

Bearings & Lubrication



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Different Types of Lubrication systems Used on pumps and turbines and Motors

- **Constant Level Lubrication**

Oil level is maintained in a bearing housing and delivered to bearings via lube oil rings which rotate with the shaft or in some applications the rolling element is partially submerged in oil

- **Pure Mist Lubrication**

Provides an atomized oil environment to wet and lube rolling elements

Only used on rolling element bearings

Never on Babbitt, Liquid film bearings

- **Pressurized Lubrication**

Oil pump supplies lubrication through passages drilled in bearing housing and journals

Can be also delivered by a spray nozzle to lubricate gears

- **Grease packed bearings**

Some rolling element bearings will be lubricated by grease. These can be sealed (permanently greased) or user lubricated

Bearings commonly used in the Process Industries

Rolling Element bearings, also known as anti-friction bearings, are used because they carry combined loads better than any other type of bearing. This bearing is the type commonly used in wheel bearings on most automobile applications. This type of bearing operates with the least amount of friction, and is the **only** type of bearing rugged enough to survive with **pure mist** as its only source of lubrication. (see slide # 25)

These bearings are made to exacting dimensions with tolerances of .0003" or better. Properly installed and lubricated these bearings can provide service of ten years or more.

Rolling element bearings consist of four main components:

1. **Outer race**
2. **Inner race**
3. **Rolling element cage, or separator**
4. **Balls or rollers**

Babbitt, Fluid Film Bearings consist of a strong metal sleeve coated with a soft, silvery alloy compound of tin, copper, antimony and lead. This coating is then machined to exact dimensions usually to allow clearance of .001"- .0015" per inch diameter of the shaft it supports.

Babbitt bearings are very sensitive to high temperatures, as the soft babbitt will begin to distort at approximately 340 ° F.

Babbitt bearings require a film of clean oil in between the babbited surface and the rotating shaft.

If this oil film is compromised bearing damage will be greatly accelerated.

A 2" shaft rotating 3600 RPM will generate temperatures of 400 ° F+ within seconds without its required oil film.

Babbitt is soft enough to be scratched with a fingernail with out too much effort and thus very sensitive to lube oil contamination. For this reason lube oil condition monitoring is very important to maximizing bearing life, and a reason we employ the use of sediment bottles on our bearing housings. (Some facilities claim to have reduced bearing problems by implementing a routine of lab testing oil to provide earlier warning of problems).

Fluid Film bearings will never utilize PURE Mist lubrication as it single source of lubrication as the atomized oil is not sufficient enough to provide the oil film required between the bearing surface and the rotating shaft.

**Clevite™
Liquid Film
Babbit
Bearing Inserts**

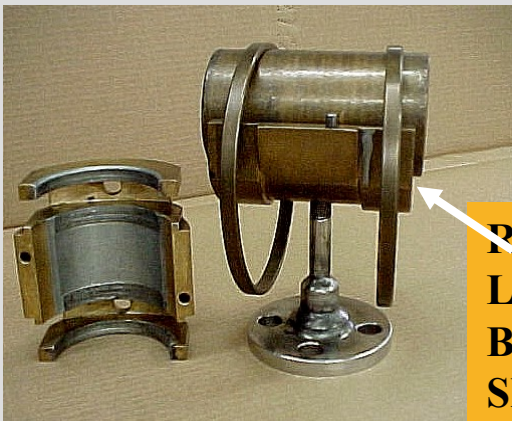


**Tilt Pad
Liquid Film
Babbit
Thrust
Bearing
and Thrust
Collar**

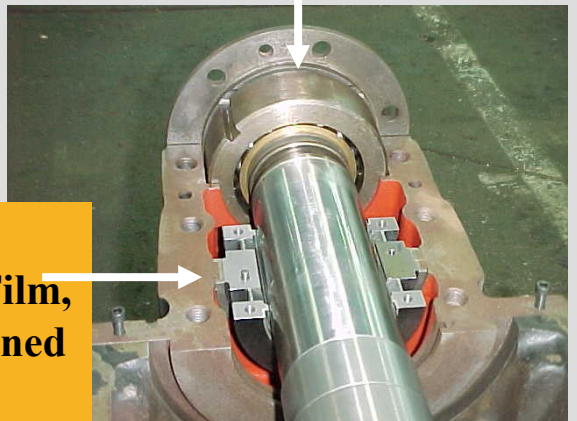


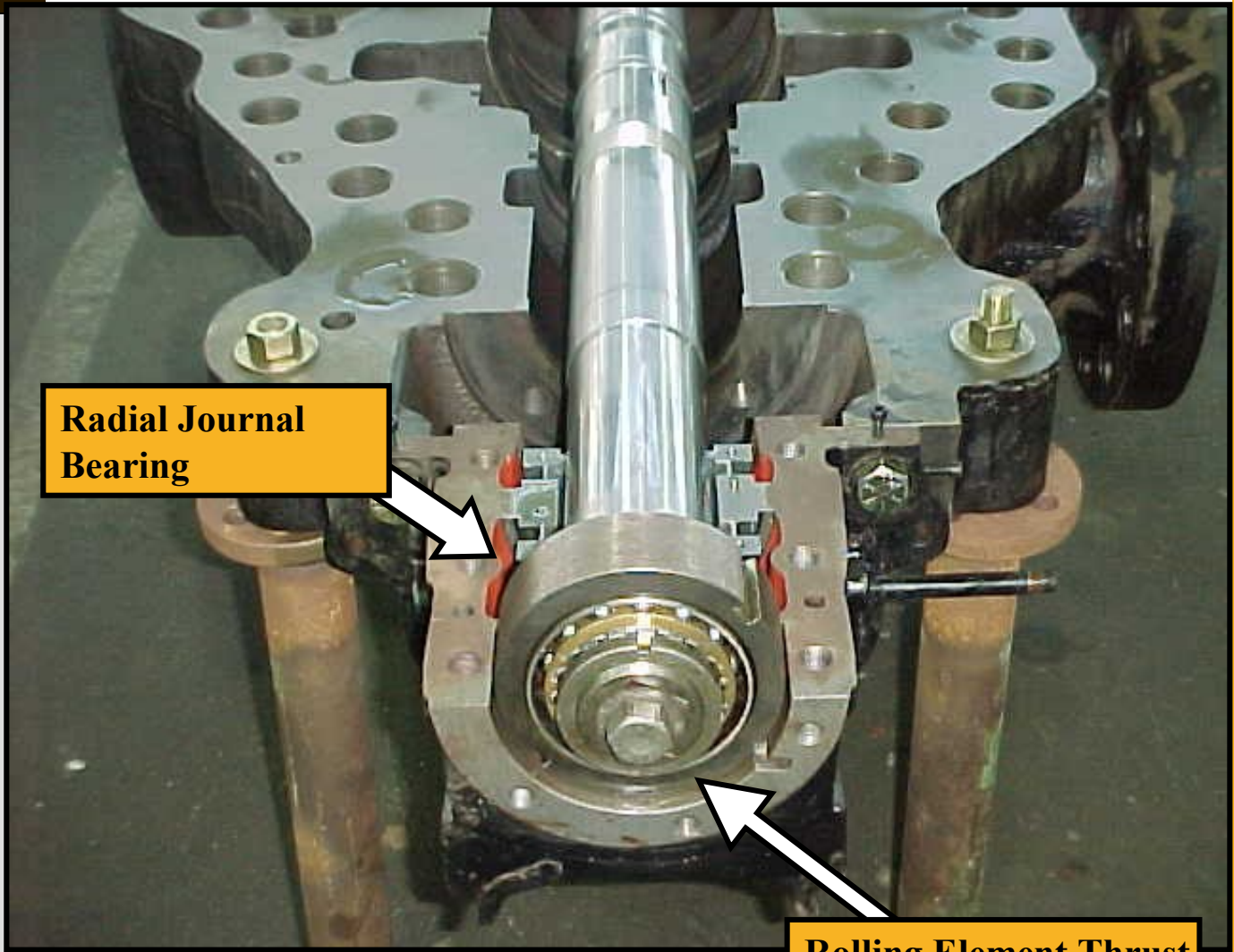
**Bearing
Isolator
(Empro)™**

Rolling Element Thrust Bearing



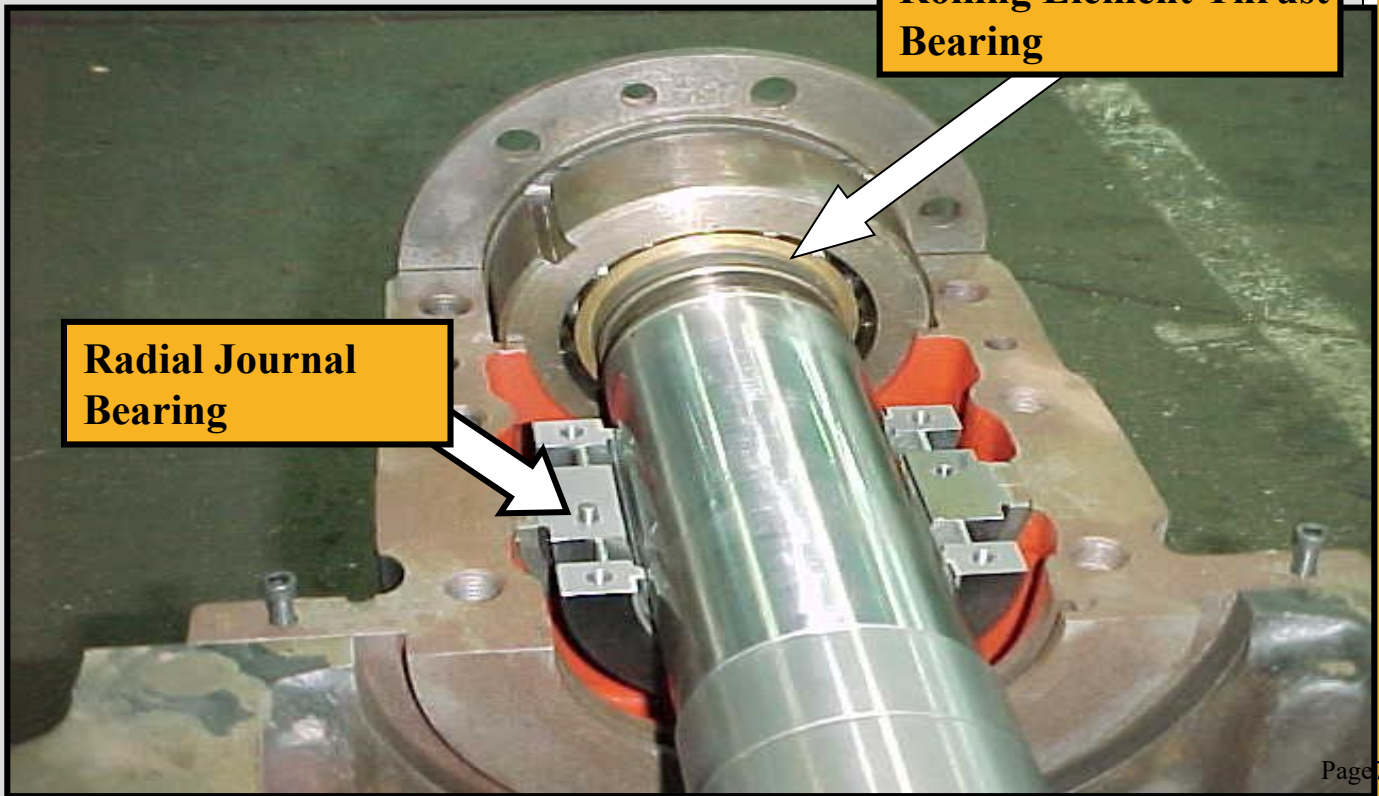
**Radial
Liquid Film,
Babbit lined
Sleeve
Bearing**





Radial Journal Bearing

Rolling Element Thrust Bearing



Radial Journal Bearing

LUBRICATION CHECKS

The Benefit of Lubrication Checks on Equipment

One of the most important checks we are required to perform on our rotating equipment is lubrication checks.

Most of us would not knowingly operate our personal vehicles with an inadequate oil level, or contaminated oil. No matter how well a piece of equipment is designed or how well it is operated, unless the lubrication is kept in proper condition, the equipment will fail.

With proper lubrication bearings could last 10 years or more.

Sampling Oil can Show Beneficial Results

Lube oil condition can warn of impending problems.

Sediment and Trico bottles should be kept clean, so any contaminates can be easily seen.

Occasionally sediment or water will be trapped inside a bearing housing and not be visible in the sediment bottle until some oil is drained.

To get a better idea of the condition of the lube oil it is advisable to drain a small amount of oil to allow any contaminates present to flow into the sediment bottle. **(never leave drain valve open longer than 3 seconds).**

There have been instances where the sediment bottle has been discolored by the sun or heat giving the impression lube oil was in good condition when in fact the bearing housing contained mostly water. These must be replaced.

(See Sediment Bottle replacement on slide #18)

LUBRICATION CHECKS

1. The amount drained should not be more than the amount contained in a sediment bottle. (3 seconds is the maximum time a sediment drain should be left open, to prevent compromising the bearing lubrication).
2. Never allow the level in the “Trico” constant level lubricator to drop below 1/2 the visible level. If the machine is in service.

CAUTION

NEVER DRAIN MORE THAN 3 SECONDS WORTH OF OIL IF THE MACHINE IS IN SERVICE

While draining a small amount of oil from the sediment bottle look for air bubbles rising in the “Trico” bottle, This will indicate three things:

1. Oil is maintained at the set level. (Equal to lowest portion of bottle)
2. The 1/4” supply pipe from the “Trico” cup to the bearing housing is not plugged.
3. The level in the bearing housing is not over filled.
The oil level in the Trico cup should match the oil level tag on the bearing housing.

