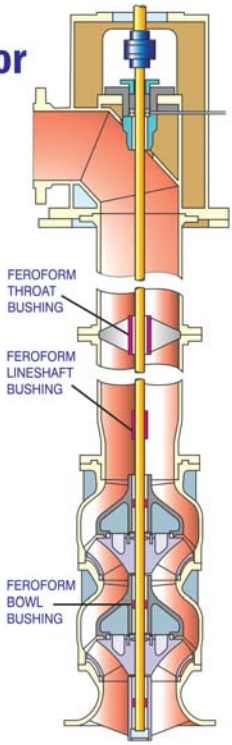
FEROFORM

PUMP BEARINGS

Self / Water Lubricated Bearings for Horizontal & Vertical Pumps



FEROFORM PUMP BEARINGS have exceptionally long life, toughness and are used in critical pumping applications TENMAT is the leading manufacturer of specialised, high performance, non-metallic engineering materials and components that are supplied to a broad cross-section of industrial applications throughout the world.

Pump bearings have critical application in many industries including chemical plants, power plants (nuclear, conventional and hydro), fire fighting etc. where reliable operation is essential because the cost of failure is too high. **FEROFORM** materials have proved their durability in these pumps and have become the first choice fitment for both OEM and next user refurbishment replacing bronze, lignum vitae, rubber, carbon and elastomeric bearings.

FEROFORM has Successfully in the following Pump types : Sea Water Pumps, Cooling water Pumps for Power Station, Fire fighting & Service Water Pumps, Irrigation & Portable Water Pumps, High Pressure bilge Pumps, Sewage purification plant pumps, Vacuum Pumps to circulating, ASH Slury disposal Pump, drain, Stock, dry Dock, Deep well, Drain water Lifting, Condensate Extraction Pump, Stages Pump, Submersible & Screw Lift, Eco Pump etc.

TENMAT

T127 Grade Bearings

Self / Water Lubricated Pump Bearings

FEROFORM T127 is a Composite Material Cured Phenolic resin Matrix Reinforced with Woven Synthetic Fibre cloth + molybdenum disulphide as a friction modifier + Heat Stabilizer. It has been given a special treatment to make it suitable for high temperatures & in abrasive working condition.

FEROFORM T127 has strength, durability, dimensional stability, low friction, and excellent wear characteristics. It is particularly suited for the bearings for vertical pumps where it can run dry at start upon the top bearings.

PROPERTIES	UNIT	T127	F3637
COMPRESSIVE STRENGTH	Mpa	285	305
	PSI	41325	44225
NORMAL WORKING	MPa	75	75
STRENGTH	PSI	10875	10875
COMPRESSIVE YIELD	%	2.5	3.0
TENSILE STRENGTH	MPa	80	100
	PSI	11600	14500
SHEAR STRENGTH	MPa	75	80
	PSI	10875	11600
IMPACT STRENGTH	KJ/m	75	89
DENSITY	g/cm3	1.32	1.30
BRINELL HARDNESS	HB	23	21
WATER SWELL	20°C	0.3	0.3
	80°C	2	1
FRICTION	μ	0.08 - 0.16	0.04 - 0.08
THERMAL EXPANSION	X10-6/°C normal	70	70
	parallel	30	30
NORMAL MAXIMUM	°C	100	200
TEMPERATURE	°F	212	390
INTERMITTENT MAXIMUM	°C	120	300
TEMPERATURE	°F	250	270

PR18 Grade Bearing

LOW COST PUMP BEARING SOLUTION
LOW COST..... HIGH PERFORMANCE....
LONG LIFE....

PR Grade Bearings : Cured Polyester Resin Matrix Reinforced with Woven Synthetic Fibre Cloth FEROFORM PR Grades Pump Bearings

FEROFORM PR 18 is a high performance bearing material with excellent dry running capabilities at high load. Low friction properties & low wear rates are characteristics of this product.

Tenmat the leading composite bearing manufacturer introduce FEROFORM PRI8 grade of self / water Lubricated pump bearing & neck/case ring.

