Catalog of TRI Journal Bearings

TRI’s Standard, Specialized, and Custom Journal Bearing Designs

Bearing Refurbishment Options - Related Auxiliary Equipment

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“Dr. Mel”
Melbourne F. Giberson, Ph.D., P.E.
TRI President
and Sr. Technical Consulting Engineer

New 24 inch (610 mm) Journal Bearing with Lift Oil and 6 Saddle Blocks.
Designed and Manufactured by TRI for Nuclear Powered Low Pressure Turbine.
TRI’s Analytical Engineering Background:

TRI was founded as a Consulting Engineering Company in 1961 to provide rotor-dynamic and bearing design and analysis services for rotating machinery. Through the years, we have helped manufacturers and users obtain improved vibration levels and extended bearing life in a wide range of rotating equipment.

TRI Engineers have developed mathematical models of flexible rotors and film bearings and prepared extensive computer programs that have been used to simulate hundreds of rotor-bearing systems. We continue to use these programs to determine bearing performance characteristics and vibratory behavior of customers’ rotating equipment.

TRI has manufactured hundreds of journal bearings since the early 1970s: tilting-pad and fixed bore, from 1” (25 mm) to 30 “ (750 mm), all types of supports, and for a wide range of applications and speeds. **As of 2015, TRI has manufactured journal bearings that are installed in over 50,000 MW of electrical generation and other processes around the world.**

**TRI’s Specialty Journal Bearing**

TRI’s specialty journal bearing is the TRI Align-A-Pad® Tilting Pad Journal Bearing, the premier journal bearing for almost all applications where long term performance is required (100,000 hours between inspections) and where dynamic alignment conditions between the foundation and the journal exist (cold to hot, loaded to unloaded), as occurs in most turbines, generators, and related machinery. The TRI Align-A-Pad® Bearings have also been found to survive when lube oil supplies are interrupted for short time periods, and they continue to run afterwards.
TRI Customer Support and Schedules:

TRI works with many customers: Manufacturers of rotating equipment, End Users, Turbine and Generator Retrofit Companies, Engineering-Procurement-Constructors, and other Consultants. In early conversations with a customer, a plan of action is developed that identifies the problem to be addressed, such as a new design or resolution of an existing vibration or bearing damage problem. Whether it is an emergency matter or a long-term issue to be solved in a future scheduled outage, the customer’s anticipated schedule for completing the solution is critical to the action plan.

If the problem is a damaged bearing to be repaired immediately, TRI can work around the clock to rebabbit, refurbish, and remachine the bearing, large (30 inches –750 mm or bigger) or small (under 2 inches –50 mm). In many such cases, with no additional time, or very little additional time, TRI can provide an improved design of an existing bearing to avoid repeat failures. In some cases, the best solution is to redesign the bearing completely to be installed in the future. A redesign may use a different type of bearing, such as a tilting pad bearing to replace a fixed bore bearing, different materials, and/or major feature upgrades.

TRI engineers have the experience to analyze rotor vibration issues and bearing failures and TRI has the capabilities to get your machines turning again.

TRI Shop resources are very substantial: TRl can centrifugally cast Babbitt Bearings up to 70 inch (1.750 mm) outside diameter, generally up to 40 inch (1.00 meter) bore, and weighing up to 20,000 lbs (9,500 kg).

Catalog Contents:

This catalog is divided into 5 sections, each related to a portion of our Bearing Business:

Section 1 addresses TRI’s design philosophy regarding bearing clamping. TRI’s preferred method is described as well as reasons why TRI Bearings often replace bearings using other clamping methods.

Section 2 describes a number of tilting pad bearing designs, especially demonstrating the benefits and features of TRI Align-A-Pad ® bearings.

Section 3 shows many fixed bore bearing designs that TRI has designed and manufactured new. These designs use the best features known to minimize bearing wear on turning gear, to control rotor vibrations, and to limit bearing metal temperatures. There are different alignment schemes, bearing Babbitt bore geometries, lube oil supply and drain features and passageways, and other details to be considered.

Section 4 presents bearings initially made by other manufacturers that TRI has refurbished, repaired, or modified.

