TURBO COMPONENTS & ENGINEERING
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BEARING JOURNAL

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Early warning

Temperature is best indication of bearing operating condition

Condition monitoring has become of major importance in the installation and maintenance of all types of turbomachinery over the past 30 or 40 years. Babbitt bearing temperature is of primary importance because bearings are the critical links between the rotating and stationary components in a machine. If temperatures are taken in the correct location with respect to the direction of bearing load, to direction of shaft rotation, and to the distance of the tip of the sensor from the bearing running surface, then babbitt metal temperatures can be the best indicators of a bearing's operating condition.

Through the analysis of data of many bearing tests, prototype turbomachinery tests, and day to day operation, a general consensus has pinpointed the locations of greatest sensitivity for installing temperature sensing probes. In most bearing applications, the current state of the art uses some type of electrically variable tip at the end of a current conducting set of wires. The wires provide a flexible connection to the outside of the bearing while the sensor tip is engineered to the smallest practical size for insertion into the bearing.

As a practical consideration, the choice of temperature sensors has been narrowed to three basic types: Thermocouple (TC); Resistance Temperature Detector (RTD); and the Thermistor. TCs and RTDs have metal to metal sensing junctions and are the most popular. They can be fashioned into miniature sensing tips for ease of installation. Thermistors are ceramic semiconductors of limited use, thus far, being mainly used for establishing close monitoring over a limited temperature range.

For consistency and repeatability, the 3rd Edition of API 670 (1993) has defined the recommended measuring points in babbitted bearings. These locations closely approximate the zones of peak temperature as they relate to the peak hydrodynamic oil film pressure zones. These are worth repeating here for sleeve bearings, tilt pad journal bearings and for tilt pad thrust bearings:

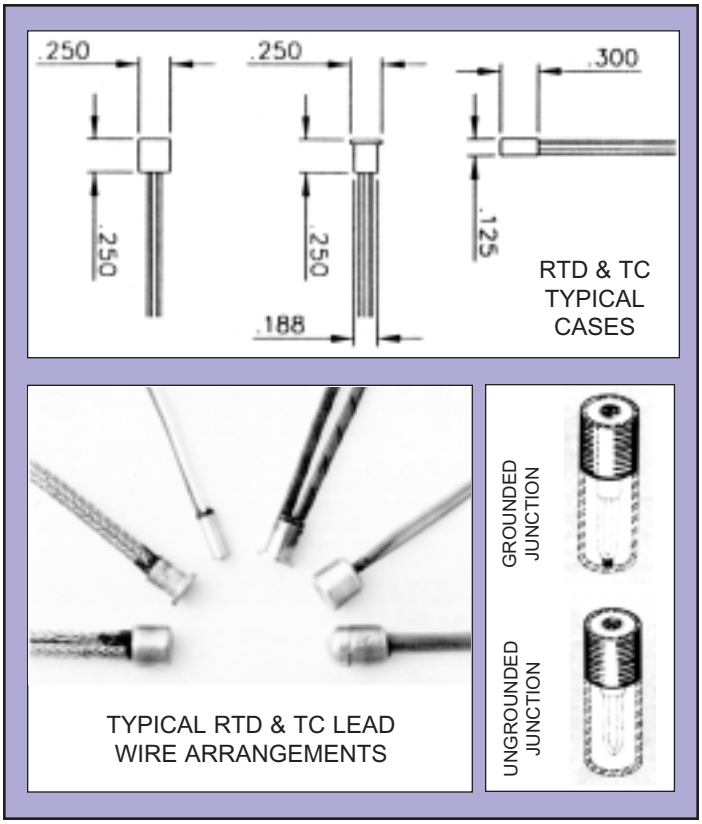
Sleeve Bearings

The probe or probes should be located 30º ± 10º beyond the point of maximum bearing load in the direction of shaft rotation. More precisely the best location is in line with the point of minimum oil film. See Notes 1 and 2 on page 2 for axial location of probes.

Tilting Pad Journal (TPJ) Bearings - Load on Pad

The probe or probes should be located in the pad carrying the greatest share of load, usually the bottom centerline pad. Probes should be embedded and located 75% of the circumferential pad length from the leading edge in the direction of rotation. For pads

Continued on Page 2



TCE introduces publication

Turbo Components and Engineering is introducing *Bearing Journal* as a vehicle to provide useful information to our customers and others who have an interest in our industry. If there is a particular topic you would like to see addressed in future issues, call us at (713) 943-9100 and let us know.

TCE is a quality source of after-market products and services for the rotating equipment industry. TCE specializes in the design, replication, manufacture and repair of labyrinth seals and babbitted bearings for turbomachinery, and excels in problem solving. The company offers a brochure with solutions to such problems as thrust bearing failures, compressor and turbine reliability, excessive balance piston labyrinth leakage, inadequate compressor output, turbine oil leaks and high thrust bearing temperatures. A copy of the brochure is available free upon request.