PROPERTY	PR18	PR18
Density	g/cm^3	1.3
Ultimate Compressive Strength	Mpa	300
Normal Working Pressure	Mpa	75
Compressive Yield @68.9MPa	%	2.5
Brinell Hardness (nominal)		25
% Swell in Water	@ 20°C	0.15
Average Coefficient of Friction	Dry	0.08
	Wet	0.12
Coefficient of Thermal Expansion	10-^{6}/°C normal	110
	parallel	40
Maximum Continuous Operating Temperature	°C	100

NF22 Grade Bearings

NF22 grade have a resin bonded composite structure with added friction modifiers to give a controlled friction.

NF22 have been the chosen bearing material for Submersible Pump applications offering low wear and friction rates.

Features

Abrasion Resistant
Can be Supplied as Split Bearings
Low Stick Slip
Low Water Swell
Thermally Stable

Benefits

Longer Bearing Life
Reduced Maintenance
Bearings Can Be Replaced Without Removal Of Shaft
Reduced Shaft Wear
Reduced Noise
Eco Friendly

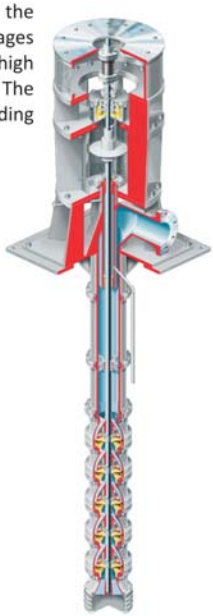
PROPERTIES	UNITS	NF22
Density	g/cm3	1.64
Ultimate Compressive Strength	MPa	220
Normal Working Pressure	MPa	55
Shear Strength	MPa	41
%Swell in Water @	20°C	<1
Coefficient of Friction	μ	0.25-0.4
Coefficient of		
Thermal Expansion	10-6/OC	35
Maximum Continuous		
Operating Temperature	°C	120°

RG12 Grade Bearings

RG12 is based on a woven fabric bonded with resin with the inclusion of a friction modifier. RG12 grade have the advantages of high temperature capability, high compressive strength, high pressure velocity, low friction, and low swell in fluids. The material is used as bushes, bearings, thrust washers, sliding pads.

Benefits of RG12

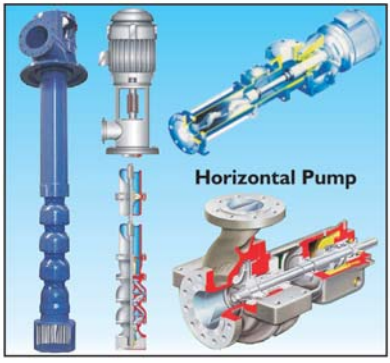
- High compressive characteristics
- High temperature capability
- Tolerant of misalignment
- High pressure velocity
- Good chemical resistance
- Low friction values



PROPERTIES	UNITS	RG12
Density	g/cm^3	1.38
Ultimate Compressive Strength	MPa	250
Normal Working Pressure 4 to 1 safety factor	MPa	62.5
Hardness Rockwell M		90
Coefficient of Friction Comparative testing on same equipment needed to compare Different materials	Dry	0.28
Coefficient of	10-^{6}/°C	35
Thermal Expansion	normal	25
Maximum Continuous	°C	160°
Operating Temperature		

FEROFORM offer significant advantages over Conventional Pump Bearings

Vertical Spindle Turbine Pumps



Top stuffing box bearings

- FEROFORM is ideal for dry start up conditions where lubricating water may take sometime before reaching bearing
- Closer running clearances mean reduced seal wear

Line shaft and pump bowl bearings

- Long life and low shaft wear
- Can be lubricated with process water as well as oil
- FEROFORM able to survive dry start up conditions or temporary suspension of waterflow
- Closer running clearance means less shaft run out and vibration

Suction cover bearings

- Good wear life even in dirty conditions
- Can be lubricated with process water ratherthan dedicated grease or oil supply and so problems with cumbersome lubrication lines are avoided.