Section 5 explains various auxiliary items and related equipment that TRI designs, manufactures, and supplies to our customers to support TRI equipment and bearings. Also included is a description of our large centrifugal Babbitt casting machine.
TRI’s Bearing Design Philosophy Regarding Bearing Clamping Methods

Many rotating equipment manufacturers seat a bearing in an end wall of a bearing standard / pedestal and use the standard cover to hold the bearing in place. This design method is definitely simple and low cost, and it works when the air temperature surrounding the bearing standard / pedestal is “ambient”, i.e., not heated.

However, there are applications for which this clamping design is not very effective and even inappropriate. For applications where the wall of the standard/pedestal is heated by exposure to hot steam escaping from shaft seals of a turbine, or is exposed to the radiant heat from an adjacent hot turbine, the standard / pedestal wall grows due to thermal expansion. While the bearing inside is cooled with lube oil in the neighborhood of 130 to 160 deg F, the external heating may cause the temperature of the standard wall to increase to 250 deg F. For a fit diameter of 32 inches and a temperature differential of 100 deg F, a gap between the two grows by 0.020 inches (0.5 mm) so that the bearing gets quite loose in the fit, even if clamped with a slight interference when installed cold. Looseness of bearings contributes greatly to increased rotor and bearing vibrations, as well as fretting of the bearing seat, which is why TRI considers this design to be inappropriate for hot steam turbine applications.

Consequently, where possible, TRI prefers to use a bearing clamping design wherein the bearing top half has an integral “strongback”, and the ears of the top half are bolted directly to the horizontal joint, as shown on Page 3. In this case, the standard cover can get hot and expand, but the bearing remains tightly fastened to the lower half. In a number of retrofit cases of TRI journal bearings, bolt holes are drilled and tapped into the horizontal joint and the standard cover is milled way to provide space for the ears of the bearing top half to fit.

This design of a top half bearing with ears and hold down bolts into the horizontal joint is definitely more expensive than fitting a round bearing into a hole in a wall, but the long term benefits of vibration control for light weight, high speed, high power density turbine rotors cannot be matched any other way.

It is important to give proper credit for the origination of this design feature. GE Engineers in Schenectady, New York developed this design method in the 1930s for the very reasons cited above. It became a standard GE bearing design feature by approximately 1940.

Through many years of solving severe bearing damage problems and various difficult rotor vibration issues, TRI has developed a large repertoire of bearing designs that were “custom or special designs” at the time, but which over the years have become “TRI standard bearings”. Many are now relatively popular designs.

TRI continues to design and manufacture the journal bearings presented in this catalog, or similar bearings adapted to meet customer’s specific needs, or other designs to suit new applications.
Align-A-Pad® Bearing with Ears — “Drop-in” for GE Steam Turbines

TRI 6-pad Align-A-Pad® Bearing has machined and assembled clearances that provide a “geometric pre-loaded design” which is excellent for controlling rotor vibration.

TRI designs Tilting pad bearings to be direct replacements for GE and other OEM bearings. Saddle Blocks on the Outside Surfaces of TRI Bearings match original ones, so lube oil supply passageways are maintained. This bearing style replaces GE elliptical bearings.

Align-A-Pad® Bearing with Integral “Strongback” For WECO Steam Turbines

TRI 6-pad Align-A-Pad® Bearing for Westinghouse Turbine Bearing No. 1. Much easier assembly, disassembly, and alignment. Bearing pads are contained in housing.

This bearing design has three Shimmable Saddle Blocks to permit the No. 1 Bearing to be Aligned Independently the same way as the other bearings. The “Strongback” is integral to this Bearing Housing to add stiffness.

Align-A-Pad® Bearing with Yoke Support

A new TRI 6-pad Align-A-Pad® Bearing is fitted into a TRI Refurbished Yoke Support for a class of Westinghouse Steam Turbine Bearings. TRI refurbishes the bottom yoke and the top removable “keyblock” to remove distortion resulting from years of service. Then, TRI finishes the TRI bearing outside surfaces to mate to the yoke to provide stiff support.