If you suspect the oil level is incorrect contact your machinist

CAUTION

**On line oil changes should only be performed by a qualified mechanic,
and only in extreme emergencies**

LUBRICATION CHECKS

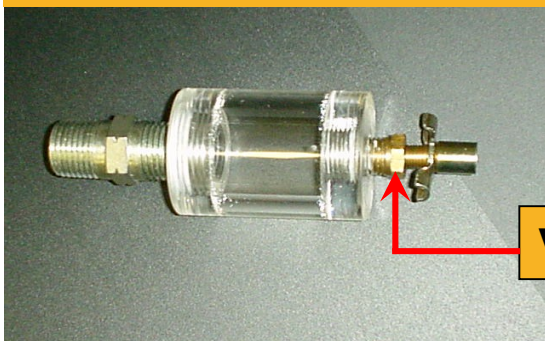
How to Sample Oil

When sampling oil from a pump in service, **Caution Must be Taken:**

1. To ensure that the sediment bottle or drain valve **does not come loose** causing loss of all lube oil, resulting in severe damage to the bearings.



If the sediment Drain valve installation nut turns while attempting to open the valve, or if valve requires excessive force to open, It is advisable to hold valve installation nut. This is done to prevent unscrewing valve from bottle, and loosing all lube oil.

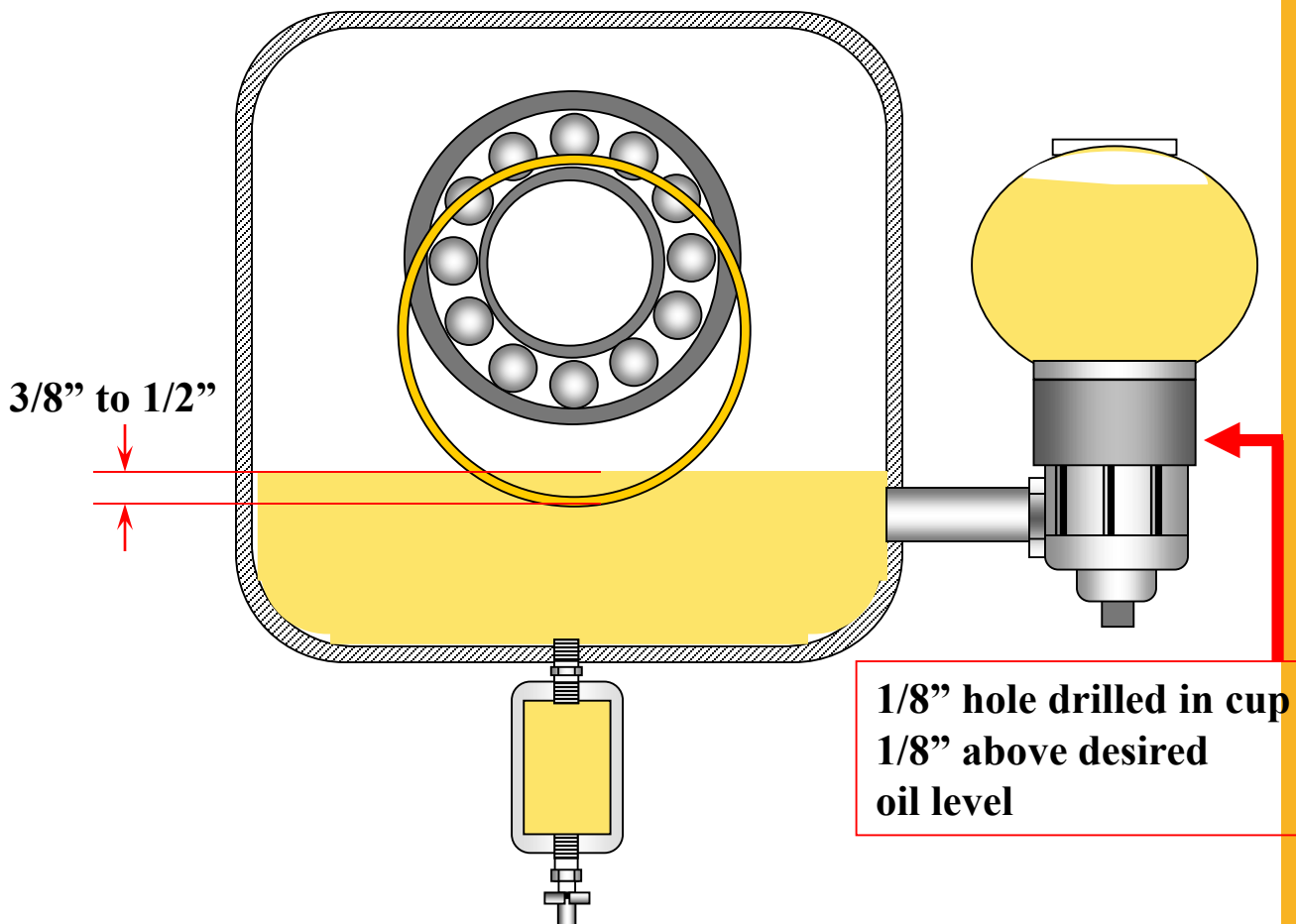


Valve Installation Nut

LUBRICATION CHECKS

How to Sample Oil

2. Be careful not to drain too much oil at once. The oil slinger ring that supplies oil to the bearing is submerged $3/8''$ - $1/2''$ below the oil level. If the oil level is drained below this level the bearing will be deprived of lubrication and damage could occur.



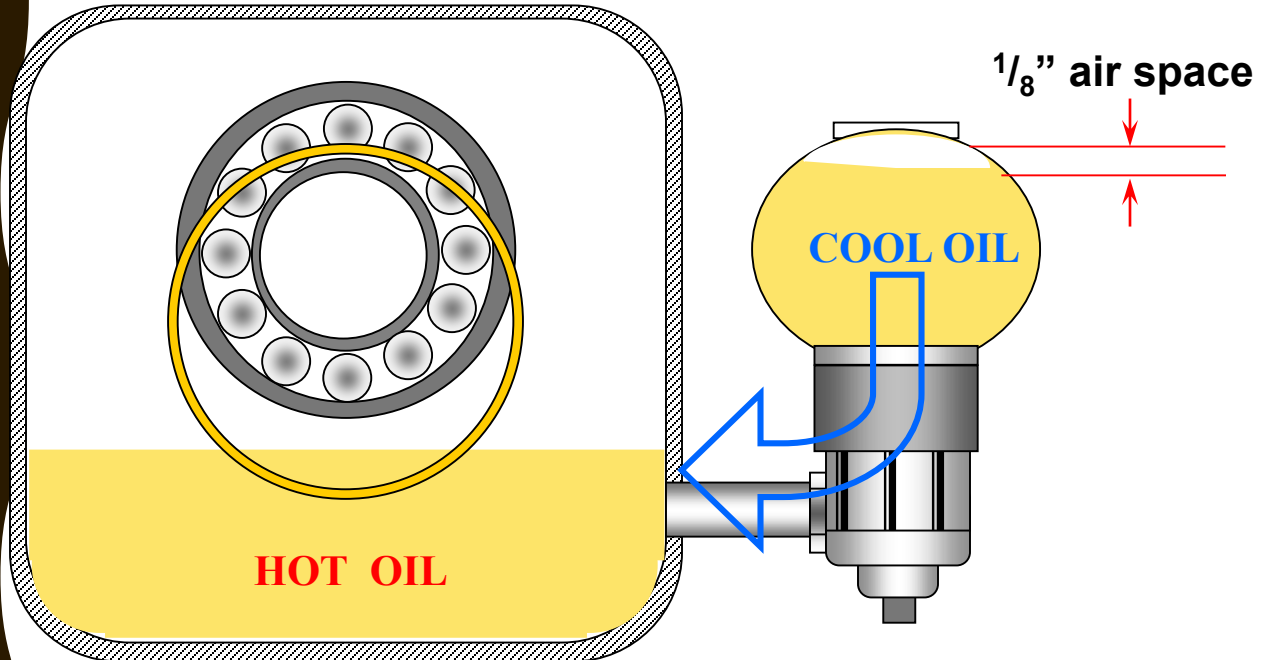
**FOR A
EXAMPLE OF DAMAGE TO A
BEARING THAT
LACKED PROPER LUBRICATION
SEE SLIDE # 13**

LUBRICATION CHECKS

How to Sample Oil

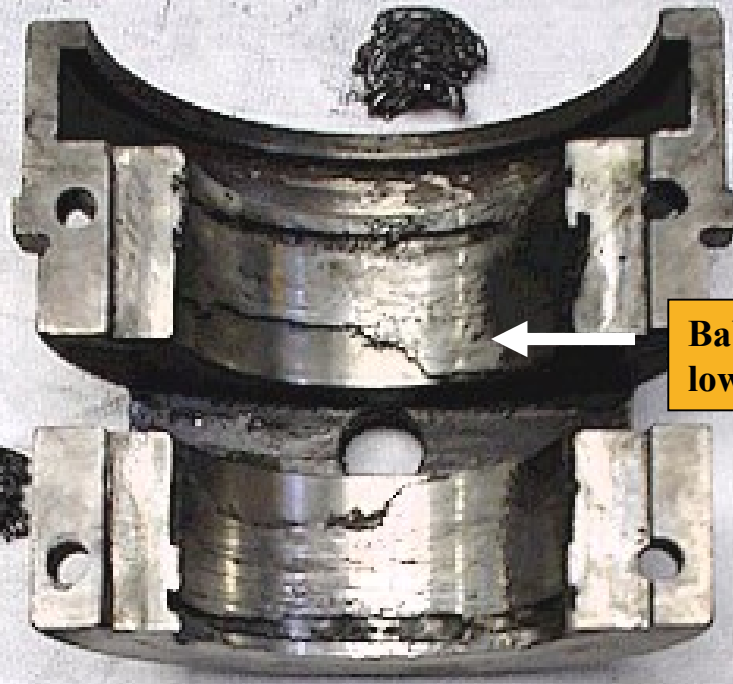
3. Keep in mind when draining hot oil from a bearing housing, the hot oil will drain faster than the “Trico” constant level lubricator can replenish the level due to the difference in temperature and viscosity.

NEVER DRAIN MORE THAN 3 SECONDS WORTH OF OIL FROM A SEDIMENT BOTTLE. WITHOUT REFILLING TRICO AUTOMATIC LUBRICATOR. THEN WAIT FOR LEVEL TO EQUALIZE BEFORE DRAINING ANY MORE OIL. THIS MAY TAKE A MINUTE OR TWO AS THE VISCOSITY WILL BE DIFFERENT DUE TO THE DIFFERENCE IN OIL TEMP.



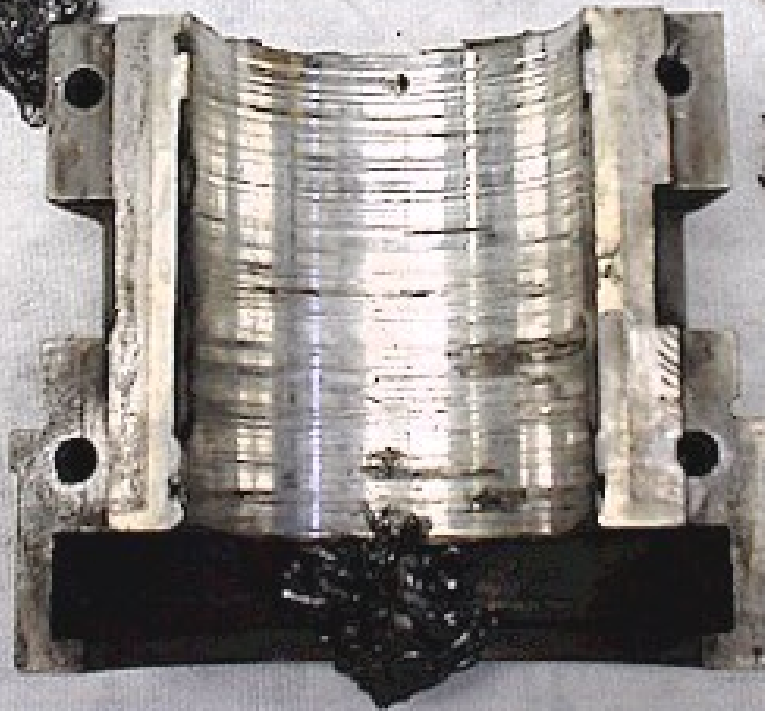
4. Maintain 1/8" air space in the “Trico” bottle to prevent vacuum lock.