Vertical Spindle Sump Pumps

Shaft support bearings

- Can be lubricated with water or process fluids as well as grease or oil, reducing problems with lubrication lines during installation
- Able to survive temporary suspension of lubrication during start up or pump snoring reducing requirements to prime pump and maintenance

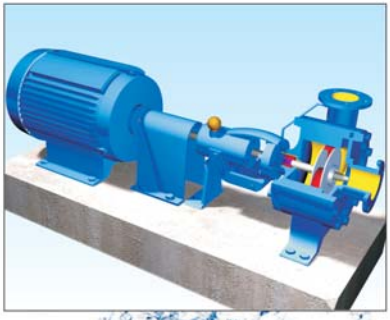
Impeller support bearings

- Close running c earances
- Low wear
- Can run dry temporarily

Wear rings

- Close running clearances improve pump efficiency
- No damage is caused in the case of contact between wear ring and impeller or casing

Centrifugal Pumps



Support bearings

- Low wear rate
- Closer clearances give a stable shaft and lower seal wear

Lantern rings

- Lowfriction gives ability to survive temporary suspension of lubrication water
- Dimensional stability allows for closely defined clearances to regulate water flow

Impeller and casing wear rings

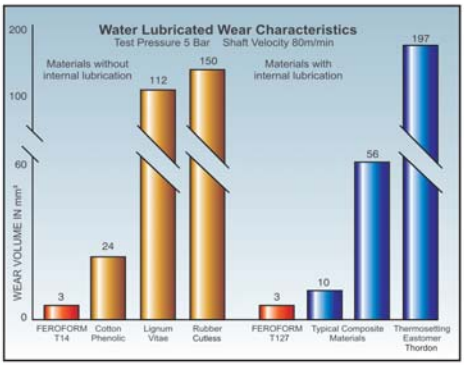
- Low friction and low water swell allows smaller running clearances giving better pump efficiency

Why FEROFORM is ideal for Pump Bearings ?

* ABRASIVE RESISTANT
* DRY RUNNING CAPABILITIES
* LOW FRICTION
* LOW WEAR, LOW SWELL
* HIGH COMPRESSION STRENGTH
* LOW SHAFT WEAR
* EASY TO INSTALL AND REMOVE
* EASY TO MACHINE
* RESISTANT TO CHEMICALS
* SAFETY AND HEALTH
* LOW THERMAL EXPANSION
* ENVIRONMENTALLY FRIENDLY

Abrasive Resistant

FEROFORM composites are extremely versatile materials, having very good abrasive resistance capability. **FEROFORM** can be used in environments where abrasive particles are present, like sea water with high amount of sand & silt, raw water etc. Independent laboratory tests shows that high amount of abrasive foreign debris had no effect on the **FEROFORM** bearing & on the shaft.



FEROFORM Self Water Lubricated Bushes Replaces - Glass Fill Teflon Bushes (GTB), Carbon Bushes, Rubber Cutlass Bearing, Bronze Bushes, Led Tin Bronze (LTB) Bushes, Carbon Fill Teflon Bushes etc.

Dry Running Capabilities

Pump bearings often need to withstand dry running for short intervals, for example at start up or if the pump inlet becomes **blocked. FEROFORM** interna lubricants provide a very low friction even when lubrication is not present. Many bearing materials operate well under well lubricated situations, but fail when lubrication is not present. **FEROFORM** can survive operating conditions where lubrication is delayed or intermittent without damaging the bearing.

Low Friction

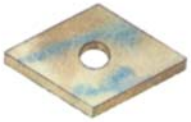
FEROFORM is compounded with internal lubricants to produce a material with a low coefficient of friction. This low friction is maintained even when lubrication or water is not present.

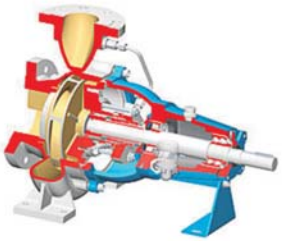
FEROFORM low friction applies not only under laboratory test conditions, but also under actual operating conditions. Stick-slip does not occur with FEROFORM bearings even if pumps have been in standby mode for long periods of time without operating. This can reduce the requirement to prime bearings before starting a pump. This is critically important for emergency type pumps such as fire pumps, settler pumps and flood pumps.