The machined and assembled clearances of these TRI 6-pad Bearings can be designed with unique “pre-load” to control sub-synchronous rotor vibration due to “steam whirl” and “nozzle block” steam forces associated with partial-arc steam admission.
TRI 22” 5-pad Journal Bearing for Large 3600 rpm Generators

This 5-pad TRI bearing is a “drop-in” replacement for an elliptical bearing with spherical outside surfaces on the saddle blocks. The end plates and alignment screws adjust tilt and twist during installation. Self-aligning features of the TRI bearings maintain alignment of the pads to the journals at all times. The lower pads have lift oil capability. These bearings were chosen because they suppress severe sub-synchronous rotor vibration. The Saddle Blocks are “double insulated” with each layer of insulation having over 550 megohms resistance.

This 5-pad Bearing design can also be used for extremely heavy rotors at 1500 or 1800 rpm. Examples are large LP Turbines and Generators with 1 meter (40 inch) diameter journals for approximately 1800 MW nuclear powered units. The features of this bearing can be tailored to suit new applications or to suit retrofit units, regardless of the manufacturer.

Combined Journal and Thrust Bearing for LP Turbines

TRI Combined 17” 5-pad Journal Bearing and 20” Fully Equalizing Double-Acting Thrust Bearing for a GE Large Steam Turbine.

This TRI bearing replaces the entire outer bearing ring, mating journal bearing with spherical fit and tapered land thrust bearing.

Self-aligning features of the TRI bearings compensate for irregular sliding of the front standard, permitting journal pads and thrust pads to remain aligned and properly loaded at all times. The TRI bearing assembly does not require any spherical ball fit to slide as the original GE design requires.
Steady Rest Bearing with Support Bracket

A Heavy Duty 5-pad TRI Bearing and support bracket replaces an existing 4-pad WECO Bearing when the Turbine Extension Shaft drives a Variable Speed Fluid Drive and Boiler Feed Pump. Major improvements are large robust contact supports of TRI pads and the TRI Bearing is moved as an assembly to align the Extension Shaft. WECO bearings are replaced because the pad supports are half-inch diameter rods that pound out leading to high vibrations, whereas TRI Bearings control rotor vibrations for many years.

Steady Rest Bearing with Pedestal

A TRI 5-pad Tilting-pad Steady-rest Bearing with Pedestal and Elevation Blocks is used for another style of Westinghouse steam turbine extension Shaft. This TRI bearing arrangement is used when no steady-rest bearing was used before. A primary objective achieved by this heavy duty TRI bearing is to stop vibrations of the extension shaft which greatly reduces the wear of the floating seal rings in the main oil pump. The Bearing Clearances are set at TRI factory, and the bearing is aligned and the shaft is loaded by adjusting the three shimmable saddle blocks located on the outside of the Bearing.

Combined Journal and Thrust Bearing for Synchronous Condensers

TRI Combined 8.5 inch 5-pad Journal Bearing and 10 inch Diameter Thrust Bearing for 200 MVA Synchronous Condenser Extension Shaft. The journal bearing is used in both generation and synchronous condenser modes. The thrust bearings are used for synchronous condenser, and removed for generation mode. These TRI bearings are designed for “quick change”. Lift oil permits easy rotation for start-up in sync mode.
Small TRI Tilting Pad Bearing for High Speed Turbines or Compressors

This TRI Small Bore 5-pad Journal Bearing is a “drop-in” replacement for certain standard journal bearings manufactured by others.

As is common for most TRI Tilting Pad Bearings, “Geometric Preload” is used to stiffen the oil films, which dramatically reduces rotor vibration amplitudes. TRI pad support contacts permit tilt and twist so the pads are self-aligning to the journals. Consequently, these pads typically survive very high unbalance forces due to loss of buckets.

TRI Tilting Pad Journal Bearing Upgrade for American-Standard Fluid Drives

High-powered Variable Speed Fluid Drives in Boiler Feed Pump Service under certain operating conditions develop high amplitude sub-synchronous rotor vibrations that damage the original pressure dam bearings.

