

ALIGN-A-PAD™ TILTING PAD JOURNAL BEARINGS

The Turbo Research Align-A-Pad™ tilting pad journal is “State of the Art.” The heavy duty operating performance characteristics result from advanced design detail and careful selection of materials. The Align-A-Pad™ journal bearings are designed for ease of installation, alignment, and maintenance by customers’ in-house personnel.

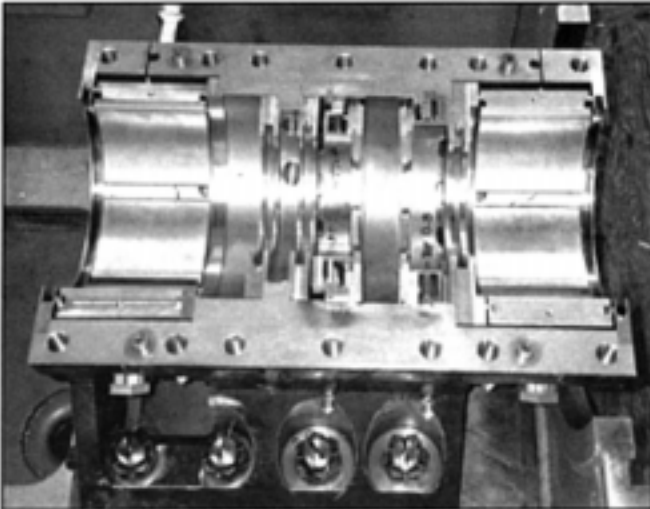
The design details which make the Align-A-Pad journal bearings so successful are the direct result of many years of analytical, diagnostic and in-place optimization efforts by Turbo Research in its consulting work with turbo machinery users around the world.

EXPENSE OF DOWNTIME

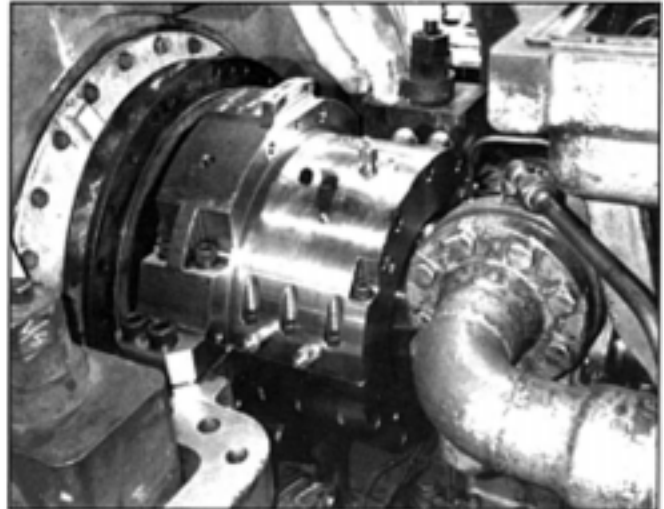
Turbomachinery downtime is very expensive, and it will become increasing more expensive in the future. For this reason, the rapid installation, alignment, and maintenance features of these bearings which accompany their heavy duty long term operating characteristics make them extremely cost effective.

INDEPENDENCE FROM ALL OEMs

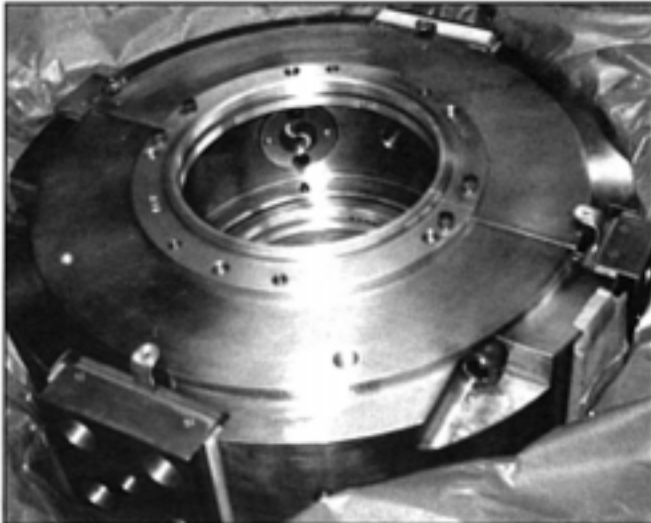
An ever increasing trend is for turbomachinery users to strive to use their own ‘in house’ personnel to install, align, and service their bearings. TRI tooling, fixtures, and written procedures are made so that customers can install and maintain the TRI Align-A-Pad journal bearing independently. The only additional tool required is a Bridgeport milling machine, or equivalent.