Low wear, Low swell

FEROFORM does soften in water, where as most synthetic materials swell in water. FEROFORM bearings can be machined accurately to size and they maintain these sizes even when immersed.
Close clearances can be maintained, reducing vibration and shaft run out. Large clearances should be avoided because:

- Bearing wear rate increases
- Bearing life is shortened
- Shaft vibration increases, makingthe shaft less stable.





High compression strength

FEROFORM keeps its strength even when wet and does not creep under high loads. Loads on FEROFORM bearings do not result in compression, deformation or compression set. This means that the shaft is more stable.

High load capacity FEROFORM bearings offer better load

capacity than many traditional rubber or elastomer bearings.

Low shaft wear

Wear of expensive shafts can be more of problem than wear of a bearing because of cost of the shaft. Shaft wear is especially severe in dirty operating conditions.

Appropriately designed hard shafts running on **FEROFORM** bearings exhibit exceptionally low wear. **FEROFORM** further reduces shaft wear due to its lower friction. Particular nylons and many rubber materials are noted for damage caused to shafts.

Easy to install and remove

FEROFORM bearings are easy to install and remove without the need for expensive equipment. Bearings can be easily installed on site with minimum effort and equipment, using simple mechanical methods.

FEROFORM does not corrode and seize in bearing housings, unlike bronze and metal backed bearings which become difficult to remove.

Easy to machine

FEROFORM can be easily machined on standard metalworking or woodworking equipment. **FEROFORM** does not creep, deform or swell and can be machined easily to desired tolerances.

Resistant to chemicals

In addition to its excellent performance in water. FEROFORM is resistant to a wide range of chemicals including acids, organic chemicals, water solvents, hydrocarbons, oils and fuels.

Safety and health

FEROFORM does not contain any hazardous substance such as asbestos that make using, handling and machining unsafe. **FEROFORM** is an exceptionally clean material to machine and possesses no asbestos & dust hazards.

Low thermal expansion

FEROFORM bearings do not change size significantly as the operating temperature changes, so close cearances can be maintained across a wide temperature range. This means that **FEROFORM** bearings can be designed with minimal running clearances without danger of shaft seizures.

Environmentally friendly

Environmental problems caused by oil or grease lubrication can be avoided. This means simpler pump design and operation, with great cost savings.

The good chemical resistance of **FEROFORM** means that a large range of pumped media can be used to lubricate the bearings.

High Mechanical Strength

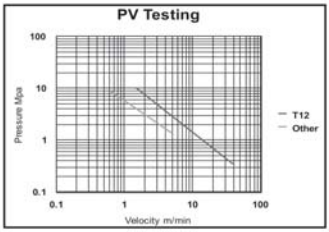
Ultimate Compressive Strength = 300 Mpa Normal Working Loads — 75 Mpa

Extremely stable material

Very low water swell = 0.25% of wall thickness
LowCTE = 70x10-6/C

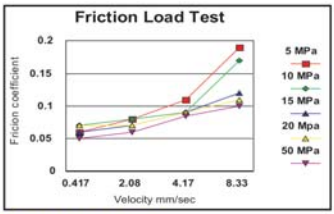
Good Stiffness

But also resilient (shock load applications) Resistant to abrasive conditions, as proved by Independent Test Centres (Ministry of Defence and Powertech Laboratory Testing)



L/D ratio

Typically 1:1 or 2:1



The above permits:

- Adequate cross sectional area, to allow for shaft load
- Ease of alignment
- Adequate outside surface area for interference fit
- Good pressure distribution
- Allows a hydrodynamic film to develop
- Experience shows that the shortest possible bearing should Be used

Shaft Materials

Most common shaft sleeve materials can be used with FEROFORM bearings. The harder the shaft sleeve the better its resistance to shaft wear.

Bronze: Phosphor Bronze, Admiralty Gun Metal, Nickel Aluminium , Copper Nickel. Not recommended for abrasive conditions.

