



# TENMAT

ADVANCED MATERIALS



**RAILKO**

**FEROFORM**  
MARINE BEARINGS

ADVANCED MARINE BEARINGS



# TENMAT

ADVANCED MATERIALS

## INNOVATION

## SAFETY

## SERVICE

## QUALITY

TENMAT is a leading manufacturer of specialised, high performance engineering materials and components with over 100 years of experience.

TENMAT stands for innovation, safety products, commitment to our customers and the latest quality standards worldwide.

### A World of Materials

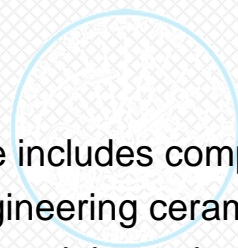
The diversified product range includes composite wear parts and bearings, engineering ceramics, high temperature resistant materials, and passive fire protection solutions.

### Commitment to Quality

TENMAT operates an ISO 9001:2008 Quality Management System for the design, development and manufacture of specialised high performance engineering materials and components.



SUR  
VERI



# High Performance Marine Bearings



*FEROFORM* and *RAILKO* technical composite materials, exclusively manufactured by TENMAT, are widely recognised as the industry standard for demanding applications such as stern tube, rudder, and propeller bearings, deck equipment, steering gear and many other applications.

TENMAT bearings offer considerable benefits in terms of performance, price, reliability, design, ease of use and installation.

The innovative *TENMAT FEROFORM* and *RAILKO* material grades combine high strength with excellent wear resistance and durability, yielding high performance bearings for all types of service conditions, from the arctic to the tropics, from coastal waters to deep sea conditions.

TENMAT marine bearings are proven not to support biofouling which can help avoid shaft damage due to organic growth on the bearing.

## Material Benefits:

### - Market-Leading Wear Performance

Resistant to abrasion and arduous conditions. Exhibit consistently lower wear rates against all competitive materials, hence longer life.

### - Does Not Require Clean Water Systems

Superior resistance to abrasion in arduous conditions and sand-laden waters.

### - Excellent Stability

Minimal water swell and thermal expansion allow tighter clearances, ensuring longer life.

### - Low Noise

Lower noise levels due to lower friction levels and tighter tolerances.

### - Shaft Friendly

Excellent with stainless steel, gunmetal, and nickel aluminium bronze counterfaces, alongside other common shaft materials.

### - Accepts Misalignment

Capable of absorbing high shock loading, thus accommodating misalignment without damage or fracturing.

### - Approved by All Major Classification Societies

*FEROFORM* and *RAILKO* marine bearings boast full approvals from all leading marine classification bodies worldwide.

### - Significant Worldwide Stocks

Stocks of *FEROFORM* and *RAILKO* base tubes are held at strategic locations worldwide, allowing for immediate despatch to any location.

### - Works with All Lubrication Systems

Can operate with sea water, oil, or grease lubrication.

### - Easy to Machine, Fit, and Install

Available in sheets, tubes, and fully machined components as well as complete bearing packages with bronze housings.

# COMMERCIAL

FEROFORM F3637, T12, T14; RAILKO NF21, NF22

## Applications:

- Stern Tube Bearings
- Stave Bearings
- Propeller Bearings
- Rudder Bearings
- Hatch Cover Pads
- Deck Equipment
- Sheave Bearings
- Stinger Rollers and Stern Rollers
- Cargo Pump Bearings



TENMAT easy to install marine bearings are hard wearing, outliving rubber and thermoplastics. This gives longer operational life and lower operational costs which are ideal characteristics for all commercial ships; Bulkers, Tankers, Panamax, Aframax, Cruise Ships etc.

Using these proven bearings, ship owners no longer cause contamination of the aquatic environment inherent to oil-lubricated bearing systems. Thus, the potential risk of large environmental fines is avoided.

TENMAT marine bearings are ideal in sediment rich waters, with over 8000 vessels being successfully fitted to date.