Heat

Continued from Page 1

with self-aligning pivots only one probe on the axial centerline is required regardless of pad length. For line contact pivots see Notes 1 and 2.

Tilting Pad Journal Bearings - Load between Pads

The probe or probes should be located in the trailing of the two loaded pads in the direction of rotation. In this pad, the probe or probes should be located 75% of the circumferential distance from the leading edge in the direction of rotation. For pads with self-aligning pivots, only one probe is required regardless of pad length. For line contact pivots see Notes 1 and 2.

Thrust Bearings - Tilting Pad

Probes or sensors should be located in at least two pads in the designated active thrust bearing, at the 75%-75% location as shown in the thrust bearing sketch. Regardless of the number of pads in a bearing, an attempt should be made to have sensors in two pads located in the bottom half of the bearing assembly at least 120º apart. When installing probes, the tilting action of individual pads should not be compromised.

"Standardizing on sensor location will develop confidence in temperature readings."

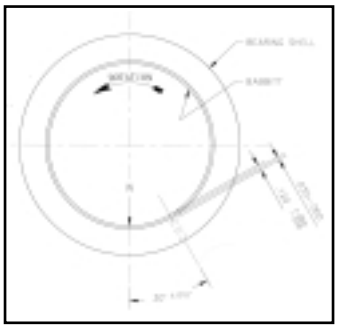
Notes (For non self-aligning TPJ's and Sleeve Bearings)

1. If the length to diameter ratio (L/D) is less than or equal to 0.5, a single sensor shall be located on the axial center of the bearing.
2. If the L/D is greater than 0.5, two probes shall be installed, each located 1/4 of the total length from each end.

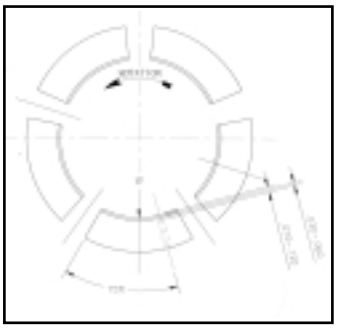
Guidelines

As a general guideline for all bearings; sleeve, tilt pad journal, and thrust, probes or sensors can be installed from any direction that is most convenient from a machinery assembly standpoint as long as bearing function is not compromised and lead wires are not subjected to excessive stress, movement, or fretting.

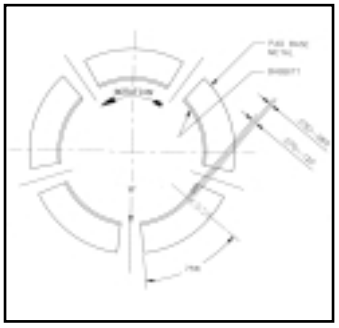
The distance of the sensor from the running surface of the babbitt is more critical in steel and bronze than in backing material of copper because of copper's better thermal conductivity. Regardless of backing material, there is a drop in temperature from the running surface to the sensor tip as heat travels through the babbitt layer, through the backing material, and through the contact zone between the backing and the sensor tip. Standardizing on sensor location will develop confidence in temperature readings. Babbitt thickness is a variable sometimes out of our control. Since we do not penetrate the bond line into the babbitt, but stay back from the bond line by .030 to .060, the overall distance may exceed the .120 distance shown.



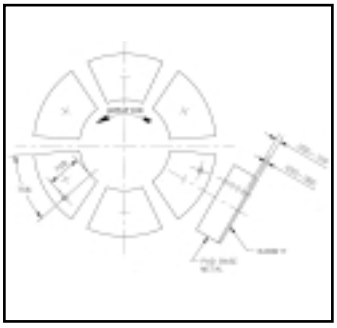
Sleeve Bearing



Tilting Pad Journal Bearing Load on Pad



Tilting Pad Journal Bearing Load between Pads



Thrust Bearing - Tilting Pad

Technical papers available on variety of topics

TCE has several technical papers available on topics that may be of interest to our customers. These papers cover topics ranging from the use of thermoplastic labyrinth seals to babbitted bearing failure analysis. This section of the newsletter will present a brief introduction each quarter to one of these papers. This month we introduce "Babbitted Bearings: Instrumentation, Inspection, and Installation," this paper was first presented in 1995 at a seminar sponsored by the Houston Chapter of the Vibration Institute.

There are many aspects of babbitted bearings that need careful attention. This paper starts with an introduction to journal bearings with emphasis on tilting pad journal bearings, covering various design options including; L/D ratio, preload, on pad vs. between pad loading, endseals, pivot designs, "bump" checks, etc. A section is devoted to field checks of journal bearing installations including "crush" and "lift" checks.

The paper then goes into thrust bearings with introductions to flat land, taper land, tilting pad and equalized designs. The paper concludes with a section on instrumentation covering RTD and TC placement in journal and thrust bearings.

If you are interested in getting a copy of this paper just let us know.

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