



## Thermoplastic Composite Wear Components in Boiler Feed Pumps

### The Materials:

Lanson Polymers supply a range of advanced thermoplastic composite wear components to address common problems in rotating equipment.

In general terms, our materials offer the following benefits;

- Optimised tribological properties to reduce friction and improve wear resistance
- Non-galling to allow tighter running clearances for improved reliability
- Tighter running clearances increase pump efficiency and reduce power requirement
- Non-sparking in potentially explosive conditions
- Ability to run dry or with little lubrication during start-up / shut down
- Zero swell in media
- Low thermal expansion (CTE) so components can be optimised to mating materials
- Non-brittle
- Excellent corrosion resistance
- Extremely high strength, sometimes in excess of steel
- Relatively easy to manufacture and install
- Reduced wear on counter materials (shafts and impellers etc.)

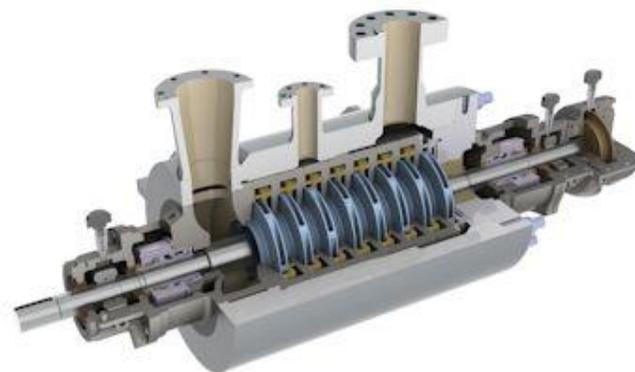
### The Application:

In the typical process plant, the boiler feed water pump is a multistage, horizontally-split, between-bearings design that is heavily dependent upon the wear components for rotor stability.

Material selection is very important to ensure long-term reliability in this service.

Reliability and efficiency impacts of close-clearance wear components – wear rings, inter-stage bushings, throat bushings, and pressure-reducing bushings – have been well documented. The following potential problems are associated with excessive wear ring clearance:

efficiency losses, loss of rotor stability, shaft breakage, driver overloading, bearing overheating or failure, unequal load sharing in parallel pump operation, noise and damage typically associated with cavitation, and possible total pump destruction



During start-up and shutdown, any centrifugal pump or motor is subject to far greater loads and much more arduous conditions than if it were running continuously.

Bearing performance is critical to ensure reliability & efficient operation during start-up, prolonged running and shutdown.



## Thermoplastic Composite Wear Components in Boiler Feed Pumps

### Specific Operational Challenges for Wear Rings

The close clearance wear components in a centrifugal pump perform similar functions. They separate high pressure areas within the pump from lower pressure areas via a minimal clearance between a rotating and stationary member.

Due to the differential pressure across these components, there is substantial flow from the high pressure to lower pressure regions of the pump – recirculation flow.

If inadequate clearance lies between two metal components, the rotating and stationary elements could possibly seize and lead to substantial pump damage.

Conversely, as the clearance between rotating and stationary components increases, the recirculation flow within the pump increases and efficiency drops. Over time, this will become evident to the pump operators as recirculation flow increases to the point where the pump can no longer operate at design capacity.

What the operators may not notice is that the wear components also contribute substantially to rotor stability. Increased clearance at the wear components can lead to higher vibration, shorter bearing life, and the potential for high-energy failure modes such as shaft breakage.

### Start-up / Shut-down

With ever-increasing use of solar and wind power, many conventional power plants have been required to vary their output to accommodate the peaks and valleys of renewable energy generation. This requires less continuous use and more cycling of boiler feed water pumps. The frequent starts and stops of cycling cause a significant increase in contact at the pumps' wear rings, throttle bushings, and other wear parts. This leads to increased wear and a higher risk of pump seizure.

### Summary

So, in summary, the bearings need to address the following requirements;

Possible Multiple Stop/Starts	Limited Lubrication
High Loads During Dynamic Contact	Low Wear Rates
Non-Galling to avoid damage to mating components	Corrosion Resistance
Dimensional Stability (No Media Swell and Low CTE)	

To optimize performance, improve reliability and increase MTBR, we would typically recommend the following materials:

Thrust Bearings : PCF103 | Wear Rings : PCF101 | Bearing Bushes : TPC200

Installation of one or more of these upgrades should prolong life of those components.

Installation of all the above should significantly improve MTBR & reliability, improve operating efficiency and reduce power consumption.





## Thermoplastic Composite Bearing Upgrades – Thrust Bearings – Boiler Feed

### Thrust Bearings

Thrust bearings are typically manufactured from metal, with a series of pads operating against a disc.

Some manufacturers use a phenolic resin based thrust plate running against metallic pads.

During operation thrust bearings are designed to run on a hydrodynamic fluid film and assuming the unit is stable and does not run in any offset condition, there should be very little load or force acting on the bearings.



During Start-up and shutdown, however, the thrust bearings are subject to extreme loads with limited or no lubrication.

In metallic pads, this often results in galling damage as the pad and plate grind against each other.

Extreme frictional heat build-up can also occur resulting in carbonising damage to the metallic thrust bearings.

Phenolic resin plates are known to absorb moisture leading to volume swell and ultimate burn-out due to the dimensional discrepancies.

Any damage or excess wear to the thrust bearing will affect the performance of the hydrodynamic film, which in turn will affect the overall functionality and stability of the unit.