# NAVAL

FEROFORM T12, T14; RAILKO NF21, NF22

## Applications:

- Stave Bearings
- Stern Tube Bearings
- Propeller Bearings
- A-Bracket Bearings
- Rudder Bearings
- Steering Gear
- Rudder Stock Bushes
- Pintle Bushes
- Winches and Deck Equipment



TENMAT is the trusted supplier to all major Navies worldwide, having been at the forefront of marine bearing technology for decades. Over 35 Navies around the world continue to specify *FEROFORM* and *RAILKO* bearings for safety critical applications.

*FEROFORM* and *RAILKO* marine bearings have been fitted on a wide range of Naval vessels, including patrol boats, corvettes, frigates, destroyers, submarines and aircraft carriers.

TENMAT bearings succeed in the abrasive conditions often found in Naval operations. They offer the best combination of durability and low friction to be found on the market today.



# SUBMARINES

FEROFORM T12, T14; RAILKO NF21, NF22

## Applications:

- Stern Tube, Propeller, Impulsors
- Rudder, Dive Plane, Tiller Bearings
- Aerial, Antenna Hinge Point
- Snort Mast and Periscope Bearings
- Steering Gear Bearings
- Retractable Bollard, Capstan, Winches
- Torpedo Tube Door Bearings
- Main Hatch Bearings



*FEROFORM* and *RAILKO* composite materials are approved and used by Navies for propeller shaft and rudder bearings in submarines where reliable bearing operation is vital. The low friction and low stick-slip of *TENMAT* composites give a low noise signature that is ideal for stealth operation.

Their reinforced matrix structure, using high quality engineering fibres, anti-scuffing resins and integral lubricants, successfully absorbs shocks and vibrations. This yields significant reductions in noise and enhances bearing life, even in estuarine waters.

*TENMAT* marine bearings have been specified and installed in over 120 submarines for deployment all over the globe, from Arctic to Tropic seas.



# DECK EQUIPMENT

FEROFORM PR18, T814, F3637

## Applications:

- Stern Rollers and Stinger Rollers
- Hatch Cover Pads
- Anchor Chain Guides
- Davit, Sheave & Winch, Lifeboat Releases
- Cylinder Rod End Bushes
- Cable Layers
- Cutter Head Bearings
- Bow Door Bushes
- High Temperature Load Pads