Tilt Pad Arrangement in Heavy Duty 15,000 HP Fluid Drive



Combination Journal/Thrust Bearing



*Insulated Journal Bearing
Pad Removed to Show Pad Support Disk*



Journal Bearing - 6 Pad Design

TRI Align-A-Pad™ Bearings with 5 or 6 Tilting Pads

LIFE EXTENSION, PM (Preventative Maintenance) INTERVAL EXTENSION

Many existing machines of all ages, types, and sizes suffer from high vibration, are difficult to get through critical speeds on start-up, have short bearing life, have continually changing alignment conditions, and/or have short intervals between preventative maintenance outages to change out bearings.

There have been many cases where the installation of TRI Align-A-Pad journal bearings has cured such problems instantly, providing a life extension of all machinery in the system.

MANY DIFFERENT TYPES OF ALIGN-A-PAD BEARINGS

TRI designs and manufactures Align-A-Pad journal bearings to meet specific customer requirements. Our designs are based upon a standard set of design features and dimensions for new and retrofit applications. For unique requirements, special design features, such as film damper bearings, are available.

Several examples of TRI Align-A-Pad journal bearing assemblies are shown in this brochure.

PRECISE, FASTER AND EASIER ALIGNMENT OF BEARINGS AND SHAFTS

The 'saddle blocks' on the outside of TRI bearings are designed to provide high contact stiffness between the bearing housing and the machine pedestal, and, at the same time, they are designed to permit easy alignment changes while maintaining a high contact area even after large alignment moves. No hand work of the saddle blocks is required after an alignment move to maintain the original contact pattern to the pedestal bore, as is typical for the saddle blocks made by almost all other manufacturers.

Experience over several years indicates that the material used by TRI for saddle blocks minimizes galling of the surfaces of the saddle blocks and wear of the pedestal bores.

Consequently, the design and material of the saddle blocks on TRI bearings contribute substantially to high stiffness of bearings over the long term.

LUBE OIL SUPPLY AND DRAIN

The oil flow pattern within a TRI Align-A-Pad bearing is given detailed attention as it is an important contributor to the successful performance of the bearings.

ENGINEERING ANALYSIS AND COMPUTER SIMULATION OF THE JOURNAL BEARING AND FLEXIBLE ROTOR SYSTEMS

Turbo Research developed a series of proprietary computer programs for modeling and simulating the performance and vibratory behavior of complex bearing and flexible rotor-bearing systems of all sizes. TRI has been using these programs since the early 1970's to understand the detailed performance of individual journal bearings and to predict accurately the vibratory behavior of complex rotor-bearing systems for specific tilt-pad bearing geometry.

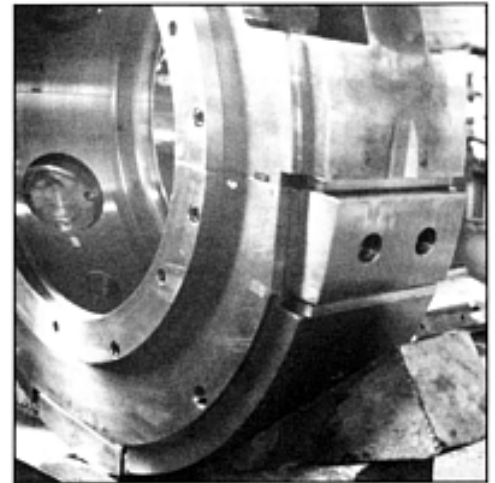
With this capability, TRI is able to design, manufacture, steam whirl, and/or other influential forces.

'PRELOADED' BEARING DESIGN

A very important feature of the TRI Align-A-Pad journal bearing is the ability to finish machine and assemble it with a precisely controlled preload. Preload is achieved by making the 'machined clearance' larger than the 'assembled' clearance'. This permits the stiffness and damping characteristics of Align-A-Pad bearing to be chosen to suit the needs of the system, such as to control rotor vibrations both synchronous (due to unbalance) and/or non-synchronous (due to steam whirl, oil whip, resonant whirl or other instability).

