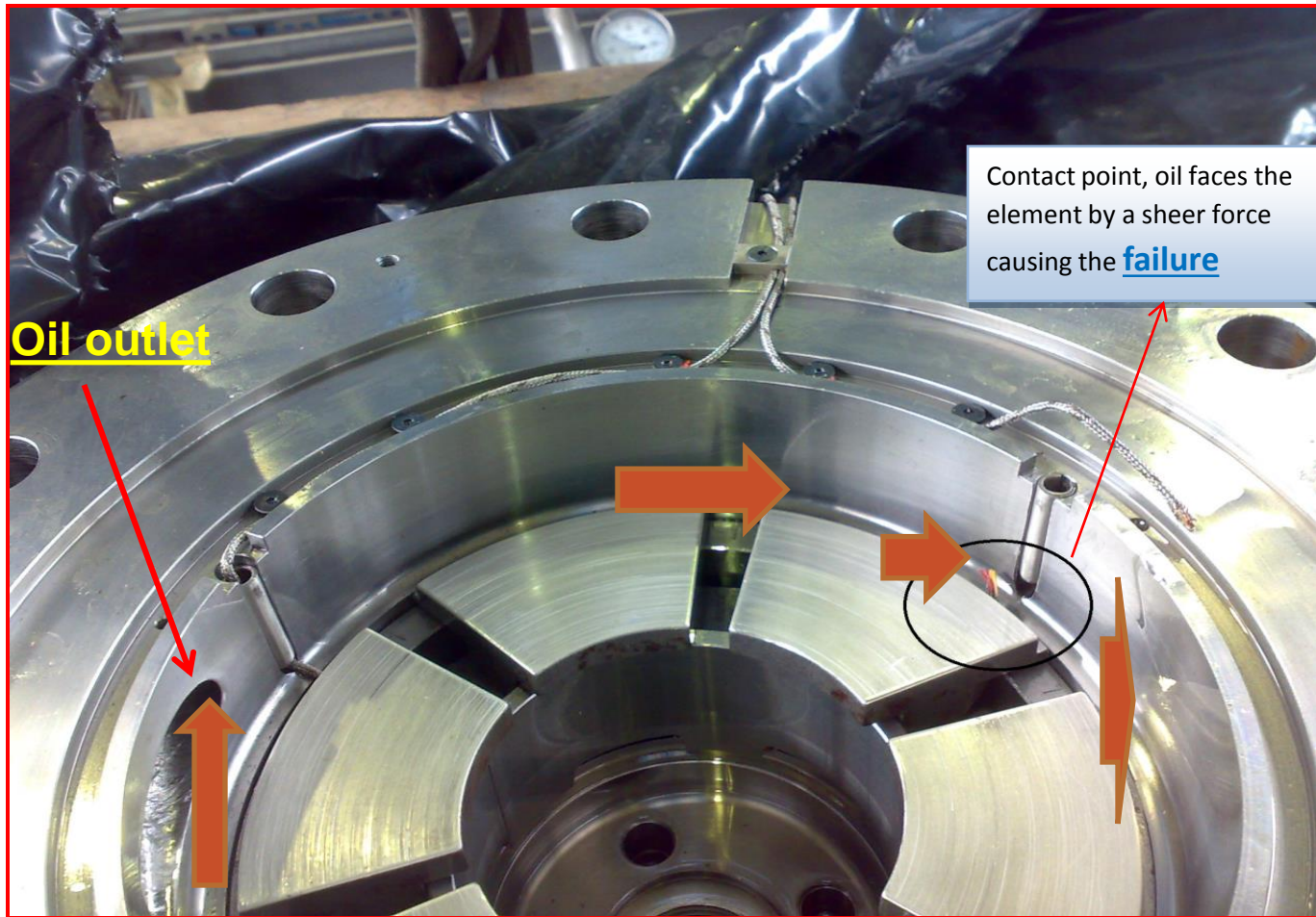
We discovered that the damage of the RTD element in active side is due to the high pressurized oil which escape at the sharp edge area concerning the outlet of RTD element