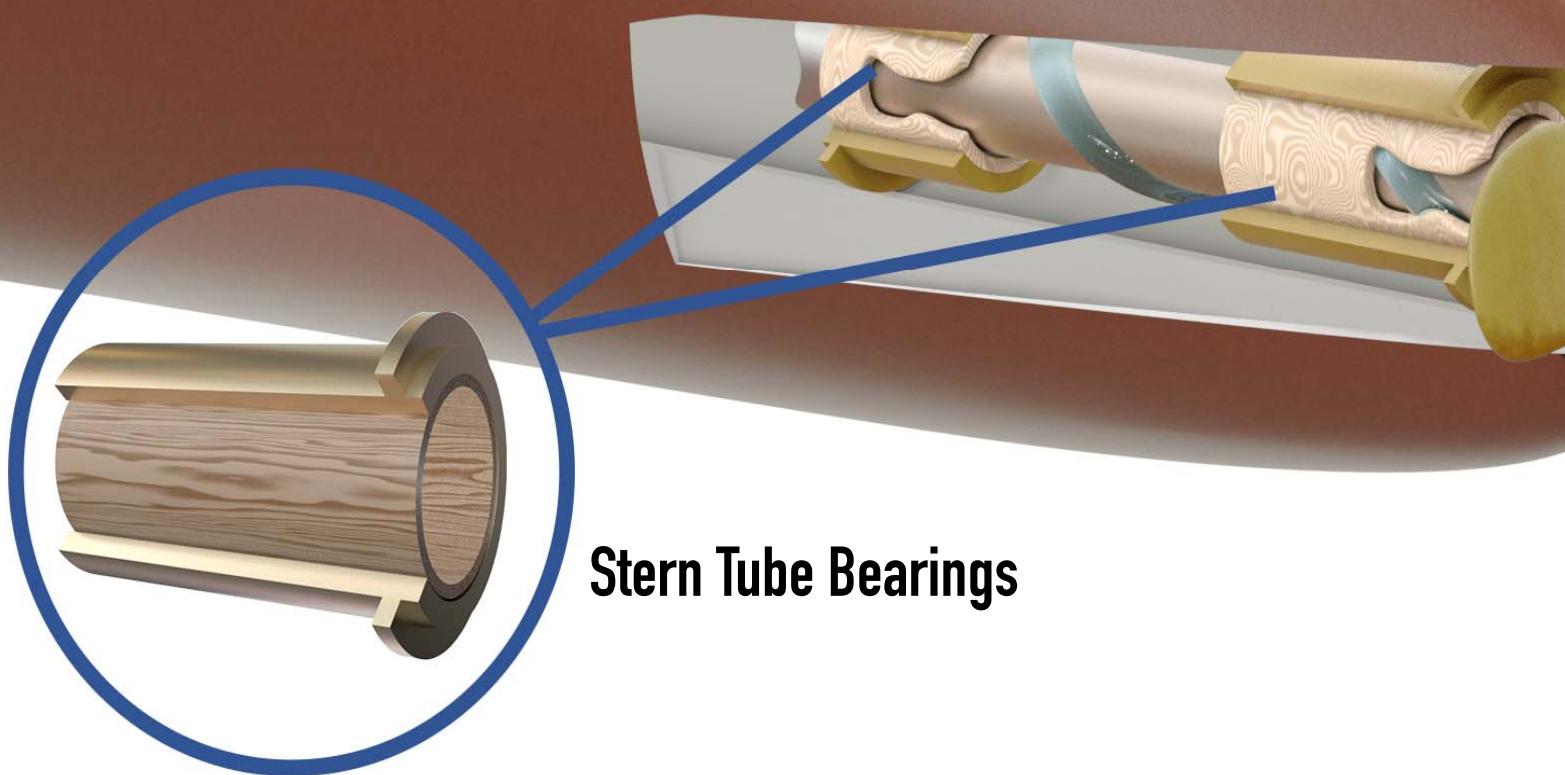


*FEROFORM* F3637, PR18, and T814 are the ideal choices when replacing metallic bearings with a lubricant free solution. *FEROFORM* material grades will not seize or pressure weld and avoid the frequent greasing and maintenance inherent to metallic bushes. This makes *FEROFORM* bushes excellent for safety critical applications like lifeboat davits.

For over 25 years *FEROFORM* F3637 high temperature insulation bearing pads have been the industry standard providing maintenance free performance in bitumen and asphalt tankers.

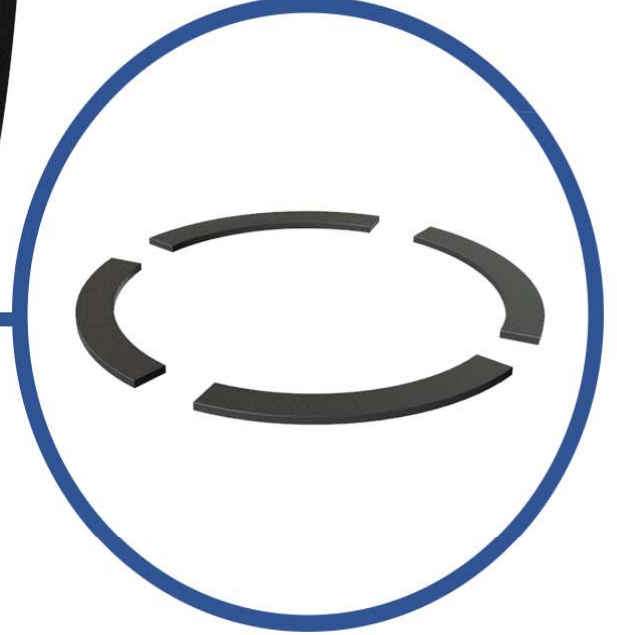
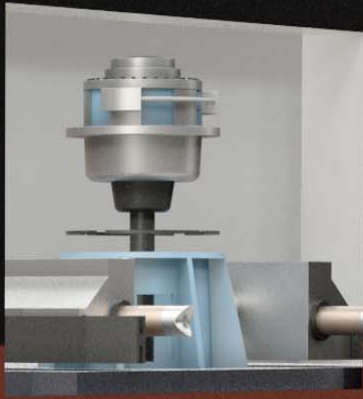


