

Sensonics Technical Note – DS1215

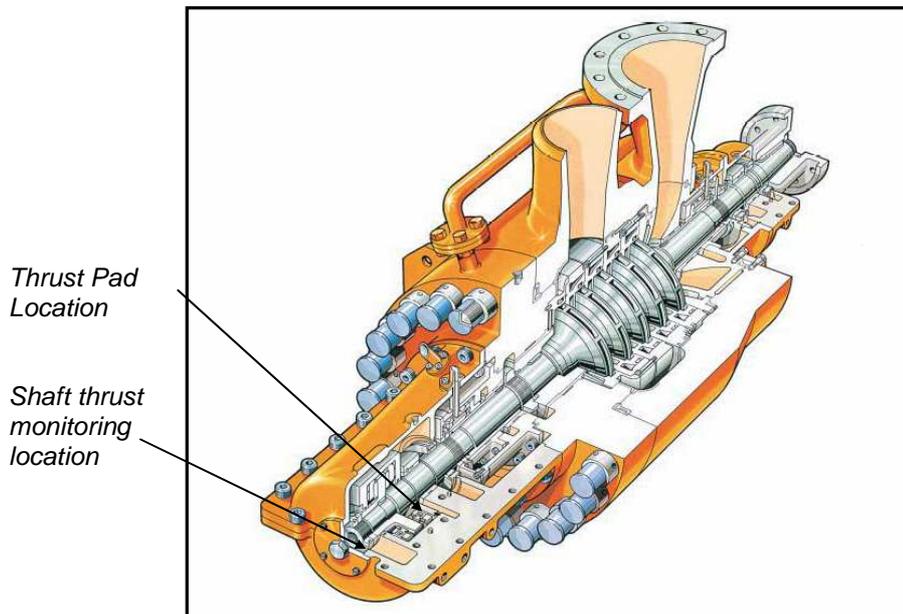
Thrust Monitoring on Boiler Feed Pump Equipment

One of the challenges facing plant instrumentation engineers is the effective and reliable monitoring of thrust bearing wear in critical pump applications. Pumps of this type are in continuous use and operational downtime normally only permitted during planned outages. Predicting the wear and hence requirement to replace the thrust pads is essential to fit in with this regime. With rotational speeds between 3000 and 7000 RPM, protection against potential pump damage is also key, excessive thrust wear can not only damage the bearing assembly but also the impeller, resulting in the plant potentially being out of action for 6 months or more.

Sensonics have been working with plant instrumentation engineers for many years providing effective measurement regimes through its range of equipment and services. The aim of this technical note is to describe the type of thrust monitoring solutions Sensonics can offer and how implementation is achieved.

A high pressure boiler feed pump set will operate with pressurised fluid within the thrust bearing, permissible total wear on the thrust pad from new is typically between 0.75mm and 1.25mm, before inspection or replacement is required. Older BFP designs utilise a hydrodynamic (water) lubrication system driven from the impeller action. Tilting pad thrust bearings, common for the newer BFP designs, utilise a high-pressurised hydraulic oil supply to minimise friction, this is particularly effective at start up or slow rotating speeds, where the hydrodynamic effect which establishes itself at rated speed is not present.

Figure 1 below illustrates a cut away of a Weir Multistage Boiler Feed Pump (© Weir Group)



Thrust pad wear indication can provide valuable feedback on how well the lubrication technique is working. Measurement of excessive wear could be due to inadequate oil pressure or flow around the assembly; a worn balance device can produce uneven forces on the bearing with the same result. Wear rates in combination with vibration measurements can provide a good guide to BEP (best efficiency point) performance of the pump. In addition thrust monitoring is a key protection measure to ensure automatic shutdown in the event of safe operating limits being exceeded.

A recent example is a 350MW turbine set and pump, where a Sensonics thrust monitoring system effected safe shutdown of the BFP preventing bearing damage and a long outage period for the turbine set.

While it is fairly straightforward to monitor the end of the drive shaft for changes in pad thickness the measurement is complicated by the following factors.

1. Shaft and Casing Expansion
2. Float in overall assembly
3. Measurement target shape and size

So the challenge is a measurement range for the shaft position that covers the mechanical expansion, float and still provides accurate thrust wear indication. Sonsonics range of eddy current proximity probes are proven in such applications, the 8mm tip PRS04, with a half sensitivity arrangement offers a 4mm (4mV/um) range. If a greater range is required an 8mm range probe (20mm diameter) is recommended.

Special bracketry is usually required to achieve correct probe positioning and adjustment; dual redundant systems are common to ensure continued measurement integrity in the event of a probe failure. Mounted axially to the shaft, the ideal location is facing the shaft end, drilling and tapping the cover plate is common. If this is not permitted or the target area insufficient (must be 2x probe diameter), a shaft collar can be utilised or added between the thrust and shaft end bearing. This has the advantage of being located closer to the thrust bearing and therefore reducing the amount of measurement error due to expansion and other shaft effects.

Both probe types are available in a straight or disk format to suit either a direct or collar mounting arrangement – Figure 2 below illustrates both the disk and straight probe types.