In the early 1980s, TRI developed large diameter TRI Align-A-Pad® bearings and related shafting that would control these rotor vibrations and eliminate bearing damage. Since then, these Fluid Drives typically run for over ten years with low vibration between scheduled inspections.

TRI Tilting Pad Journal Bearings “Drop-in” American-Standard Fluid Drives

There are a number of American-Standard Fluid Drives that experience sub-synchronous rotor vibrations but they are not so severe as to require the complete tilting pad upgrade described just above. In this case, this TRI Tilting Pad Bearing is a “drop-in” option. The wall thickness of this bearing is the same as the standard fixed bore pressure-dam bearing. Thermocouples are inserted in the end of a bottom pad.
Pressure-dam Journal Bearing

This TRI “Pressure-dam” Journal Bearing is one of a series of “drop-in” bearings that TRI manufactures to be used in American-Standard Fluid Drives. These TRI Bearings are manufactured to a semi-finish size as a spare part and then finished to specific diameters required by the application. This permits journals to be machined undersize to be round and concentric, removing prior damage or flaked chrome plating. The Bearing OD can be sized to suit the actual pedestal bore diameter. TRI uses steel backings instead of a bronze/brass to avoid the problems associated with “Copper-Tin Embrittlement and Debonding” that often occurs with the OEM journal bearings.

Elliptical Bore Bearing with Spherical OD

This TRI Elliptical Bore Journal Bearing with spherical outside surface is a new bearing using a backing made from forged or heavy plate steel. The Babbitt bore lining is centrifugally cast at TRI. There are only two pieces in this bearing, a top half and a bottom half. The dowel pins are pressed into the joint surfaces so they will not get lost or damaged. They can be extracted, if necessary. TRI recommends that the bearings be manufactured with an undersize bore so that the bore can be machined at time of installation to suit the then-existing journal diameter. This permits journals to be machined to be round and concentric, and bearing bores machined to suit the precise journal diameter without rebabbitting.

Elliptical Bore Bearing with Insulation and Spherical OD

This TRI Insulated Elliptical Bore Journal Bearing is a new multi-piece bearing using an inner bearing backing and an outer bearing backing made from forged or heavy plate steel. The Babbitt bore lining is centrifugally cast at TRI. Each half of this bearing consists of two separable steel parts and a separable insulator sheet made of NEMA Grade G-10, all bolted together. The outside surface is spherical and is sized to suit the spherical seat of the supporting pedestal or bearing bracket of a generator or an exciter/GE Alterrex.
Elliptical Journal Bearing for Reactor Feed Pump

This TRI Elliptical Bore Journal Bearing is designed for and used in a new Reactor Feed Water Pump. It is designed for pressure-fed lubrication. The bearing is supported by a short cylindrical fit in the center of the bearing. A saddle block is mounted on the top to be used to adjust the fit to the bearing housing cover.

This bearing replaces a cylindrical bore bearing with oiling ring lubrication as well as pressure fed lubrication. Elimination of the open slot for the oiling ring permits the elliptical design to function properly to control rotor vibration. The steel backing is a forged steel ring.

Bearings for Exciter Gearbox for WECO T-G

A set of 4 TRI Bearings with 4 and 5 inch bores being manufactured for an Exciter Gearbox for a WECO T-G.

In this case, TRI rebuilt the entire gearbox, starting with the journal bearings, including one with tapered land thrust faces (not shown).

The bearing housings were rebored round with parallel shaft centerlines. New hardened and ground gears were designed, purchased, and installed, replacing hobbed gears. New thermocouples were installed.

When installed, in the plant, the gear bearings were properly loaded. The end result was a smooth running gearbox and exciter.

16” Elliptical Bore Bearing with Spherical OD

This TRI 16 inch Elliptical Bore Journal Bearing is a new two-piece bearing using an upper and lower half made from a single forged ring of low carbon steel.