This is the result of running a machine without proper lubrication



Babbitt displaced from lower half of bearing

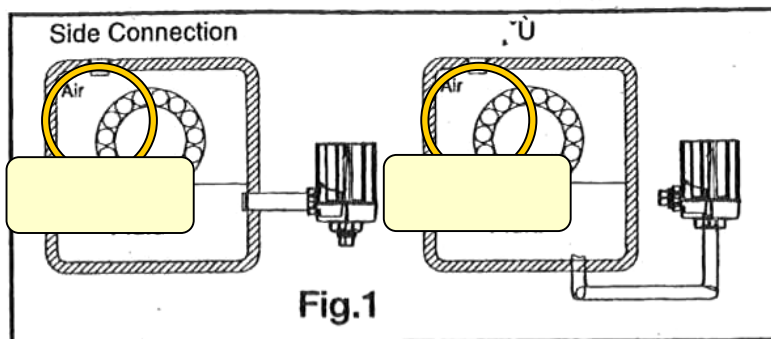
Melted Babbitt



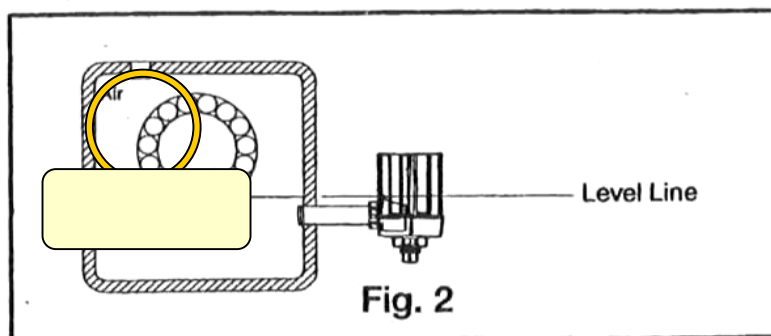
Remember: Never leave a sediment bottle drain valve open more than 3 seconds without refilling Trico Lubricator

LUBRICATION CHECKS

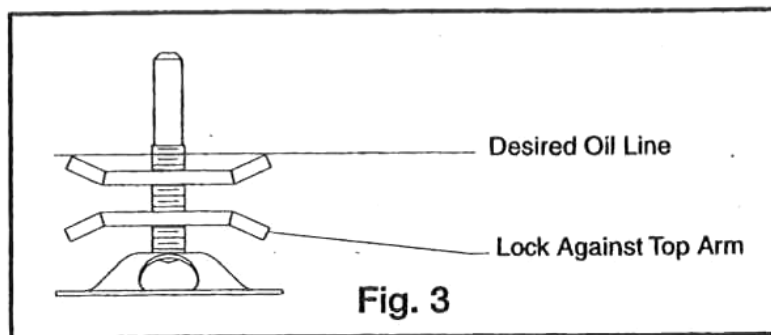
Constant level lubricator



Trico Lubricator Cup maintains oil level through capillary action. The level in the automatic lubricator will equalize in the bearing housing.



Trico Cup:
A 1/8" hole is drilled 1/8" above desired oil level to drain off excessive lube oil. This prevents stalling lube oil rings. Pay particular attention when replacing Trico supply bottle do not place thumb screw over this drilled hole.



LEVEL ADJUSTER

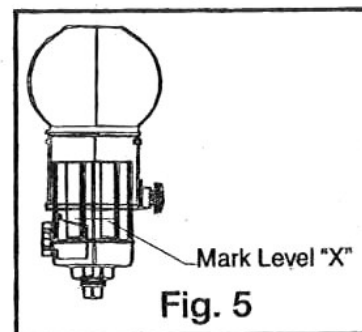
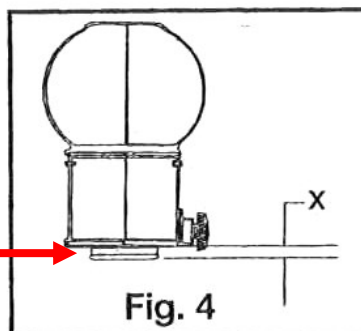
Cross Arms on the level adjuster lock against each other to maintain Trico supply bottle at correct height. There have been cases where normal vibration has caused these to loosen.

When this happens the Trico bottle drops below the required oil level. This condition must be corrected immediately.

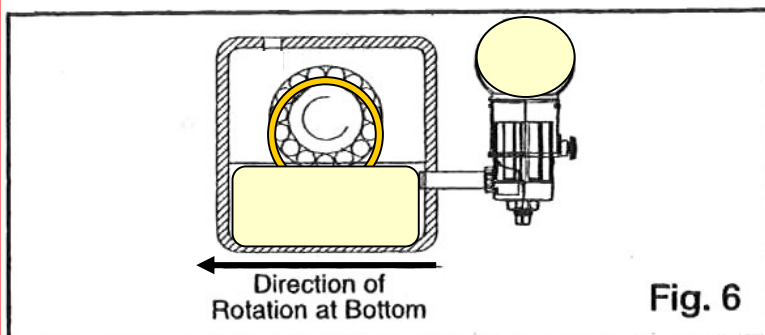
LUBRICATION CHECKS

Oil Level Guide

**Bottom of Bottle is set at desired oil level
(This should line up with oil level tag on bearing housing)**



Remember some styles of Trico bottles may extend 1/8" below skirt of bottle, this is the level where oil level will be maintained

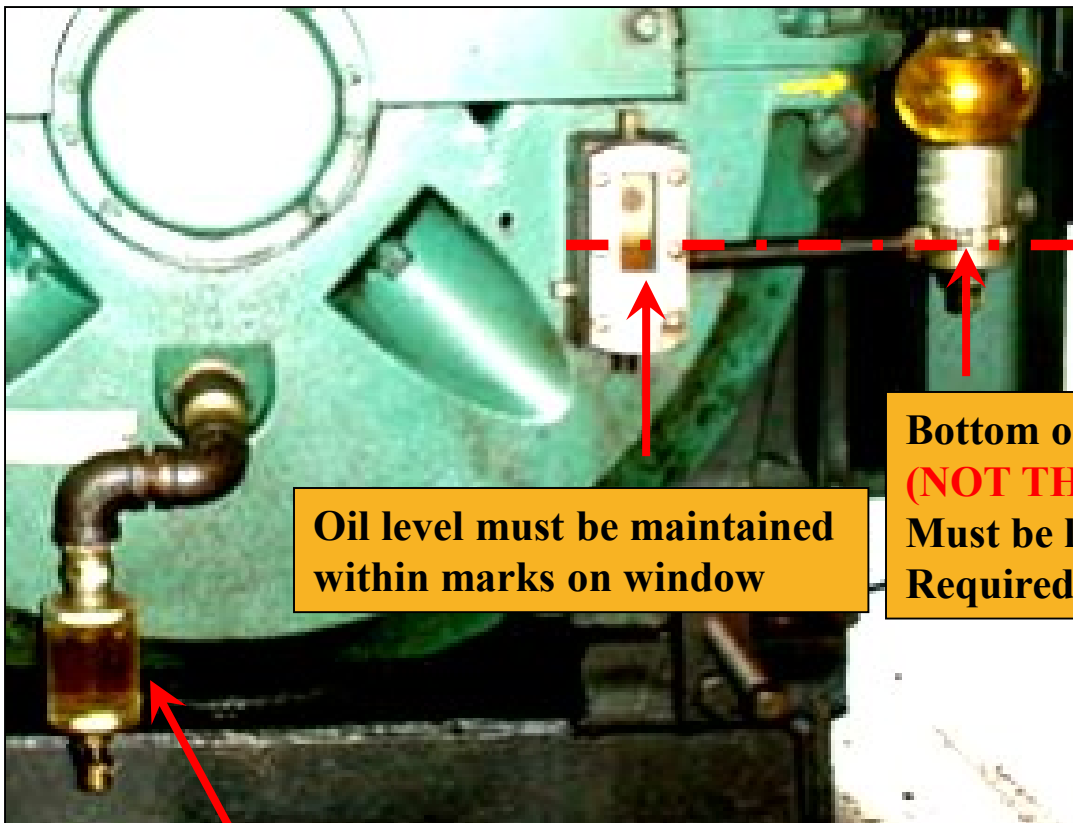


**Bottle should be oriented on side of bearing housing away from direction rotation of shaft at bottom.
This will reduce the chance of lube oil rings forcing oil out of over flow hole that is drilled into the side of the cup**

LUBRICATION CHECKS

Oil Level

Maintaining a correct oil level with clean lube oil is key to achieving maximum bearing life.



Oil level must be maintained within marks on window

Bottom of Bottle
(NOT THE CUP)
Must be lined up to
Required oil level

Drain a small amount of oil from sediment bottle to get a representative sample of what contaminants may lie at the bottom of the bearing housing

If lube oil requires flushing machine must be shut down!

OIL LEVEL TAG

**LEVEL SHOULD
BE SET HERE**

**ACTUAL
LEVEL**

**BOTTOM OF TRICO LUBRICATOR
INCORRECTLY SET 1/2"
BELOW DESIRED OIL LEVEL**

LUBRICATION CHECKS

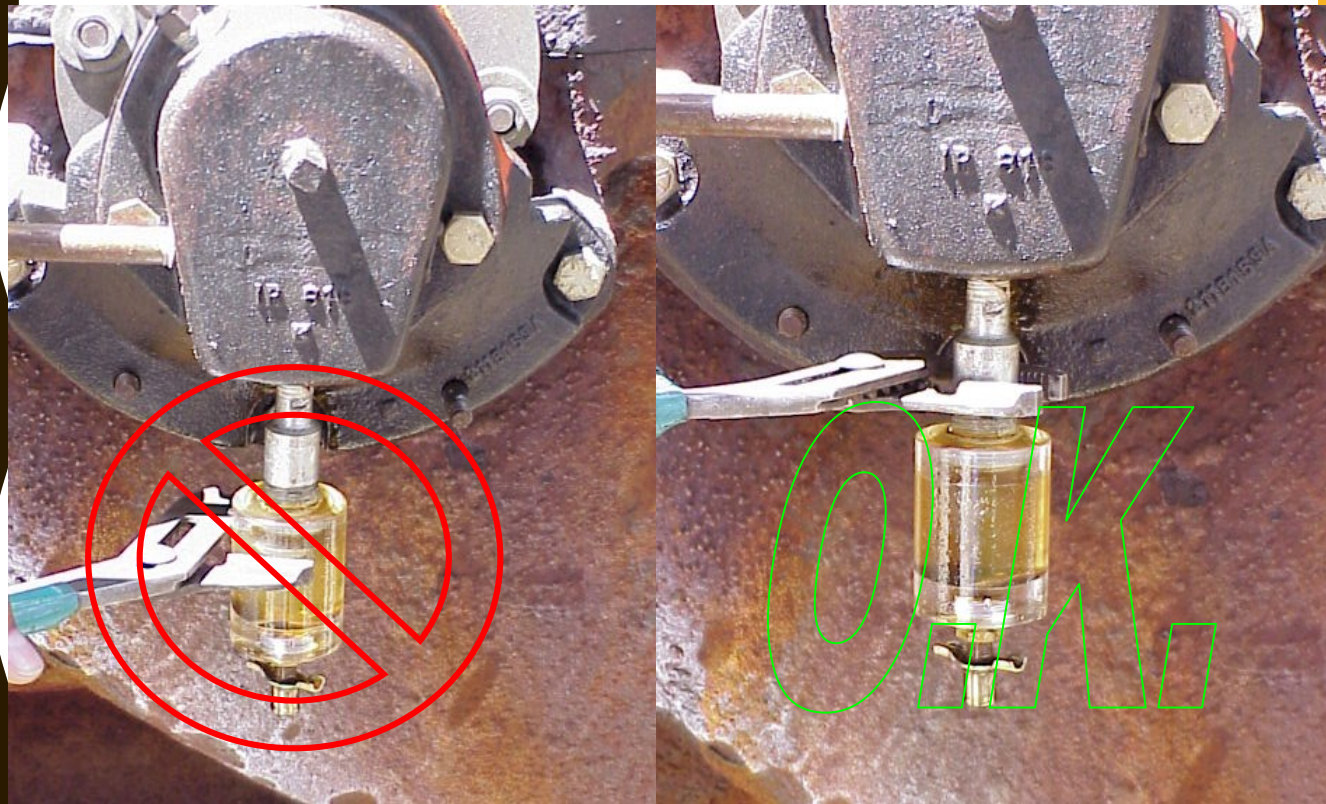
Do's and Don't on replacing the sediment bottle

The connecting nipple for the sediment bottle seals with 1/2" pipe threads at both ends. The drain valve is 3/8" pipe thread.

These are tapered and generally will not require Teflon tape.

Do not over tighten sediment bottle as it is made of Plastic.

Forcing the tapered pipe threads into the plastic will fracture plastic and loss of lube oil will occur.



DO NOT USE CHANNEL- Locks ON THE PLASTIC SEDIMENT BOTTLE
Hand Tighten Only!

Final Tightening into the bearing housing should occur at Pipe Fitting ONLY!

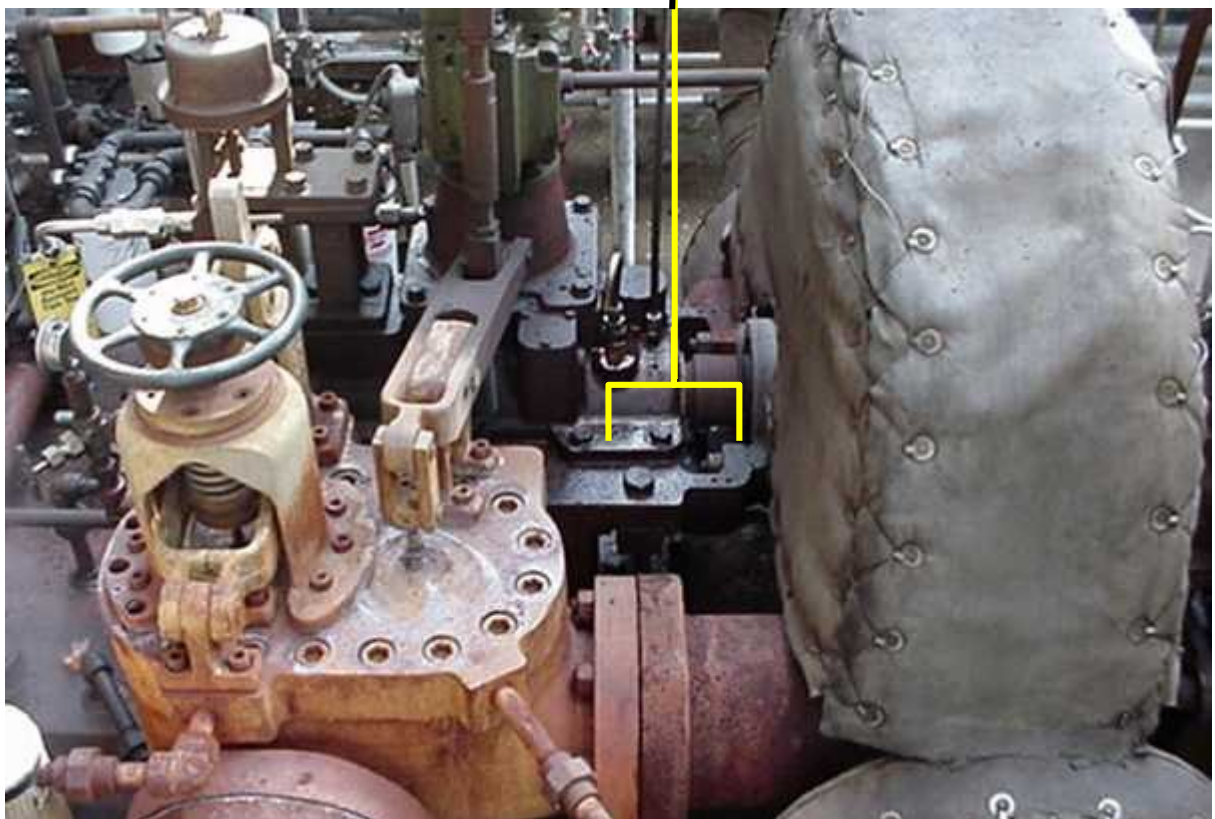
REMEMBER: Over tightening tapered pipe threads into plastic could crack the plastic bottle, developing a small unnoticeable leak.