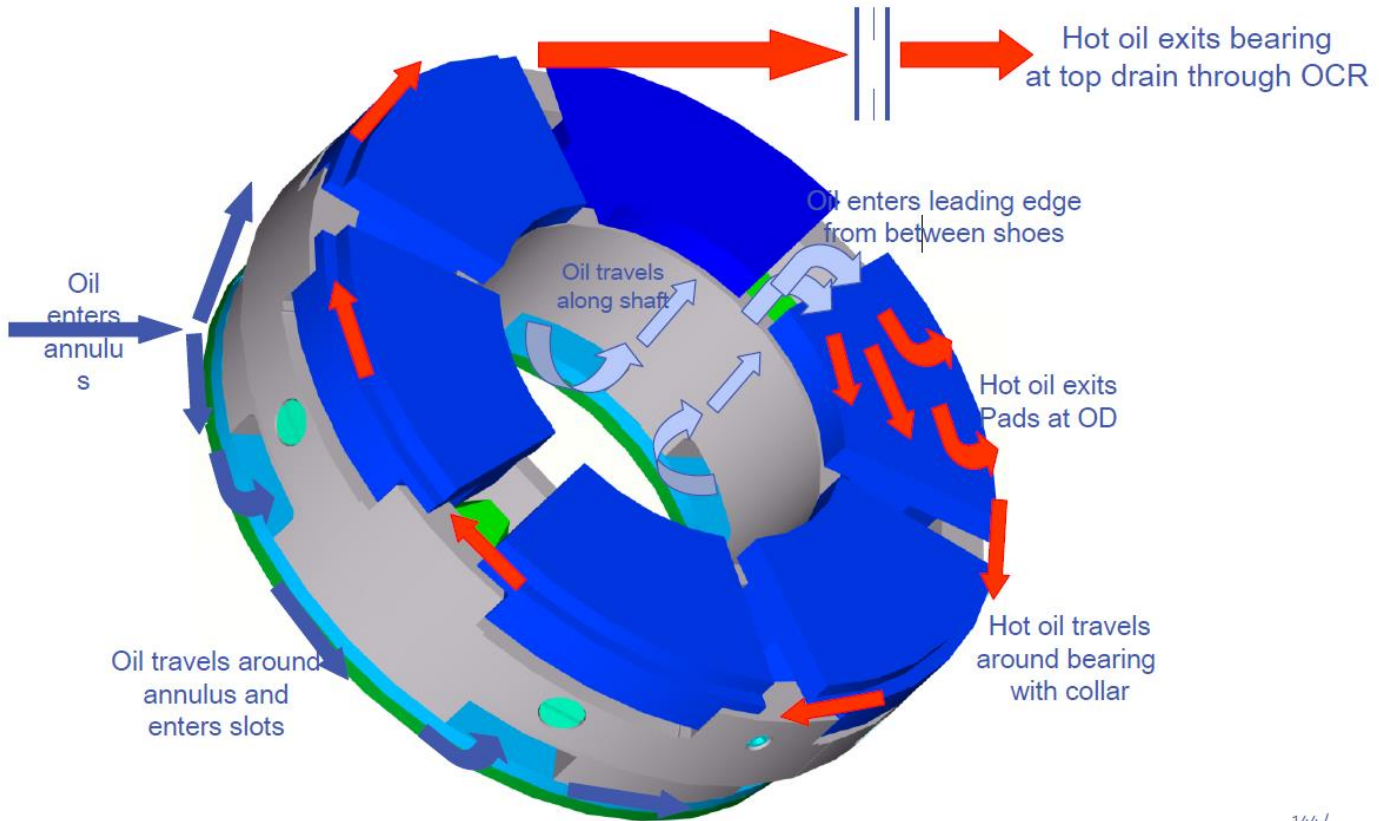
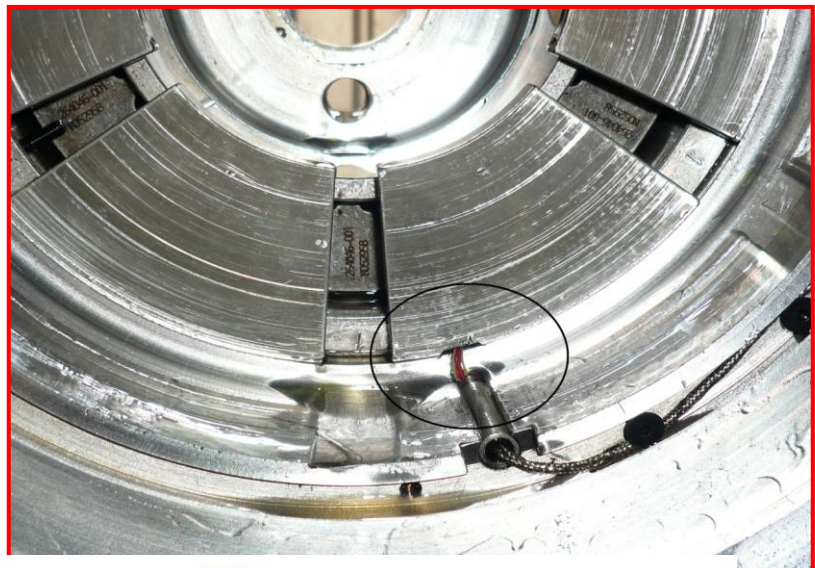
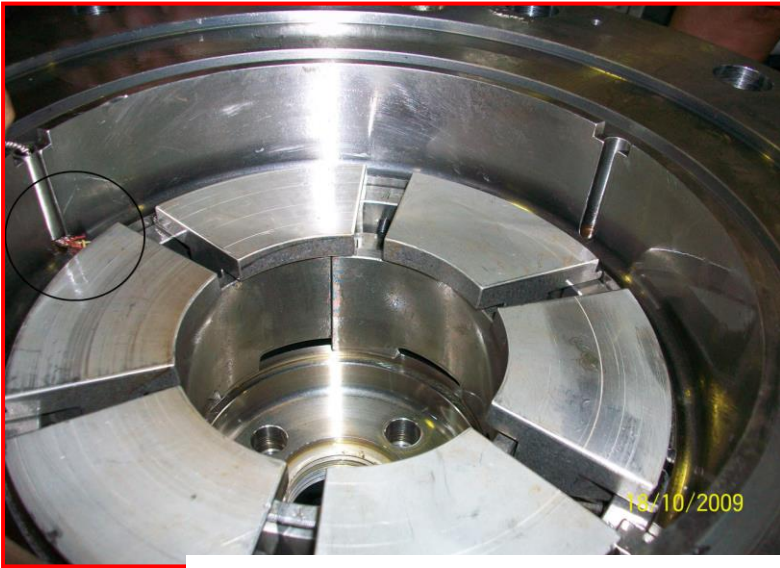
The configuration of RTD outlet pass works as a nozzle where the pressurized oil out causing damage o RTD shield body per time till failure