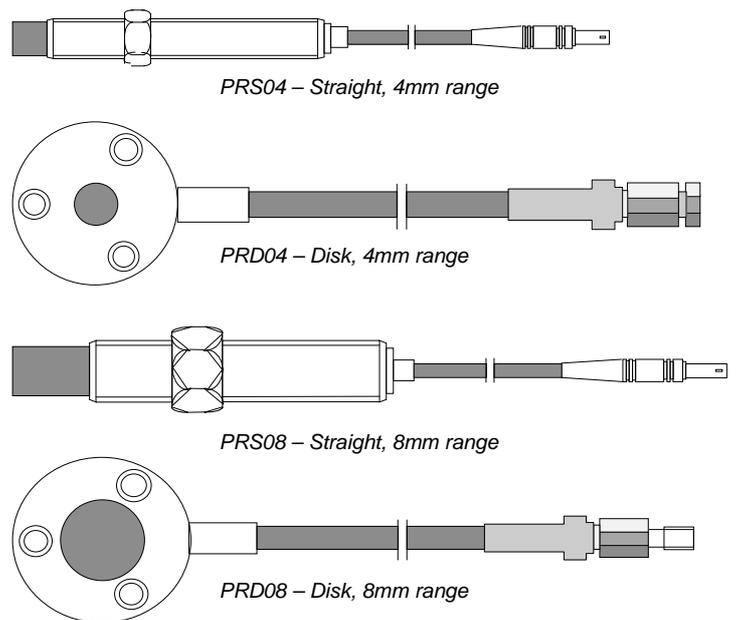
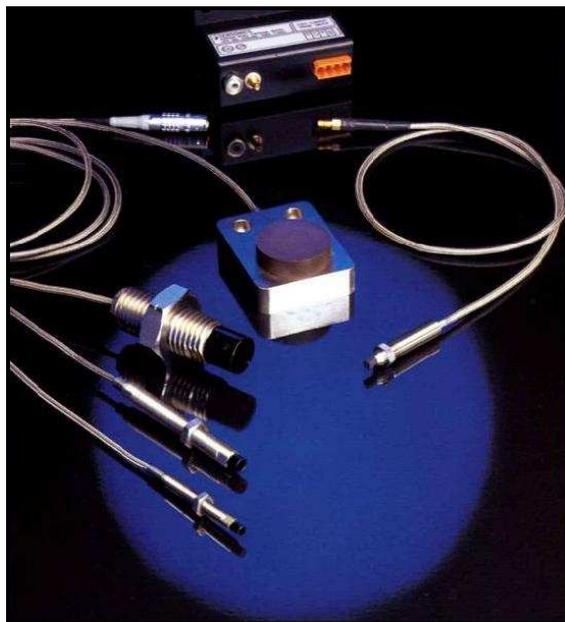


Figure 2

Sonsonics proximity probes comply with the API 670 standard and are available in a set range of tuned cable lengths. The probe is utilised in conjunction with a driver / lineariser to provide a voltage output proportional to gap.

To complement the probe system a thrust monitor and protection unit is required to process the measured signal. Sonsonics have a wide range of thrust monitors to suit various applications. The standalone type key functions are detailed below.

ME9601 Single Channel Thrust Monitor

- Fully Adjustable Dual Level Alarms
- Local Alarm and Measurement Indication
- Field Adjustable Thrust Range with Zeroing Function
- Transducer Integrity Alarm
- Voltage and Current Recorder Outputs
- Fully Configurable Alarm Relays
- IP66 Wall Mounting Standalone Unit
- Mains Powered

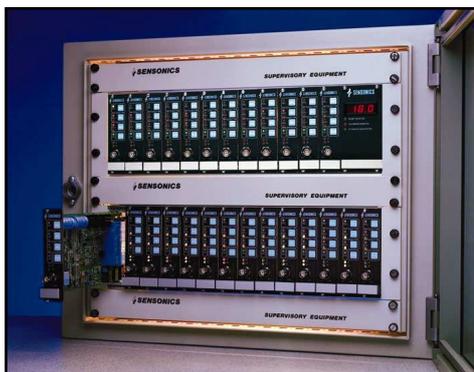
Can be mounted locally to the machine and supplied with gland fittings.



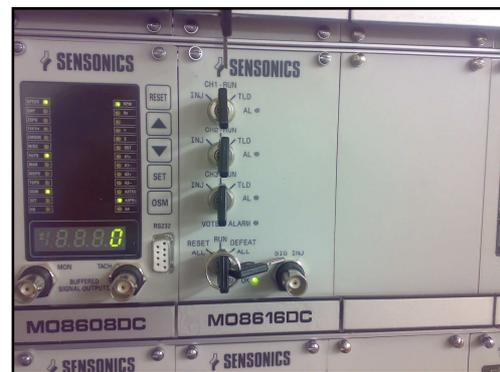
To commission the system, the probe is adjusted against the shaft target at known increments and the linearity of the measurement system checked – some adjustment at the driver is possible if the target is not ideal. With the set cold and the shaft positioned with the thrust pads against the bearing disk, the probe is set against the target at a gap (typically mid-range), which permits the full measurement range required, including the float. Note: Not taking all the shaft conditions into account could result in the probe being damaged. The monitor unit is adjusted to read zero. If the shaft cannot be set on the thrust pads, it is still possible to set up the zero point provided the shaft position is known relative to the normal thrust pad position. Once run up to rated speed and load, minor zero adjustment may be required to allow for mechanical expansion. Positive and Negative going alarm levels can then be set, and from the point of commissioning, the thrust pad wear monitored with time.

In addition to thrust it is also usual to monitor vibration, temperature and speed on such plant. Sensonics offers a wide range of multi-channel monitoring and protection equipment, including a SIL-3 Overspeed trip system. All equipment is manufactured and supported through our offices in the UK, where we offer a turnkey service from initial site survey and mechanical definition through to commissioning and support.

Aegis Multi-Channel Monitoring of vibration, temperature & thrust



Sentry 2003 Overspeed Trip with IIEC61508 SIL-3 Option



Sensonics are a leading supplier of turbine supervisory and high integrity protection equipment to industry. With over 30 years experience in providing vibration, displacement and speed instrumentation solutions in demanding environments, not only do they supply a full range of probes and API 670 compliant measuring and protection equipment, but also offer design through to installation & commissioning services.