LUBRICATION CHECKS

Lube oil Contamination

Some turbines and pumps have a potential trap that can contribute to contamination of lube oil. The distance piece, the area separating the bearing housing and the pump or turbine case, some times will have a very small drain hole, if it gets plugged off by debris, water or condensate will accumulate.

The distance piece drain is located under the shaft.

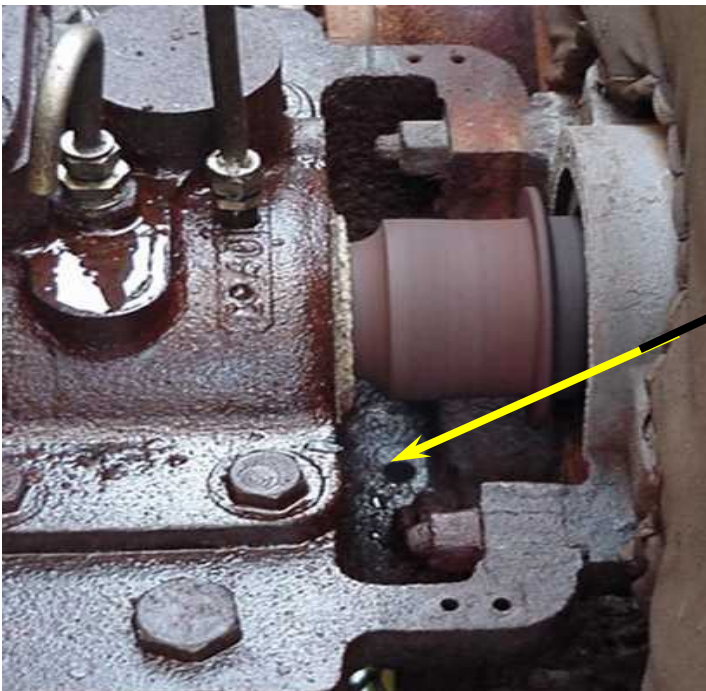


LUBRICATION CHECKS

Lube oil Contamination

Distance piece drains must be kept clean and clear to prevent any liquid build up.

The distance piece drain is located under the shaft.



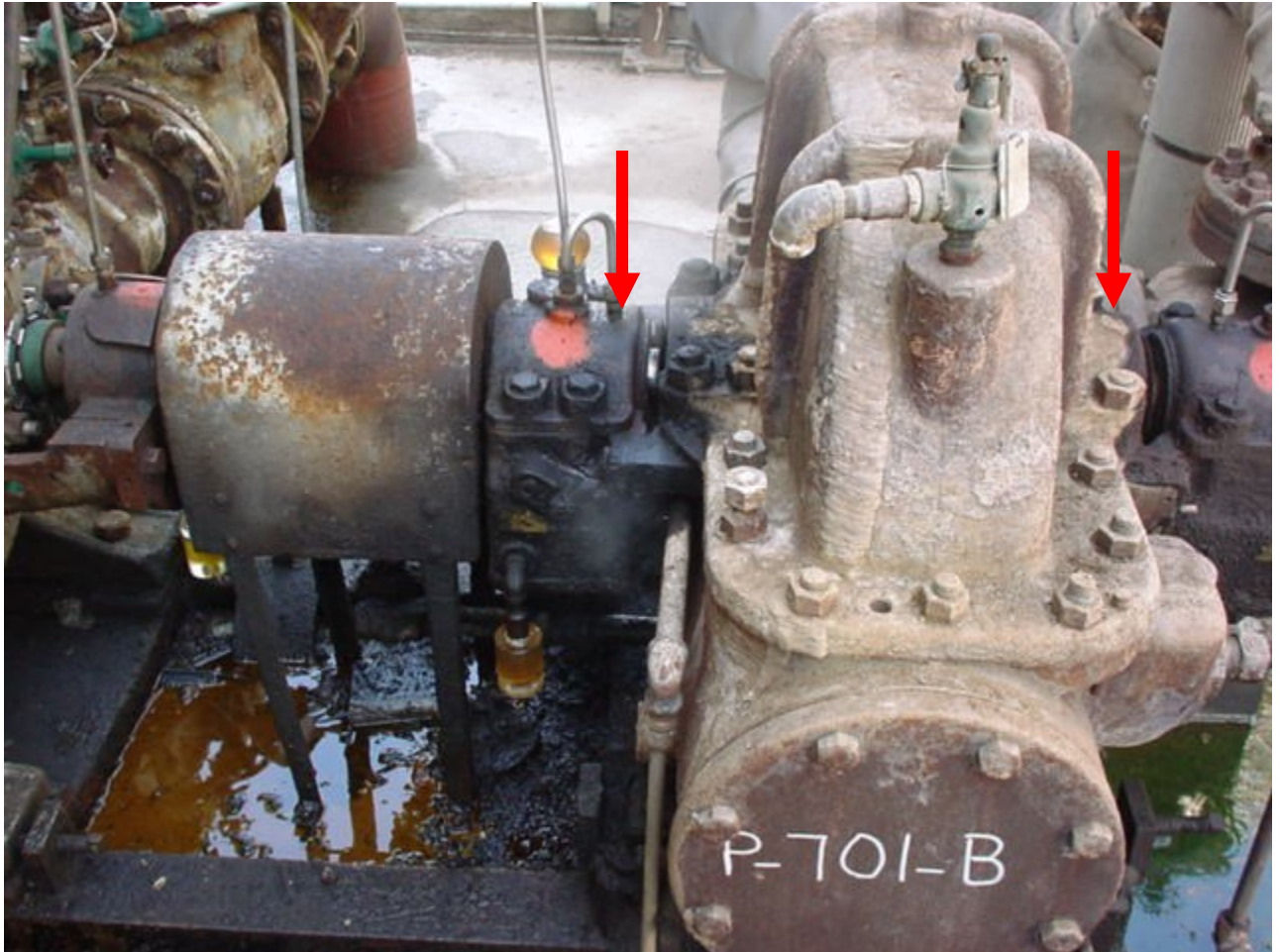
**DISTANCE
PIECE drain
hole**

If liquid is allowed to reach the height of the bearing isolator it will enter the bearing housing, **Contaminating and / or Displacing Lube Oil.**

A regular inspection of this drain should be made and if it's plugged, correct the problem immediately.

LUBRICATION CHECKS

Lube oil Contamination



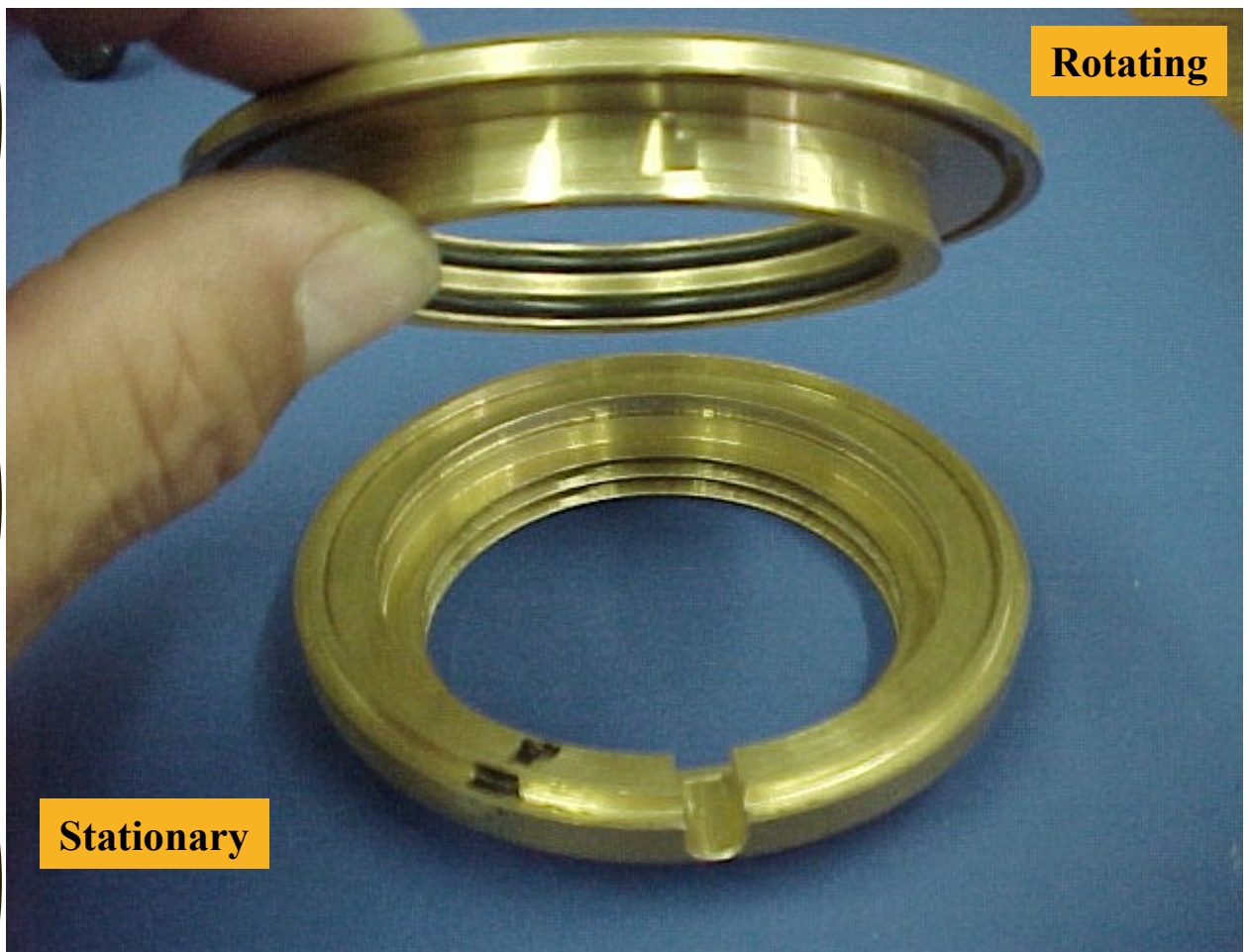
Check Distance Piece Area For Liquid Build up