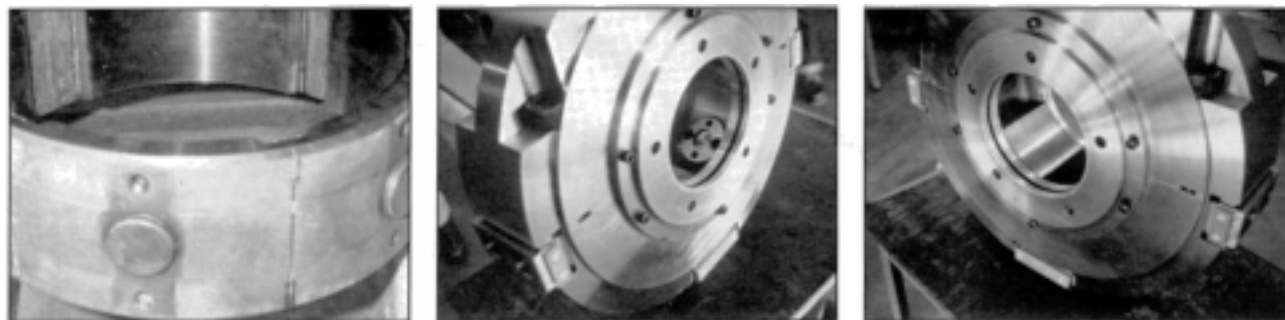
NUMBER OF PADS AND PAD LENGTH

The number of pads, the angular location, and the length of the pads are determined by several factors. These factors include the magnitude and direction of the load during turning gear operation and during on-line operation, nozzle block forces in the case of steam turbines, cold to hot alignment changes between adjacent parts of a machinery train, and dynamic loading due to unbalance or subsynchronous vibration.



Pad Retaining Bolts

Critical Design Features and Details



PAD AND PAD SUPPORT DISK DESIGN

On the back of each pad is a large male dome which is integral to the pad. It is designed to maximize the stiffness of the pad and contact, and to assure continuous tri-axis alignment of each pad to the journal at installation and during operation, even for an excessively large misalignment of over 1/16" per foot between the shaft and the housing.

The female pad support disk which mates to the male dome of the pad is very stiff and is mounted in the housing.

The materials of the pads and pad support disks are carefully chosen and processed to minimize wear. The assembled clearance of each pad is adjusted by changing the thickness of the shim plate between the pad support disk and the housing.

INSTUMENTATION: ROTOR VIBRATION, BEARING VIBRATION & BEARING METAL TEMPERATURE

TRI designed thermocouples and RTDs are available for use in any TRI bearing. They are typically used in the bottom pad of an Align-A-Pad bearing, which usually is the most highly loaded pad. The pads and housing can be drilled for non-contacting proximity vibration probes for monitoring the health of a bearing.

TRI can design, supply and supervise installation of a complete T/C and/or vibration monitoring system—from the bearings into the control rooms.

BEARING HOUSING, PEDESTALS AND SOLEPLATES

TRI designs and supplies bearing housings and pedestals for new and retrofit applications to support any TRI bearing. Where appropriate, TRI designs, manufactures, supplies and installs foundations and soleplates to support TRI bearings.

VIBRATION CONTROL

A properly designed journal bearing can control the vibrations of the rotor which it supports. The specific feature of a TRI bearing are chosen according to the types and severity of the rotor vibrations which must be restrained, as well as the magnitude and direction of any steady load. The most common types of vibration are caused by unbalance, bearing misalignment, fluid forces on the rotor assembly which are usually load related, and/or incorrect oil temperature.

For most applications, the preferred pad arrangements are either five-pad or six-pad, though other pad arrangements are available.

INSULATED BEARINGS

Large motors and generators require at least one bearing to be insulated. TRI Align-A-Pad bearings can be made with either non-insulated or insulated saddle blocks. Alternately, permanently insulated shaft couplings can be manufactured and supplied by TRI.

LUBE OIL SYSTEMS

The details of lube oil conditioning, pumping and filtering systems are critical to the successful operation of all bearings. TRI designs, manufactures, supplies and supervises installation of complete lube oil systems for new and retrofit applications for bearings of all types. TRI also supplies emergency DC powered lube oil systems to critical bearing systems.

SEALS, FLOATING RING AND LABYRINTH

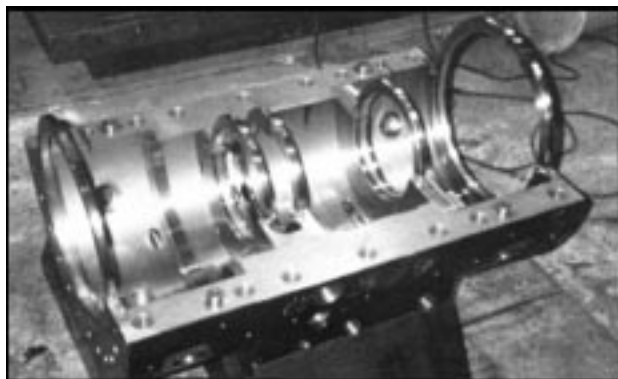
All TRI seals are made of babbitt and steel to prevent scoring. TRI specifications do NOT permit seals of aluminum or bronze.