In non active side

The oil outlet dragged by the thrust collar rotation towards the bearing outlet causing shear force on the RTD shield body causing the failure of the RTD per time





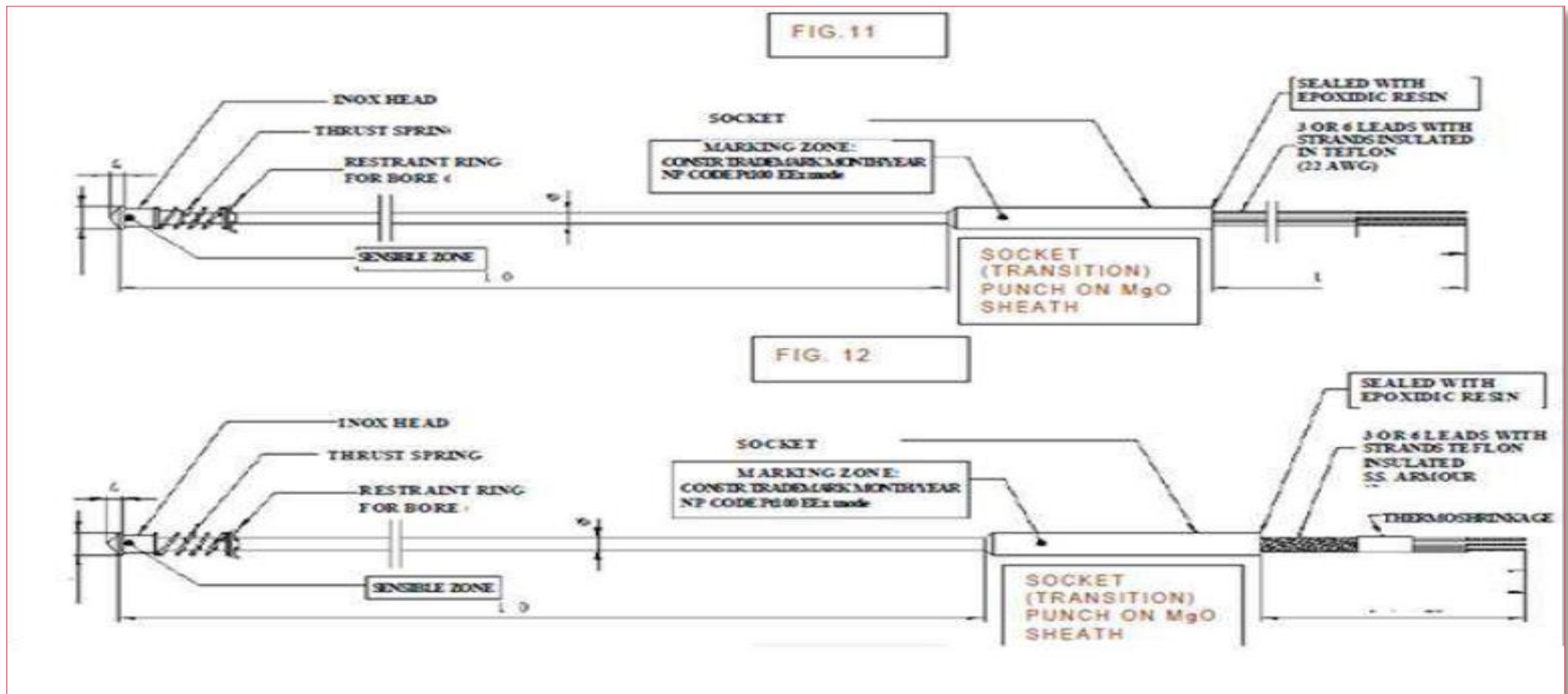
Problem solution

Finally

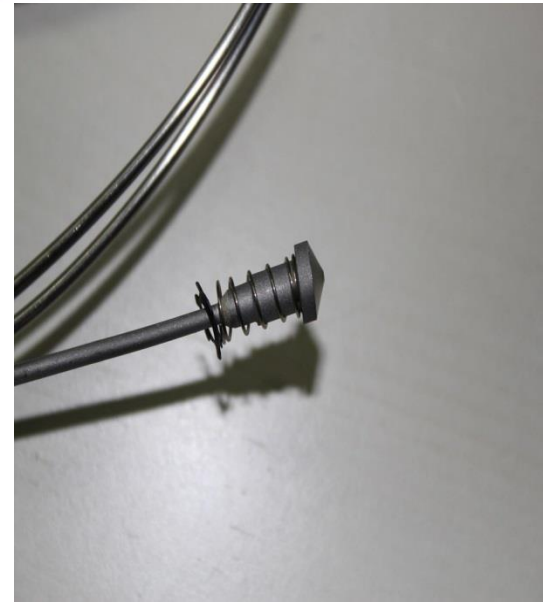
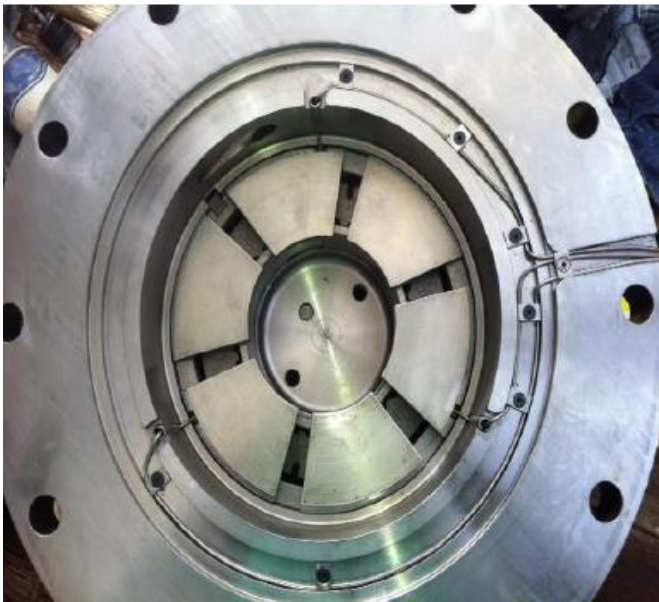
It became clear that woven shield RTD element failed due to it being snapped off from the oil launching at very high speeds.

Manufacture suggest to replace the original TE (thrust bearing only) with new type having a rigid shield made by 3 mm stainless steel capillary tube.

It is be assembled since 2012 in many machines without any problems



The new TE element installation in the thrust bearing



Lesson learned

The oil flow through the JJ thrust bearing effected on the RTD element body , that oil flow pass inside bearing house causing damage to the RTD as it is in the way of oil flow

Damping this phenomena is carried by reinforce the RTD to appear and override the oil flow forces

By other way , it is better to make the RTD element a way from oil pass

Questions?