The Babbitt bore lining is centrifugally cast at TRI. There are three saddle blocks, two on the bottom at 45 degrees from the vertical and one at the top center. The outside surface of the saddle blocks is spherical and is sized to suit the spherical seat of the supporting standard/pedestal of a Westinghouse turbine. Each saddle block has tangential and radial shims to permit quick, accurate alignment changes.
TRI 18” Bore Bearing for Nuclear Powered Turbine

TRI designed this 18” bearing to be installed in a yoke support of a WECO turbine that was being retro-fitted with uprated steam turbine rotors. The bearing has a series of features that improve its usefulness to the application compared to the original OEM bearings. One feature is the use of six “saddle blocks” that seat the bearing in the yoke. Also, shims on the saddle blocks are adjusted so that the yoke elastically deforms under the weight of the rotor, yet the bore of the bearing remains round.

TRI 24” Bore Bearing for Nuclear Powered Turbine

This 24 inch bore bearing is a sister of the above 18 inch bearing. This 24 inch bearing is shown seated in a yoke. The bore of the yoke was machined with a spherical bore to remove years of distortion and fretting.

The outside surface of the bearing is spherical and is machined to suit the spherical seat of the yoke.

The saddle blocks have both radial and tangential shims, sometimes called primary and secondary shims, to make fitting and alignment adjustment easier. In the final fitting process, these shims are adjusted to obtain high percentage contact without hand-working the surfaces of the saddle blocks.

TRI 12” Elliptical Bore ID Fan Journal Bearing

This TRI Elliptical Bore Journal Bearing is designed for a large heavy Induced Draft Fan. This bearing is designed for pressure fed lube oil so that it is no longer a ring-lubricated bearing. In so doing, the top half of the bearing is continuous from end to end, not interrupted with open slots for oiling rings. The bearing has a tapered-land thrust face on each end used to locate the rotor axially.

The spherical fit on the OD of the bearing matches the spherical bore of the supporting fan bearing housing.
This TRI Elliptical Bore Journal Bearing is one of a series of “drop-in” bearings that TRI manufactures for Gearboxes for GE Frame 5 GT-Gen Sets. These TRI Bearings are manufactured to a semi-finish size as a spare part and then finished to specific diameters required by the application. This permits journals to be machined to be round and concentric, removing prior damage. The Bearing OD can also be sized to suit the actual gearbox housing bore diameter. TRI uses alloy steel backings to provide high-strength to the bearing structure.

This upgraded TRI Journal Bearing is designed for use in gearboxes where the GT has been uprated to 30 MW (from 19.6 MW). In this upgraded condition, the gear-tooth separation forces increase in proportion to the MW. The OEM bearings cannot take this additional loading, but these upgraded TRI journal bearings can. At the same time, at very low loads, the elliptic design of these TRI bearings controls sub-synchronous rotor vibration.

This photo demonstrates a thin-wall TRI Elliptical Journal Bearing installed in a Frame 5 Gearbox.

With TRI’s design approach of spare bearings with oversize ODs, used gearboxes with distortion can have the bearing housing bores rebored. The housing bores for the two shafts can be made parallel again in order to minimize wear of the gear teeth. This will result in oversize housing bores, but the new bearing liners can easily be made to match.

In addition to manufacturing these bearings for customers, TRI also refurbishes entire gearboxes, using gears made to the user’s specification. TRI typically purchases gears of AGMA grade 12 or13 or higher made by world class gear manufacturers.

TRI also manufactures oil seals for the gear shafts to control loss of lube oil.
A class of Vertical Radial Guide Bearings was recently designed and developed by TRI for service in large vertical Circulation Water Pumps such as used in power plants.

TRI has applied for a US Patent to cover the novel features and methods of manufacture: A US Patent is Pending.

Performance advantages include: Considerably cooler bearings, and very low rotor vibrations.

This upgraded TRI bearing design replaces corresponding guide bearings that have alternate diagonal oiling grooves (45 degrees to the left, then 45 degrees to the right) milled into the Babbitt bore.

Other advantages of this upgraded TRI Journal Bearing include: After rotation of the journal is initiated, lube oil is pumped to the top of the bearing within one-half rotation. A higher flow rate (gpm) of oil flows through the bearing, assuring that the oil film is full. Larger areas of uninterrupted bearing surfaces permit higher oil film pressures to occur, resisting rotor motion and minimizing vibration. A higher portion of the lube oil that reaches the top of the bearing is directed through passageways out to flow over the cooling coils. Oil supply passageways take cooled oil entering inlet ports drilled in the outside surfaces of the bearing and direct the lube oil into viscous pumps milled in the Babbitt bore. From there, the oil flow repeats itself.