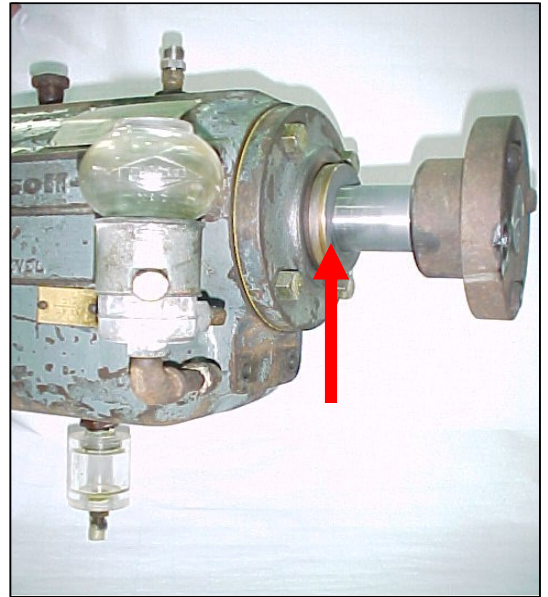
LUBRICATION CHECKS

Lube oil Contamination

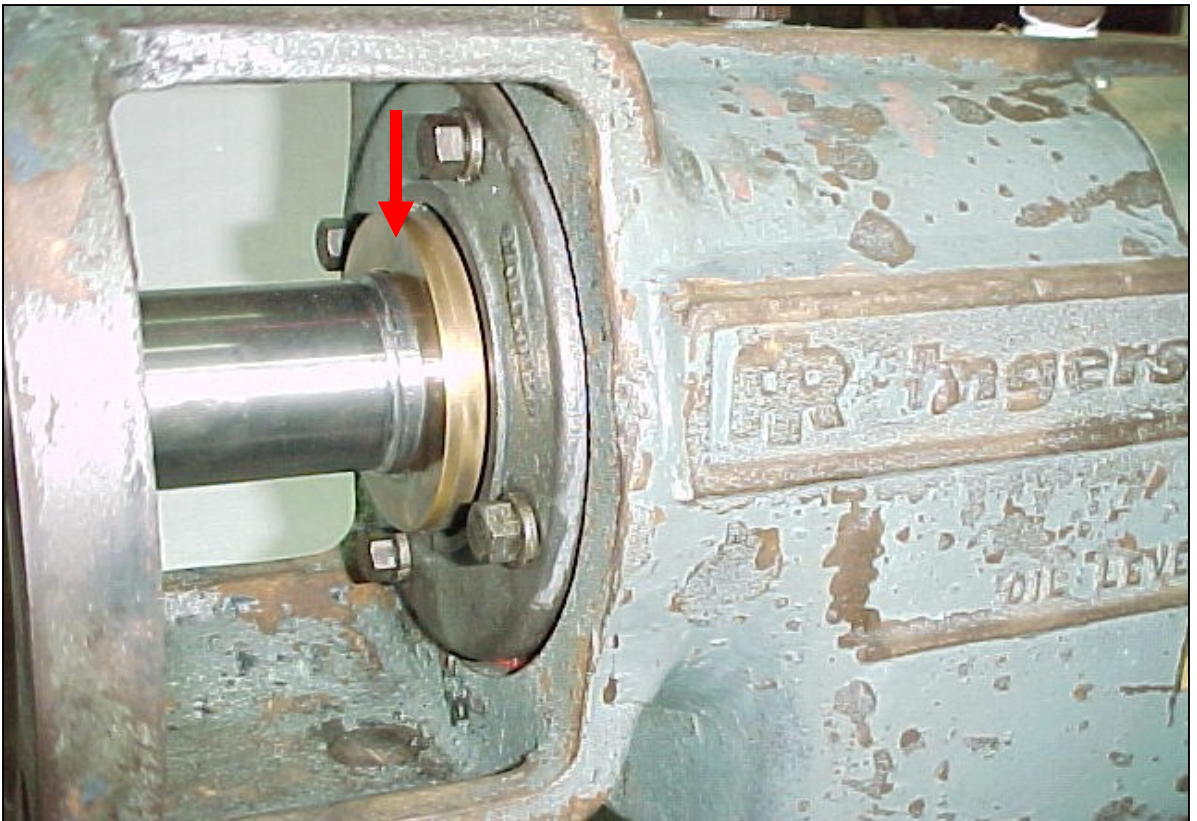
Bearing isolators are used to prevent contaminants from entering the bearing housings. They also prevent loss of lube oil as it is agitated by lube oil rings.

Another inspection in regards to bearing isolators is to look for axial movement of the rotating half of the isolator over time they can become loose on the shaft. Although this may not be an immediate problem, It could be indicative of a more serious bearing problem. Such as a failing thrust bearing.





Bearing Isolator Location



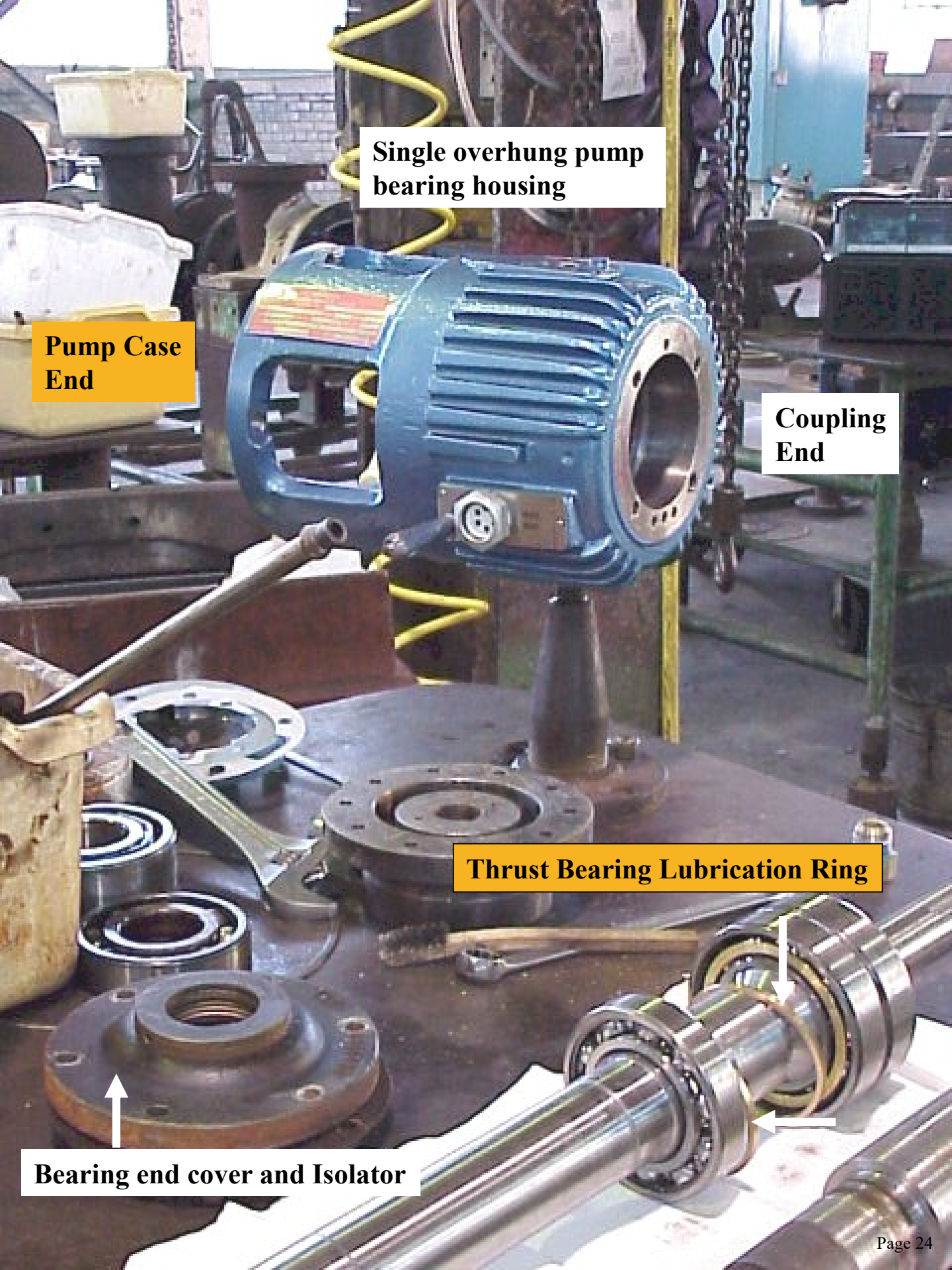
Single overhung pump bearing housing

Pump Case End

Coupling End

Thrust Bearing Lubrication Ring

Bearing end cover and Isolator



LUBRICATION CHECKS

Pure Mist Lubrication

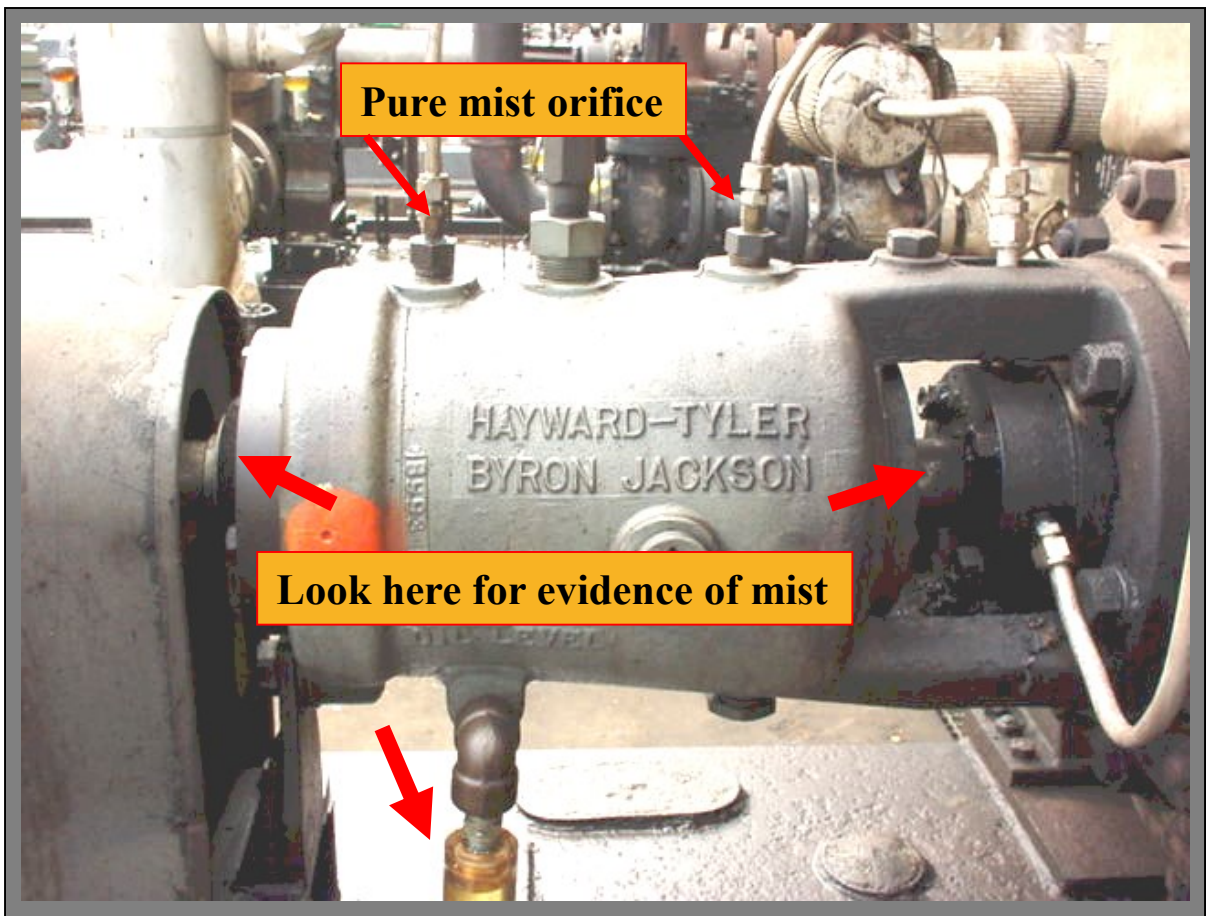
Some equipment relies entirely on atomized oil for lubrication. These systems

must be routinely monitored for evidence of mist, this may be visible where the

shaft exits the bearing housing, adjacent to the bearing isolator (seal).

1. This is most evident when the pump is not in service.

2. Seal Steam quench may have to be throttled back momentarily to view the mist.



3. If the pump is in service, windage from the rotating shaft may make the mist difficult to see. When this condition occurs mist may be visible from the 1/32" vent hole in the sediment bottle.

LUBRICATION CHECKS

Pure Mist Lubrication

If Mist is not visible from sediment bottle vent due to lighting conditions, open the drain valve wait a moment and look for evidence of the mist at valve.

Another indication that the mist system is operating correctly is to monitor the accumulation of oil in the sediment bottle, filling the bottle approximately 33% per shift. (This amount will vary with mist header pressure).



**To monitor Pure Mist Pumps while they are in service, Look at sediment bottle vent hole for evidence of mist. If the mist is not visible open drain valve and look for mist filling the bottle, and a slight wisp exhausting from open valve.
(THEN CLOSE VALVE)**



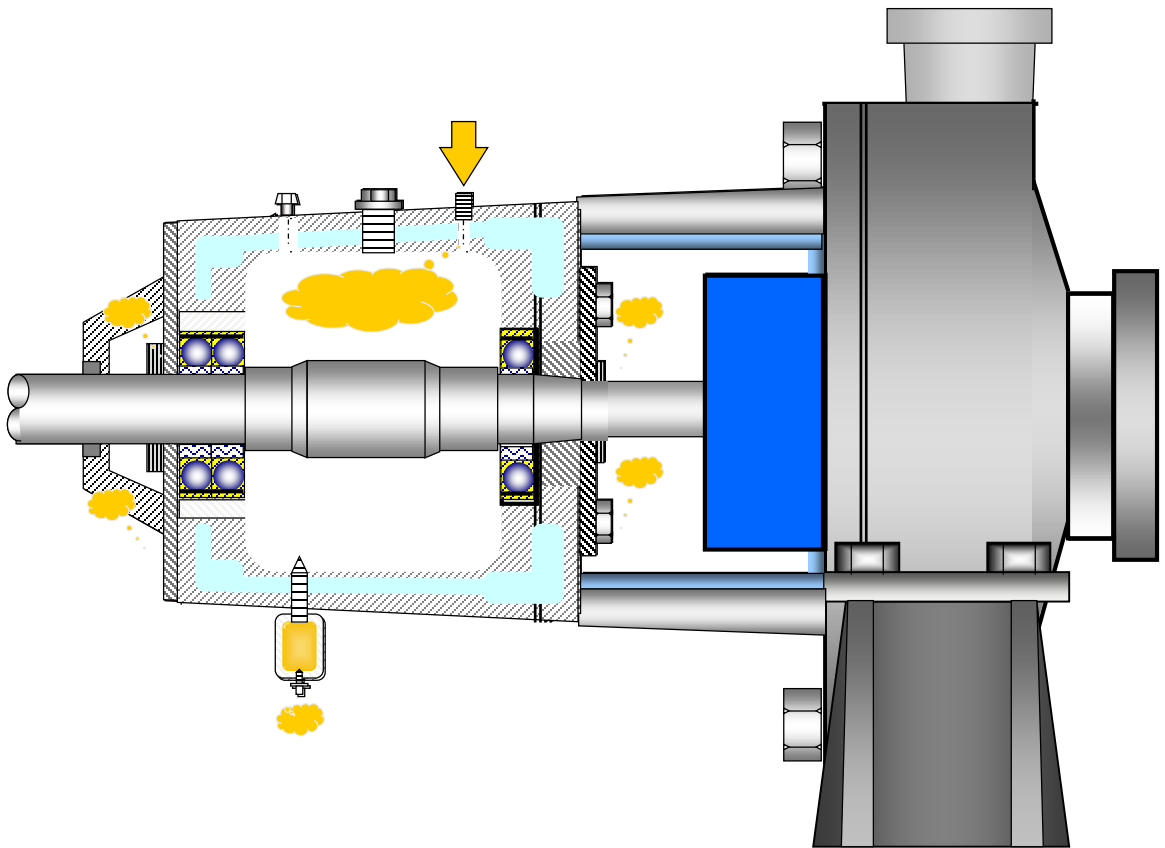
A periodic draining of a PURE MIST sediment bottle will help you determine the amount of mist supplied to a bearing housing