Steel: Stainless Steel for water lube systems. Carbide coated steel (tungsten or boron) for abrasive conditions.

Hardness: For normal operating conditions atypical hardness of 60 - 200 Brinell. For abrasive conditions approx 300 Brinell.

Surface Finish : A finish of 0.8 micro metre (32 micro inch RMS) is usual.

Bearing Design

FEROFORM bearings are designed to have an interference fit on the OD.

FEROFORM Bearings are designed to have a Running Clearance in the Bore.

Need to consider Bore Closure and Water Swell.

FEROFORM Bearings- Fitting Methods

Interference Fit:

- Freeze fitting or Press fitting
- Prevents bearing rotation or axial movement
- Provided intimate contact between the housing and bearing

Mechanical:

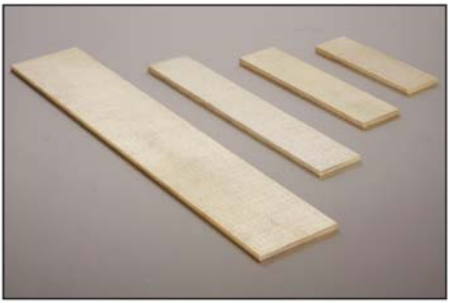
- Anti Rotation Key • Keeper Bars
- Retain ing Rings • Flange
- Stepped Housing

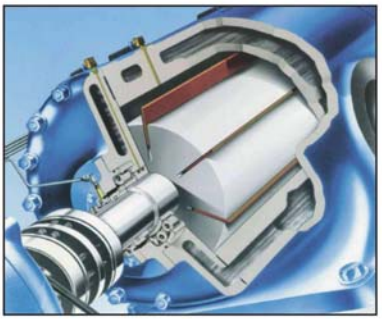
Adhesive:

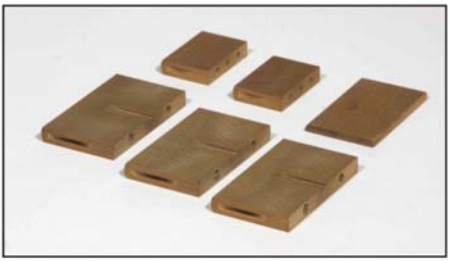
- Not Preferred
- Used forthin walls where interference not possible

FEROFORM

ROTOR BLADES FOR VACUUM PUMP







TENMAT FEROFORM F43 has been developed as the premium nonasbestos alternative to FEROBESTOS EC the industry standard high vacuum rotor blade material. The principal areas of use are in single and two stage high vacuum pumps where FEROFORM F43 exhibits superb stability under vacuum, insensitivity to moisture, excellent strength retention, low noise and fine machining ability.

PROPERTIES	UNITS	F43
Density	g/cm^3	1.8
Flexural Strength	MPa 20°C	440
	MPa 4 days @200°C	260
Flexural Modulus	GPa	22
	GPa 4 days @200°C	20
Bond Strength	KN@ 7.9 thick	5.7
Water Swell (24 hr)	% @ 80°C length	O.02
	% @ 80°C thick	<0.02
Vacuum movement	% @ 125°C length	<0.02
(96 hr)	% @ 125°C thick	<0.02
Coefficient of	10^{-6}/°C length	11
Thermal Expansion	10^{-6}/°C thick	30
Operating Temperature	°C Continuous	200
	°C Maximum	225

TENMAT is a leading manufacturer of specialised, high performance, non-metallic engineering materials and fully machined components.

FEROFORM rotor blades for rotary vacuum pumps and compressors are finished to a high degree of quality and accuracy for applications including

• High Vacuum Pumps • Milking Pumps
• Sewage Truck Pumps • Cement Plant Compressors
• Industrial Pumps

FEATURES AND BENEFITS

- High wear resistance
- High temperature resistance
- Excellent dimensional stability
- Long life • Low noise
- Low water swell
- Resistant to chemicals
- Low wear on pump casing

APPROVED BY ALL MAJOR OEMS

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