TRI can provide measurably improved performance enhancements for your vertical pumps by applying these recently developed design and manufacturing principles to new or refurbished guide bearings for your applications.
Refurbishing a TRI Align-A-Pad Journal Bearing Setting the Assembled Clearance

This photo shows a 17” diameter TRI Tilting Pad Bearing for an Allis-Chalmers Turbine that has been retrofitted for TRI bearings with ears, as discussed in the Section on TRI design principles.

The bearing is shown in the process of being refurbished after many years in service. The pads have already been rebabbitted and remachined to suit the journal diameter. Knowing the journal diameter and pad thicknesses, the shimplates are ground to prescribed thicknesses to give the specified assembled clearance for each pad.

Refurbished or New GE-style Tilting Pad Journal Bearings

This photo shows the lower half of a GE-style 6-pad “double-tilt” tilting pad journal bearing. Based on specific field measurements, TRI designed and built this bearing with upgrades as requested by the customer. It is a replacement bearing in a turbine made by a GE licensee.

TRI can also refurbish/ renew existing GE-style tilting pad bearings with various upgrades to minimize wear of the contact surfaces of pad backs and housing bores, extending the lives of these turbines.

Replacement Tilting Pads for a Westinghouse Turbine

The set of four steel-backed tilting pads shown in this photo was designed and manufactured by TRI based on specific field measurements.

These four new pads can be used to replace existing pads of a 4-pad Westinghouse turbine bearing, one pad at a time or all four pads together.

TRI can refurbish Westinghouse tilting pad bearings by rebabbitting and reboring existing pads, if this is what the customer desires.

Note that TRI offers an option of replacing an entire bearing with a TRI Align-A-Pad® Bearing which will provide improved rotor vibration performance.
Shown here is a typical GE 4-axial groove journal bearing with a commonly observed wear pattern that leads to high bearing oil film and bearing metal temperatures. Wear, generally related to turning gear wear and/or particulate matter, erodes the Babbitt surface adjacent to the axial groove on the down-coming side, in this case, the right side in this picture. This reduces the film thickness at the edge of the feed groove and limits the lube oil entering the film. If not recognized, slight additional wear can easily stop the lube oil entering the film, resulting in severe bearing damage, possibly a major Babbitt wipe.

This photo shows an elliptical bearing with only two oil supply feed grooves, one on each side at the horizontal joint.

Two important advantages of this elliptical bearing are that even severe turning gear wear in the bottom half will not shut off the lube oil supply to the oil film, and the active bearing length can be made longer because the elliptical design maintains greater rotor stability (control of sub-synchronous rotor vibration) compared to the circular bore 4-axial groove design shown above.
One of TRI’s major services for power plants is to provide round the clock support for refurbishing Babbitted journal bearings, from 2 inches to over 30 inch bore diameter.

Shown here is a 30 inch bore bearing for a nuclear powered generator that TRI refurbished recently.

TRI can centrifugally cast bearings, or if the Babbit to steel bond is acceptable, the bearing can be hand Babbit welded minimizing the need to reround the bearing extensively.

TRI rebabbitts and rebores fan bearings, whether the housing is cast steel or cast iron. Cast Iron housings are more challenging. The original bore geometry or an upgraded elliptical bore geometry with improved oil distribution can be machined. In most cases, provisions for oiling rings are retained. In other cases, pressure-fed oiling features are added.

The standard Journal Bearing is a 4-pad arrangement as shown in this photo. It has an unusual bearing support in that the contact surface of the pad is a barrel-shaped roller integral to the pad. The barrel is smaller at the ends than in the center permitting accommodation of a small amount of tilt and twist. The barrel slides in the slot as the pad tilts to form an oil wedge.