LUBRICATION CHECKS

Important:

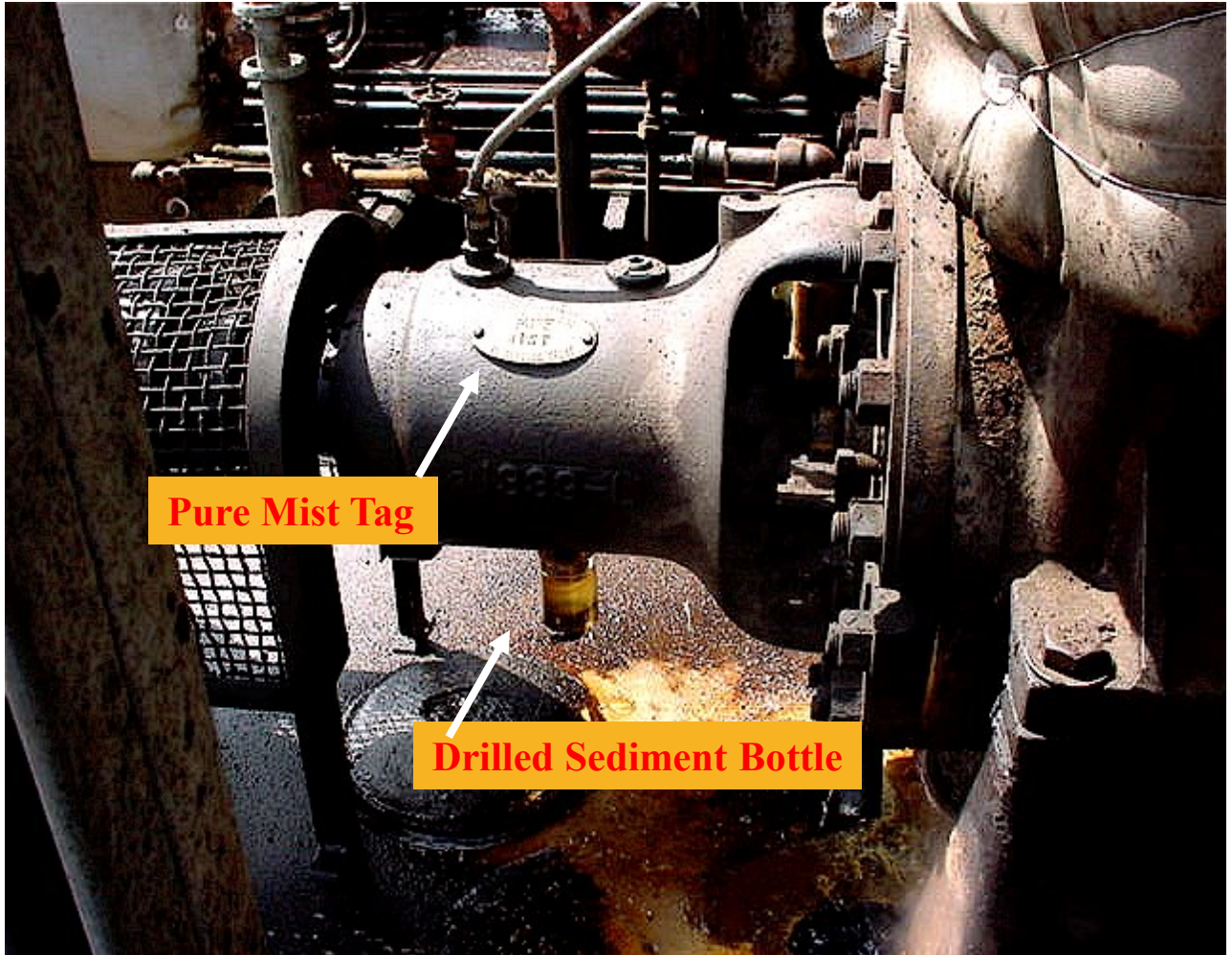
Pure Mist Pumps, If No mist is visible:

1. A plugged pure mist orifice fitting may be the cause and must be corrected immediately, or bearing damage will occur.
2. The mist header is plugged (Drain main collection bottle at end of header)
3. The mist generator has malfunctioned. Perform generator checks.



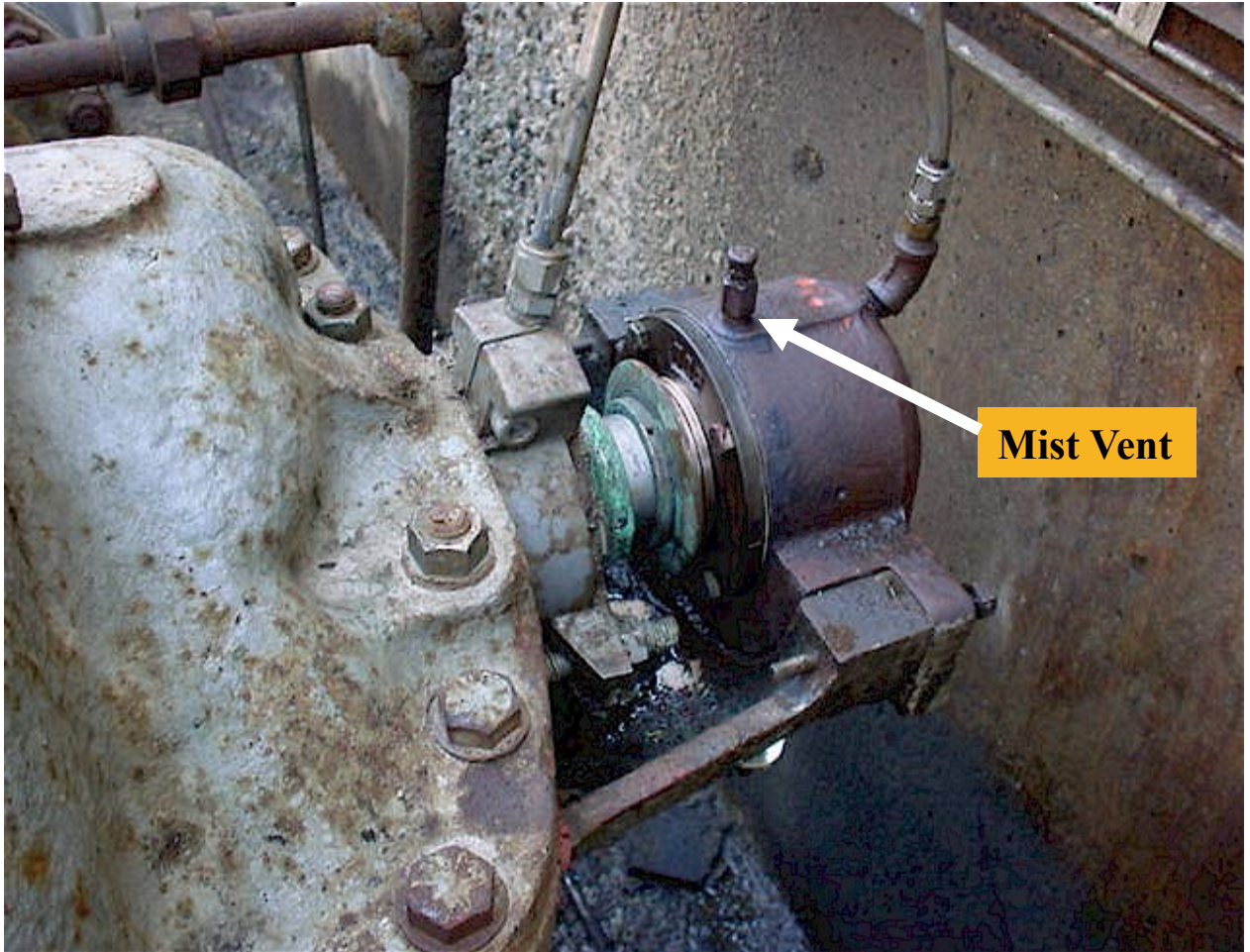
Pure Mist Lubricated bearings Can be identified by:

1. The brass pure mist tag mounted on the bearing housing
2. The absence of the Trico™ automatic oiler
3. A 1/32" hole drilled in the sediment bottle



Pure Mist will NEVER be utilized as the single source of lubrication on Babbitted liquid film bearings as the atomized oil is not sufficient to keep this type of bearing properly lubricated

P-701A
Pure mist lubricated bearing



Not all pure mist lubricated bearings will have a vent as pictured here.

In most cases it is more desirable to have the mist exit the bearing housing through the bearing isolators as more mist is forced through the bearing



**Pure Mist Lubricated Bearing
Damaged by loss of Mist**

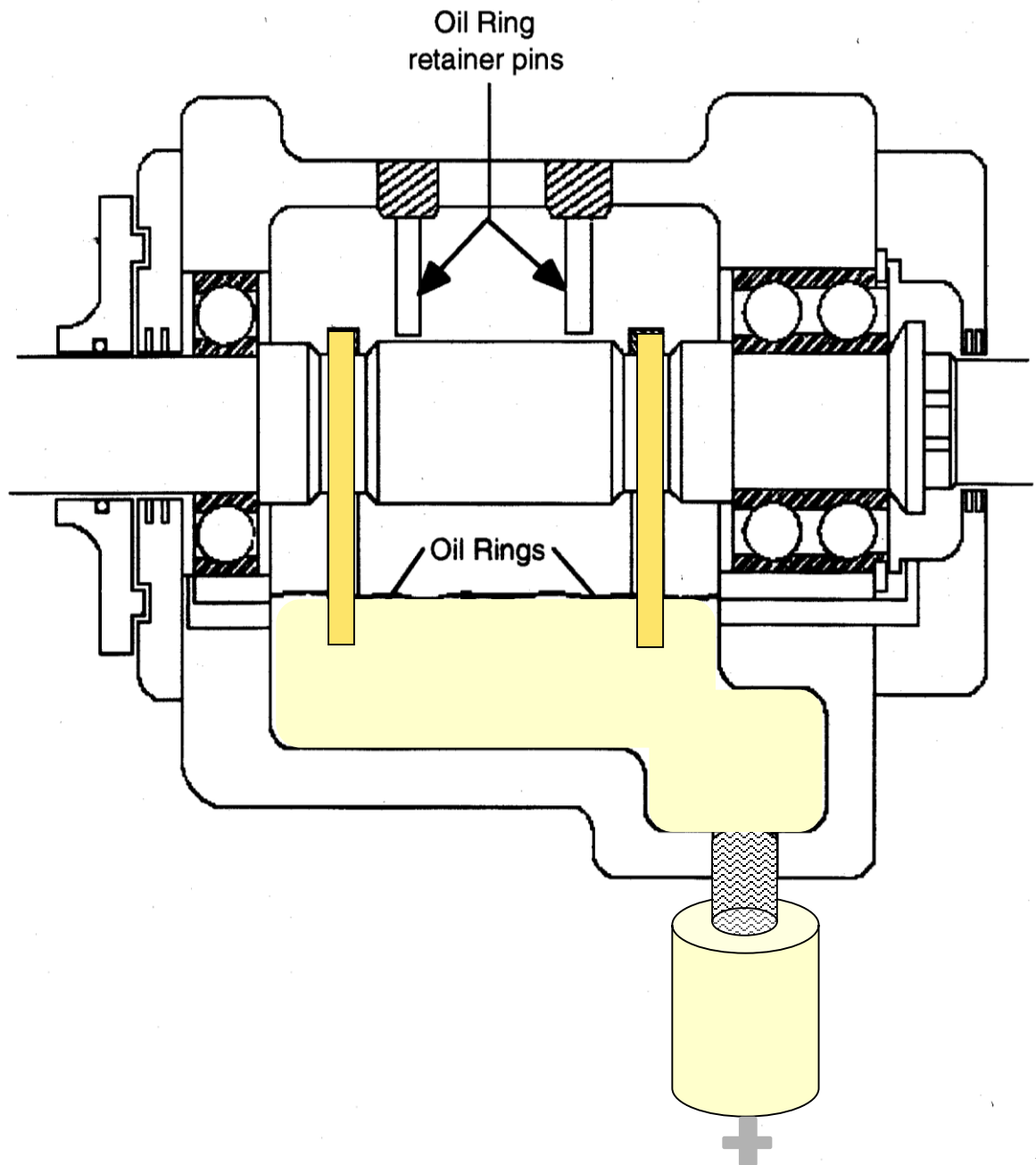


LUBRICATION CHECKS

Things to Remember

Some bearing housings may have Oil-ring retainer pins,

If these are removed while the shaft is rotating it is possible the oil rings will move from their respective groove and starve the bearings of their required oil



LUBRICATION CHECKS

Things to Remember

If Drain valve installation nut turns while attempting to open the valve, or if valve requires excessive force to open.