TIN BASED BABBITT

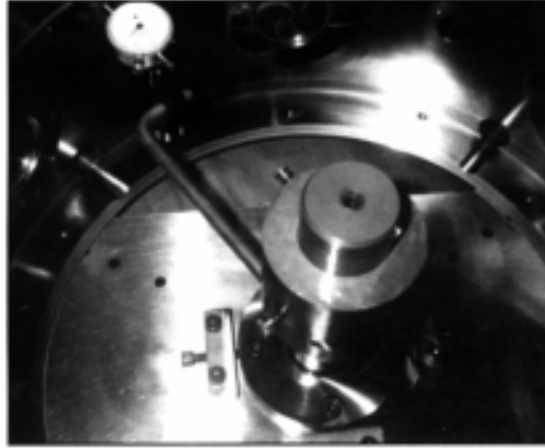
TRI uses only tin based babbitt of suitable thickness bonded to the steel with a chemically tinned bond. Dovetails are not permitted unless specifically requested by the customer, as these often tend to cause the babbitt to crack along the dovetail line and/or to 'wipe' prematurely.

Q.C. OF BABBITT BOND

All bearings and seals are 100% inspected with ultrasonic non-destructive testing. Our norm is 100% bond.



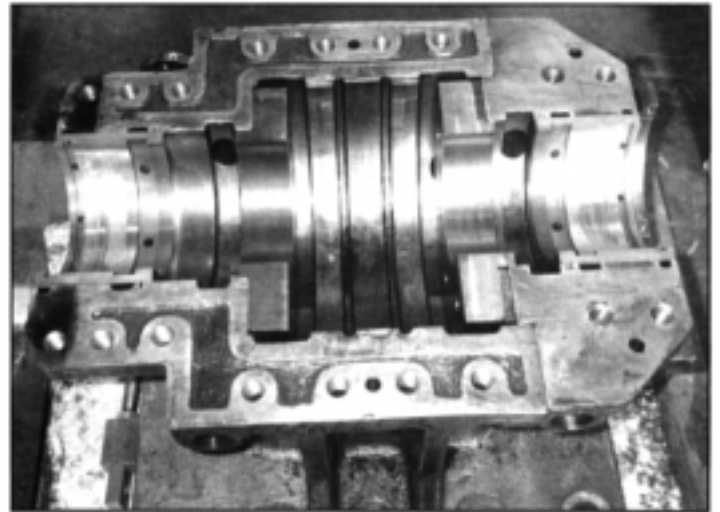
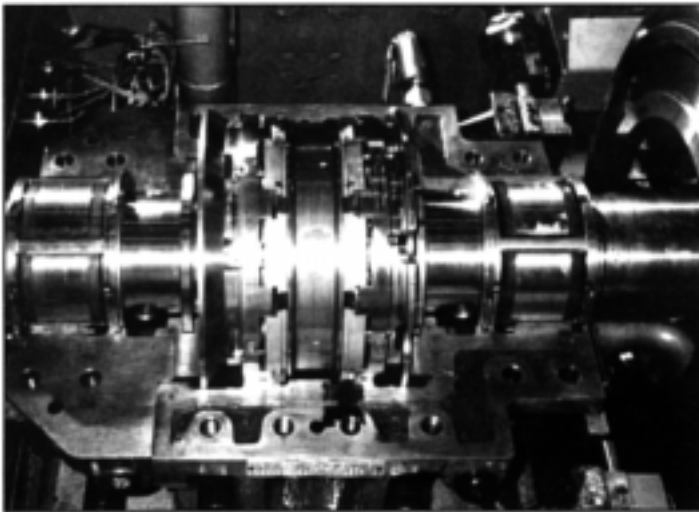
TRI ALIGN-A-PAD™ Bearings - Maintainable by Users



MAINTAINABILITY OF THE BEARING PADS

If one or more of the bearing pads needs to be recut due to turning gear wear or dirt scoring, it is NOT necessary to recut all of the pads. Individual pads can be recut, or a single new pad can be cut by setting it up on a Bridgeport milling machine and recut to proper 'machined clearance'. Then a new shimplate can be cut to the proper thickness for desired assembled clearance' and installed behind the pad support disk.

For instance, if a pad is eroded by particulate matter, and the pad is recut taking 0.009" from the original thickness, then a shimplate thicker by 0.009" is placed behind the pad support disk. With this method, complete turbine bearings have been reconditioned by plant personnel in a plant machine shop within 8 hours each from receipt to shipment for installation.



OTHER DESIGNS

TRI supplies all types of journal bearings, including elliptical, pressure dam, circular bore, and film-damper with pressure fed lubrication. Either standard or undersize bore are available. For fans and similar equipment, TRI supplies bearings with either oil ring and/or pressure fed lubrication. Our objective is to supply the bearings that are proper for the customers' requirements.