TRI has developed the tooling and fixtures necessary to rebabbit and remachine the pads and to assemble the entire bearing. Hence, turn-around time is only a few days. TRI’s process can be adjusted for the current journal diameter, should remachining the journal be necessary.
TRI rebabbitted and then remachined 6 offset arcs in this bearing using our CNC horizontal boring mill, duplicating the OEM design. This design attempts to duplicate the angular tilting of a tilting pad bearing to provide 6 oil films with a pressure distribution in each arc to centralize the journal when rotating. The trailing edges of the arcs are quite delicate and can be worn away under certain circumstances. TRI can renew these bearings and can make new ones for those machines that use bearings of this design.

Rebabbitt and CNC Machine
6 Offset Arcs in a Brass Bearing
A TRI “double insulated” saddle block is an assembly that has two layers of insulation sandwiched in the assembly of the steel parts of a saddle block on a steel bearing. In the assembly shown here, the middle layer of steel has a threaded hole for a ground detection wire to be connected. The insulating material is NEMA Grade G-10, an epoxy-fiberglass product. The resistance across each insulation layer is in excess of 550 megohms.

TRI manufactures and supplies packages of specialized machining and tooling equipment that duplicates the corresponding equipment that is used at TRI to finish machining the Babbitt bores of the bearing pads and to set the assembled clearances in the completed bearing pad and housing assemblies.

TRI prefers to provide closed secure crates in which to store and to ship the various tooling parts, but crates are optional.
TRI Synchronous Condenser Conversion Package

TRI provides overall system design for synchronous condensers based on TRI Patents 5,610,500 and 5,886,505. Shown here is a synchronous condenser that was converted from a 115 MVA GE Turbine-Generator. TRI designed, manufactured and supplied the components including the extension shaft, journal and thrust bearing package, a step-up gear and disconnect coupling, plus a new oil system. New DCS controls were used.

The drive motor and fluid drive came from a dismantled plant. The unit is easy to start and synchronize. It is very reliable, typically running over 400 days without maintenance.

TRI System Design and Components for Mating a new Generator to an Existing Steam Turbine in a New Plant

TRI provided engineering guidance on construction of a new power plant, generally consisting of optimum method for locating the generator relative to the turbine and for mounting the generator. In this case, a new surplus GE LM6000 Generator was driven by an existing Steam Turbine, about 60 MW capacity.

TRI’s responsibilities included designing and manufacturing the shaft coupling components, the soleplates and keys for the generator, as well as performing the torsional critical speed calculations.
TRI was responsible for designing, manufacturing, and supplying most of the components of the power train, shown here, connecting a 30 MW gas turbine to an existing generator. Included are the pedestal design, bearing housing, extension shafts, flexible coupling elements, and the journal and thrust bearing with limited end float for earthquake protection.

TRI Bearing System, Extension Shafts, and Flexible Coupling to Connect a new Aero-derivative Engine to an Existing Generator
Emergency Lube Oil Pumping System

The principal components of an emergency lube oil system newly designed by TRI are shown: A Positive Displacement Pump coupled to an AC Motor, a Filter, Pressure Gages, an Uninterruptible Power Supply (UPS) with a full complement of batteries, and a Variable Frequency Drive (VFD).

Upon a start signal from either a low pressure switch, a relay monitoring loss of AC Power for the main lube oil pumps, or a manual switch, the VFD starts and brings the AC motor and attached lube oil pump to speed in less than 0.7 seconds, faster than is done by most 3-step DC motor starters.

All of the components are commercially available, but must be carefully matched together to meet certain design criteria and electrical codes. The essence of the design is the use of AC instead of DC Technology. The reason for AC design: It is difficult to find anyone who understands DC motors and DC starters.

TRI’s Large Centrifugal Babbitt Casting Machine

TRI designed and built this large centrifugal Babbitt Casting Machine in 2009, and has used it very successfully for newly Babbitted and for re-babbitted Journal Bearings.

Bearings with outside diameters as large as 70 inches, lengths up to approximately 40 inches, and weight up to 20,000 lbs are Babbitted here.
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A Division of Turbo Research Inc.

Catalog of TRI Journal Bearings

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