Hold valve installation nut **before attempting to open valve any further.** This will prevent the valve from backing out and causing loss of all lube oil and a premature bearing failure.



Holding drain valve installation nut to facilitate opening a tight drain valve

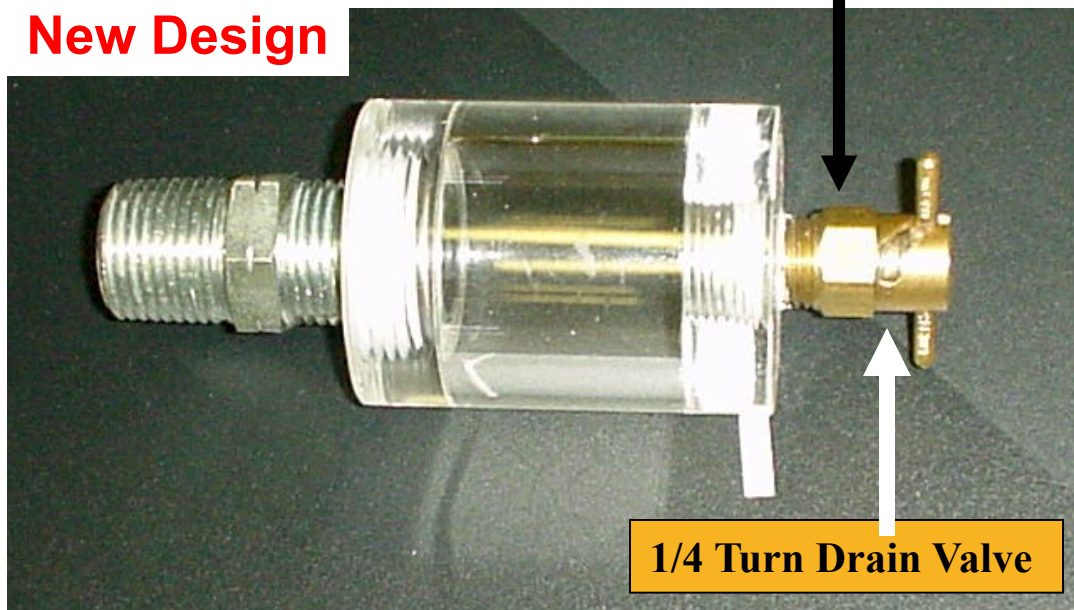
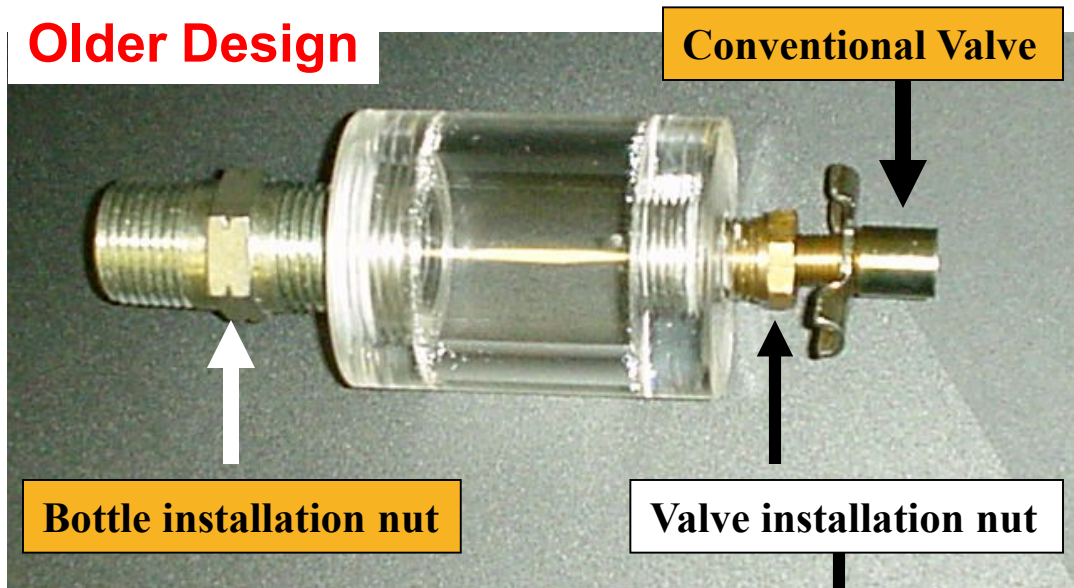
LUBRICATION CHECKS

Things to Remember

Never over tighten supply pipe or valve into plastic bottle or it may fracture and loss of lube oil will occur.

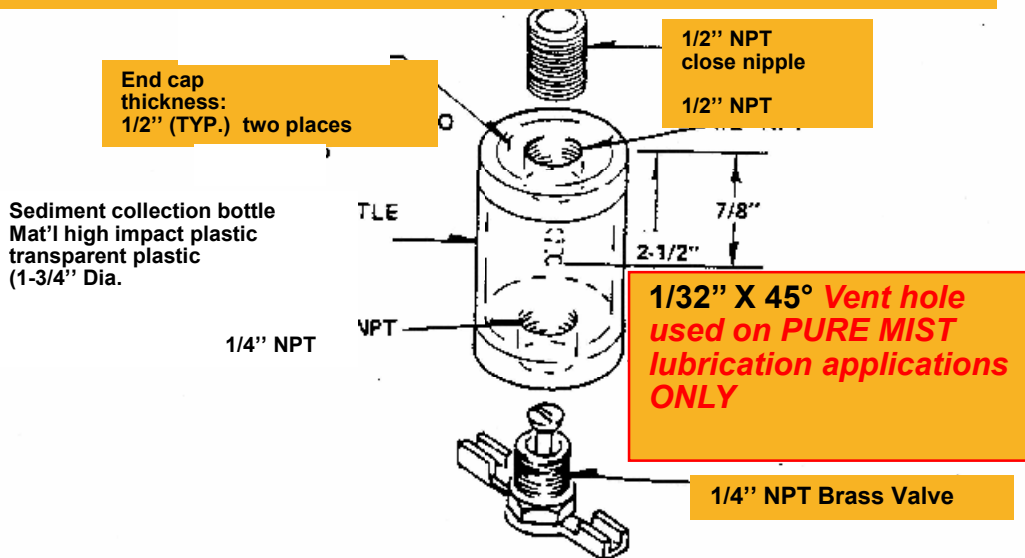
ALSO

Be aware of the two different types of drain valves used on sediment bottles.



LUBRICATION

- Oil sediment valves are designed to be opened and closed by hand
- If pliers are required the valve should be replaced.
- There is a danger of the valve coming loose from the bottle if it is over tightened when closing



Sediment Bottle Store House Stock Number and application

PURGE MIST	P&S:	1071501
PURE MIST	P&S:	1071500

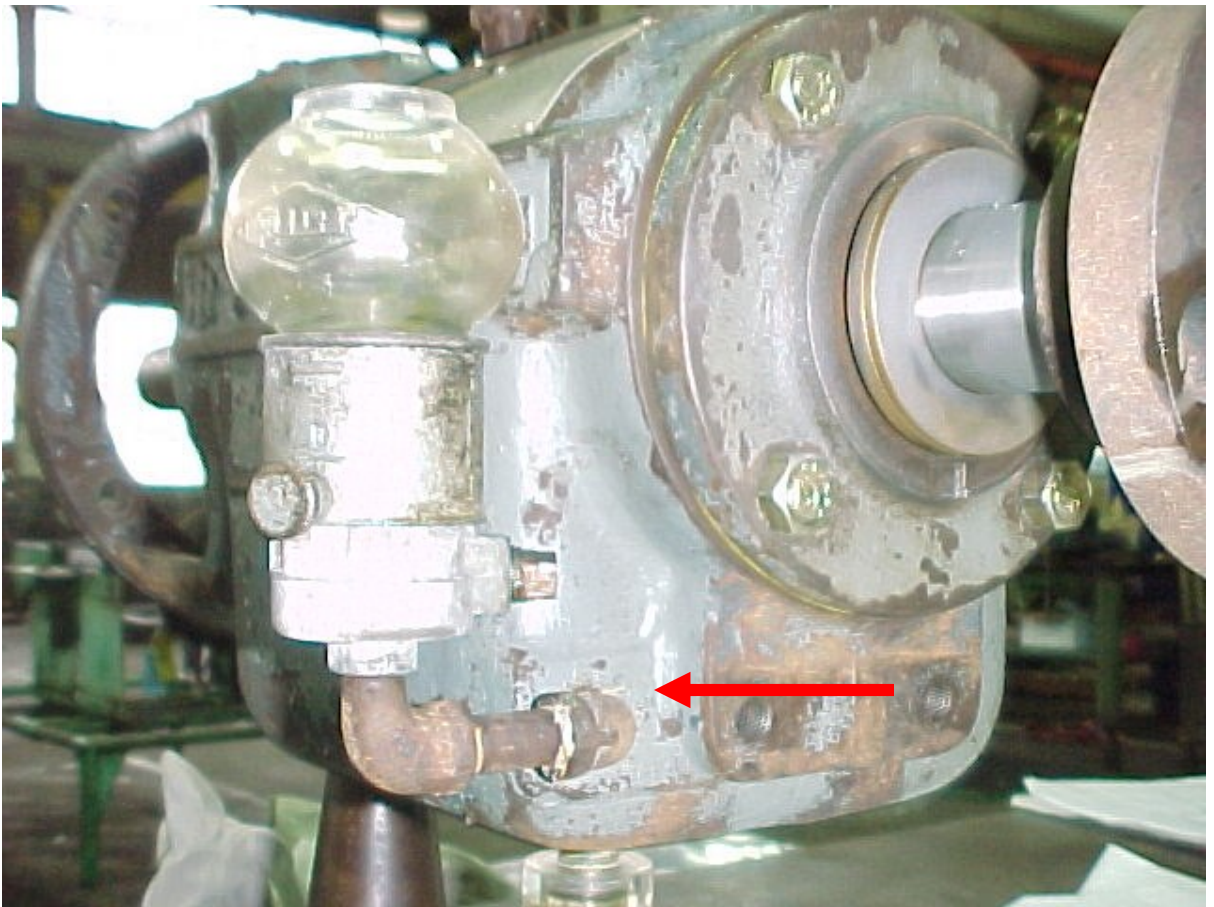
Things to remember

Lube oil Contamination will reduce bearing life.

Check the distance piece, on pumps and turbines for liquid build up

**IF THIS HAPPENS
CLEAR THE DRAIN
OF DEBRIS TO
PROMOTE
THE FREE FLOW OF
TRAPPED LIQUID**





**Some Trico Lubricator installations require use of 90° pipe fittings.
If these are disturbed from their horizontal position
oil level could be compromised**

Things to remember

The Trico Bottle should always be level & Bottom of Bottle Should be lined up with Oil Level Tag



Use of 90° elbow could allow automatic lubricator to be inadvertently pushed down causing loss of oil through the drilled overflow hole in the side of the cup

LUBRICATION CHECKS

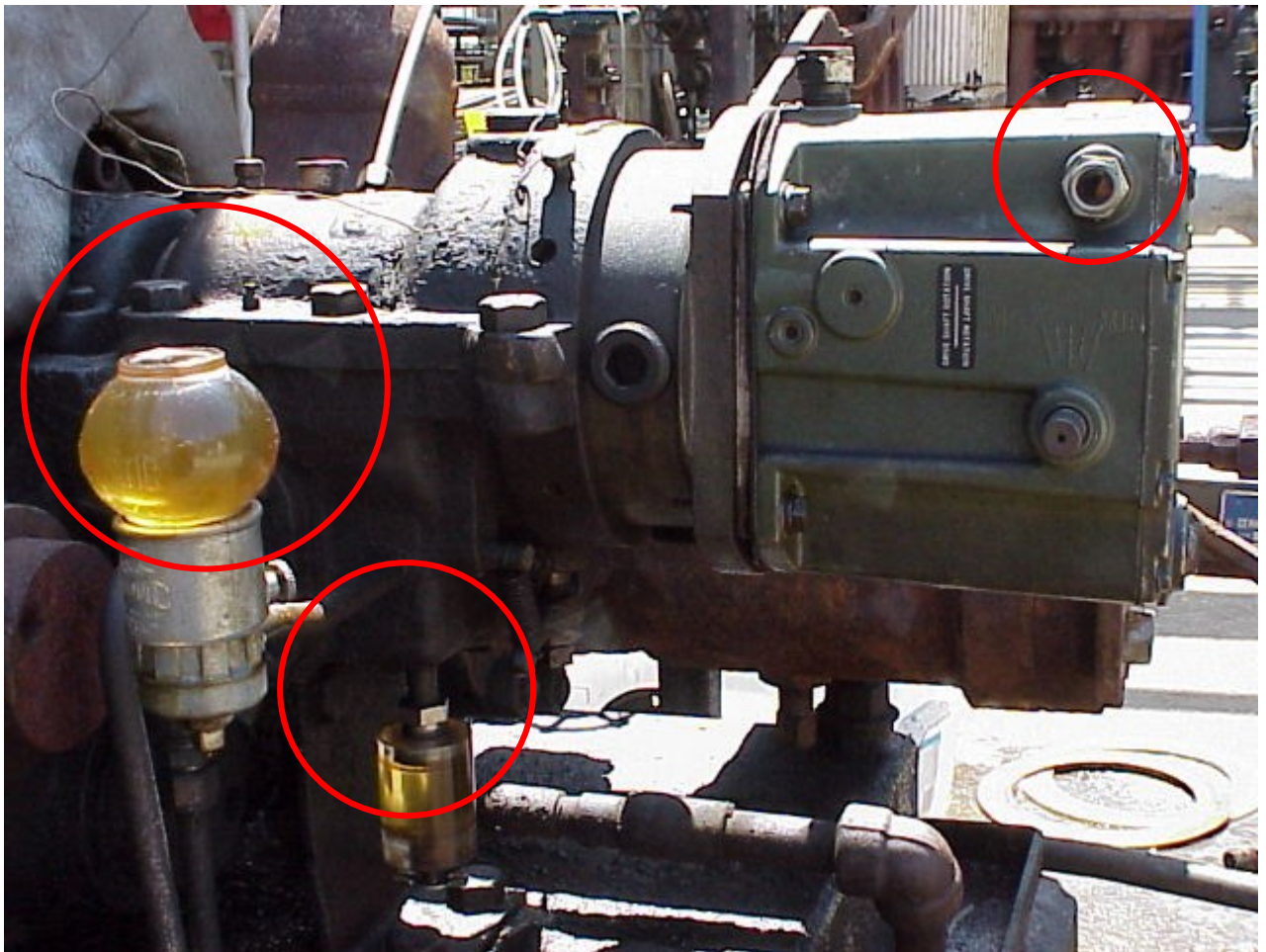
Things to remember

Here is a recap of three important Lubrication checks, take the time to look at the Governor Oil level, Trico level, Sediment bottle oil clarity.