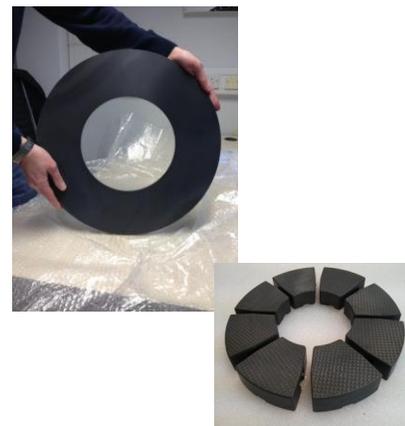
### Lanson Polymers Solution

Lanson Polymers' PCF103 is a composite material consisting of woven carbon fibre pre-impregnated with a PEEK (polyetheretherketone) polymer matrix, as well as including other ingredients to optimise its tribological properties.

PCF103 has outstanding compressive strength, in excess of most metallic materials.

This, combined with its extremely low friction and ability to run with limited lubrication for short periods, make it an ideal material for either thrust pad or thrust plate.

PCF103 is dimensionally stable, will not swell in media, and is not abrasive against mating surfaces.



Design life of 5 years was the 'optimistic' goal but most installations are still in operation after more than 7 years.

We have over 700 installations worldwide, including onshore and offshore oil & gas as well as nuclear applications. All applications are safety critical.

We manufacture either PCF103 thrust plate running against metallic pads, or PCF103 thrust pads running against metallic plate.



## Thermoplastic Composite Bearing Upgrades – Wear Rings – Boiler Feed

### Wear Rings

The close clearance wear components in a centrifugal pump perform similar functions. They separate high pressure areas within the pump from lower pressure areas via a minimal clearance between a rotating and stationary member.

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### Lanson Polymers Solution – PCF101

Lanson Polymers' PCF101 is a short carbon fibre reinforced, compression moulded PEEK material incorporating nano-fillers for reduced friction and enhanced tribological properties.

Low coefficient of friction and non-galling properties allow for reducing running clearances between static and rotating parts, without any concern if there is any momentary contact between components.

Reduced running clearances help reduce losses and improve pump efficiency, reducing power requirements and prolonging life of the motor.

Reduced running clearances also help to improve stability of the impeller.

PCF101 will not suffer any corrosion from sea water environments and will not propagate marine life growth like many metals.

PCF101 wear rings have been installed in many centrifugal pumps on original equipment and also pump upgrades.

Typical service life has been extended from 1 year to 5 years.

PCF101 also acts as a sacrificial part, reducing damage to expensive mating components.



## Thermoplastic Composite Bearing Upgrades – Bearing Bushes

### Bearing Bushes

Line shaft bearing bushes are designed to maintain stability of shafts that can be 20 metres or more in length.

Several line shaft bearings will be located at intervals across the entire length of the shaft.

Their primary purpose is to reduce shaft 'whip' and maintain concentricity in the system.

To operate effectively, tight clearances are required between bearing bush and shaft to maintain stability.



The most common form of bearing bush is cutlass rubber, consisting of a hard rubber bush installed into a metallic carrier.

Because of the location of the line shaft bearing bushes, they will be required to operate with limited or no lubrication during the start-up phase of a pump.

Cutlass rubber bearings with no lubrication will generate significant frictional heat, resulting in a high level of thermal expansion. As the bearing expands, contact is made with the rotating shaft, resulting in even higher frictional heat, therefore greater expansion.

The result is an ever-increasing friction and heat generation until the bearing either burns out or delaminates from its carrier.

Furthermore, when water finally reaches the bearing and offers some element of cooling and lubrication, the cutlass rubber will absorb the water which will result in volume swell, which will have the same negative effect as thermal expansion. Cutlass bearings also have a tendency to allow particulate matter to embed themselves into the relatively soft rubber. When this happens, the result can be like a grinding wheel against the rotating shaft, causing irreparable damage.

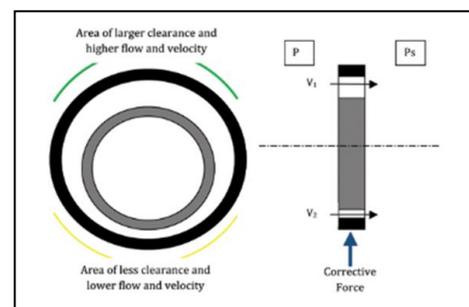
### Lanson Polymers Solution

Lanson Polymers TPC200 is a specially developed thermoplastic polymer offering extremely low friction, dry running capability, thermal stability and zero moisture absorption.



As with all Lanson Polymer materials, TPC200 is non-galling / non-seizing.

It's dimensional stability allows tighter running clearances than cutlass rubber, which improves shaft stability due to the Lomakin effect:



Lanson Polymers TPC200 has been successfully installed in many pumps since 2010, replacing cutlass rubber and extending MTBR by 3 to 5 times.



## Lanson Polymers Recommendation Summary for Boiler Feed Pumps

Boiler Feed Pumps offer one of the most demanding environments for pump bearings.

Critical wear components fitted with excessive clearance can lead to:

Efficiency losses, loss of rotor stability, shaft breakage, driver overloading, bearing overheating or failure.

To optimise performance, improve reliability and increase MTBR, we would typically recommend the following materials:

Thrust Bearings	-	PCF103
Wear Rings	-	PCF101
Bearing Bushes	-	TPC200

Installation of one or more of these upgrades should prolong life of those components.

Installation of all the above should significantly improve MTBR and reliability, improve operating efficiency and reduce power consumption.

***Recommendations in this document are based on field experience in typical applications.***

***Every pump design and application differs slightly so it is important to liaise with Lanson Polymers Engineering Team with detailed component dimensions and operating conditions, to allow us to optimise design and material selection.***