When Sampling the oil, look for Contamination.

Take the opportunity while doing your MARLIN check to document any abnormal condition and enter them in the Note Page of the MARLIN DATA MANAGER, and if a critical condition is noticed contact your machinist.

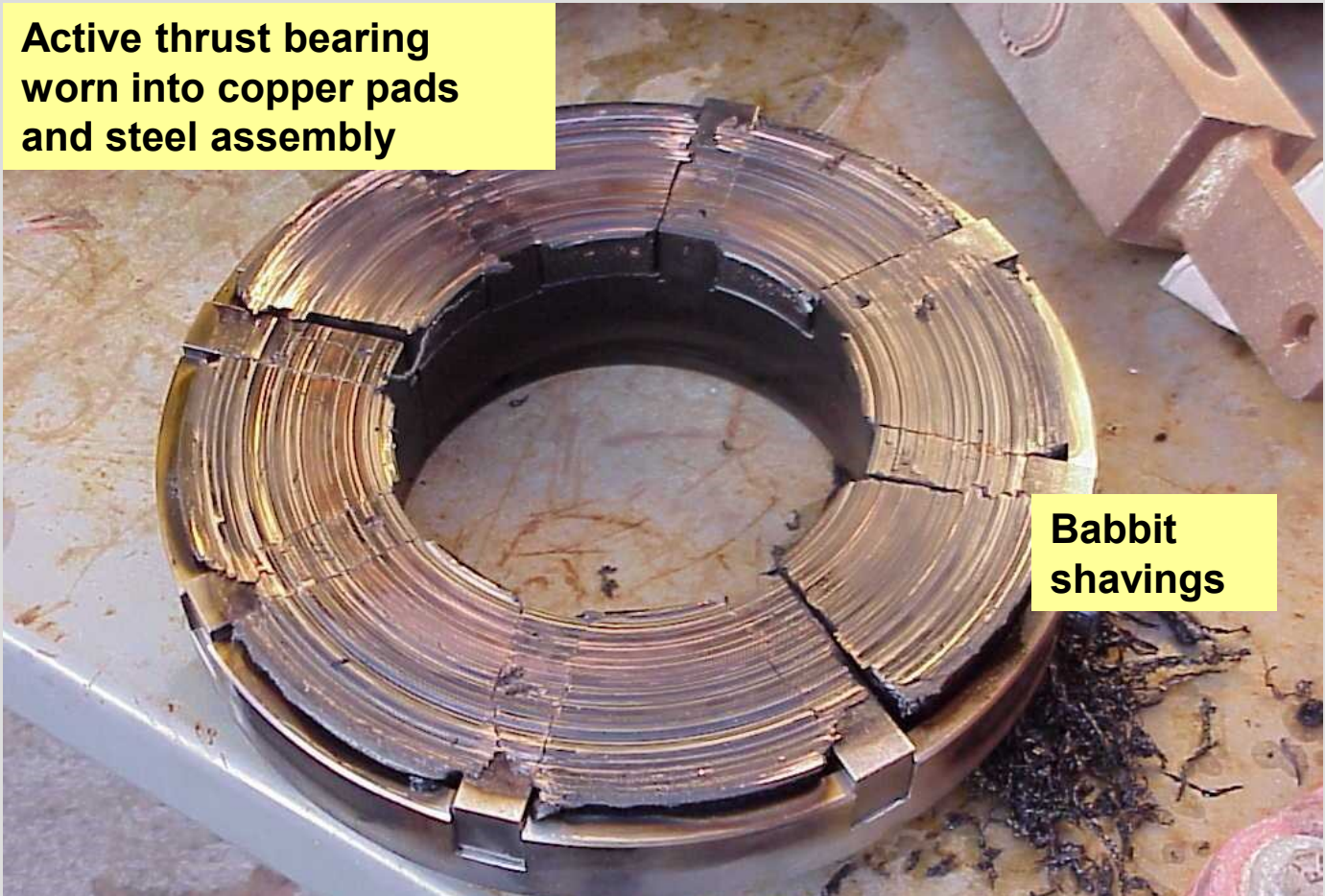
Three Important Lube Oil Monitoring Locations



An example we can learn from

Damaged: Kings Bury Tilt Pad Thrust Bearing Assembly

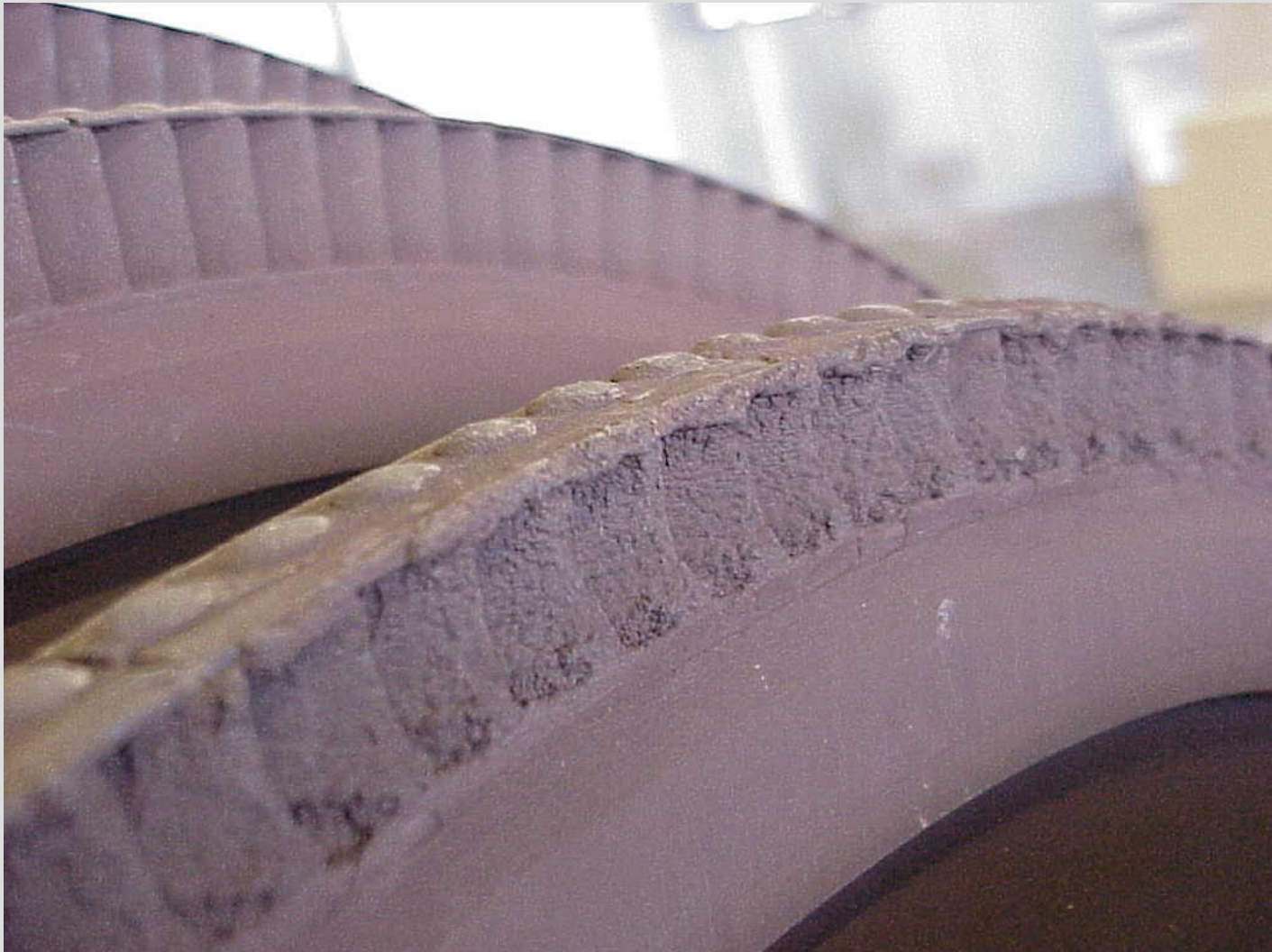
Active thrust bearing worn into copper pads and steel assembly



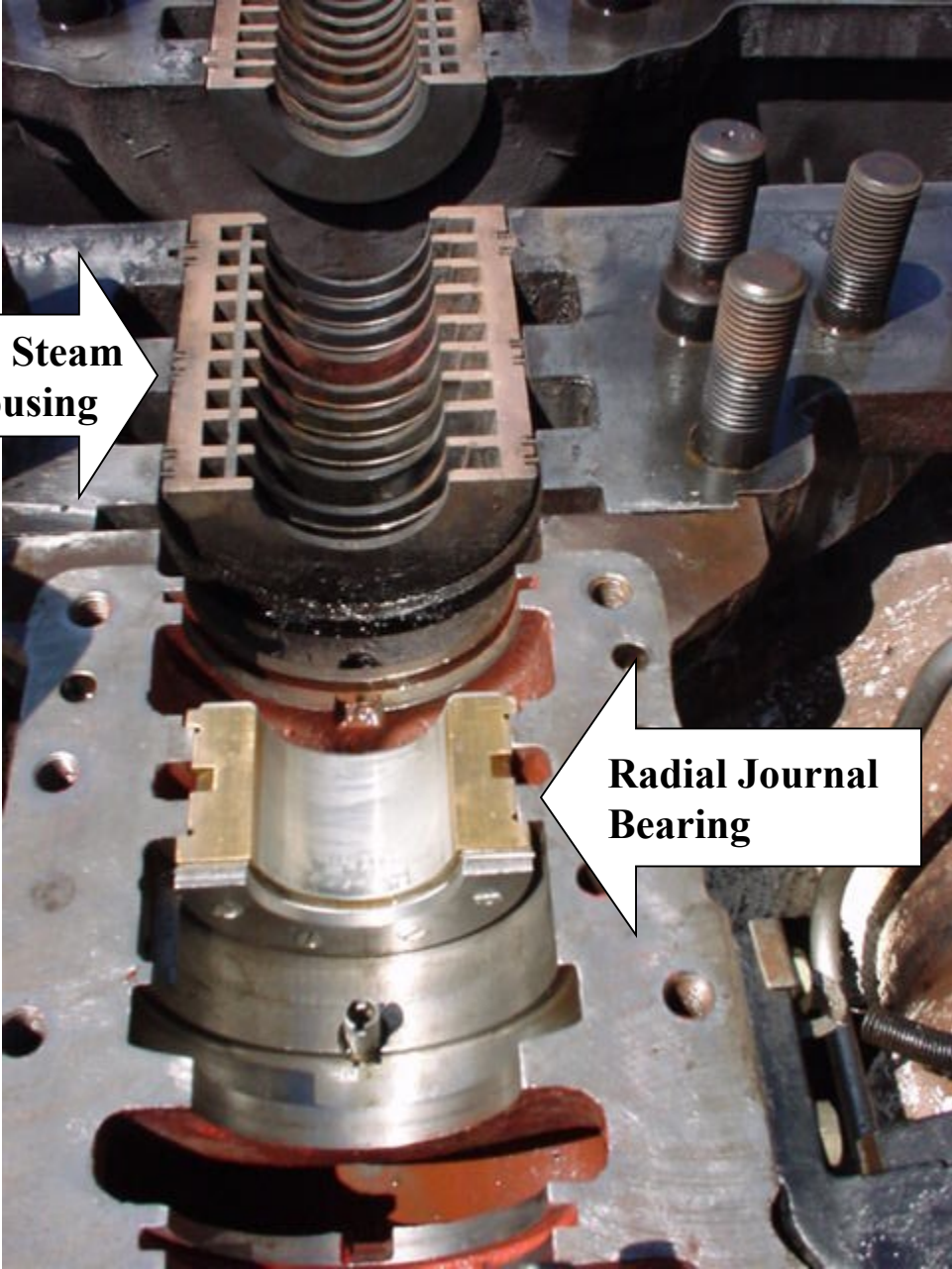
Babbitt shavings

This damage resulted from boiler compound build up on the turbine wheel, which over thrust, (loaded) the runner into the thrust bearing.

**Fouled Turbine Wheel which over loaded
Tilt pad thrust bearing (from previous slide)**



Steam Turbine With Upper Half of Case Removed



Carbon Steam Seal Housing

Radial Journal Bearing

Rolling element bearing damaged by inadequate lubrication