# Total Marine Solutions



**Stern Tube Bearings**





**Steering Gear Wear Parts**



**Rudder Bearings**

**RAILKO**

**FEROFORM**  
MARINE BEARINGS

# OFFSHORE

## FEROFORM PR18, T814

### Applications:

- Anchor Chain Guides
- Davit, Sheave & Winch Bearings
- Life Boat Release Bushes
- Cylinder Rod End Bushes
- FPSO Risers and Mooring Systems
- FPSO Turret Slide Pads
- Stinger Rollers



TENMAT high performance bearings are widely used in the offshore industry, supporting oil and gas production around the world. They excel in all sea conditions from shallow coastal waters in the tropics to deep sea wells in the North Sea.

*FEROFORM* T814 is the leading bearing solution for replacing metallic bearings with a lubricant free solution for offshore applications. *FEROFORM* T814 will not seize or pressure weld.

The dry running capability of *FEROFORM* T814 minimises maintenance requirements. Thus it is ideal for offshore applications such as risers and FPSO turret bearings where maintenance proves difficult and expensive.



# AVAILABILITY

TENMAT bearings can be supplied in a wide range of formats from base tubes to fully machined bearings including split bearings, stave bearings and even complete packages in bronze housings.

Our Technical Services department is available to provide guidance on material selection, part design and technical solutions.

## Available Base Tube Sizes

- Internal diameter from 20mm up to 1150 mm
- External diameter from 30mm up to 1260 mm
- Lengths up to 1200 mm
- Custom sizes available on request
- Sheet material also available



# WORLDWIDE STOCKS

TENMAT is fully committed to the highest standards of customer service. This commitment is exemplified by the significant stocks of *FEROFORM* and *RAILKO* base tubes held at strategic locations worldwide. Stock is designed to cover the widest range of shaft sizes currently in use and allow for speedy delivery.

Immediate despatch to any location can be arranged.

Non-stock sizes can be typically manufactured and despatched within 2-3 days.



# MATERIAL PROPERTIES

TENMAT		F3637	T12	T14	T814	PR18	NF21/NF22
Coefficient of Friction (DRY)		0.13 - 0.15	0.08 - 0.19	0.08 - 0.15	0.07 - 0.10	0.08 - 0.12	0.04 - 0.08 <sup>*A</sup> 0.36 - 0.4 <sup>*B</sup>
% Swell in Water @20 °C		0.5	0.2	0.2	0.25	0.05	0.2
Ultimate Compressive Strength (MPa)		302 <sup>*C</sup> >400 <sup>*D</sup>	310 <sup>*C</sup> >400 <sup>*D</sup>	300 <sup>*C</sup> >400 <sup>*D</sup>	310 <sup>*C</sup> >400 <sup>*D</sup>	259 <sup>*C</sup> 395 <sup>*D</sup>	192 <sup>*C</sup> >400 <sup>*D</sup>
Compressive Yield @ 68.9 MPa (%)		2.8	4.4	3.6	4.3	2.7	2.4
Normal Working Pressure (MPa)		80	75	75	75	87.5	55
Thermal Expansion (10 <sup>-6</sup> /°C)	Normal	29	50	50	43	93	43
	Parallel	15	21	30	31	N/A	43
Maximum Operating Temperature (°C)	Continuous	200	100	100	100	100	120
	Intermittent	300	120	120	120	120	140
Shear Strength (MPa)		101	62	65	72	N/A	41
Impact Strength (kJ/m <sup>2</sup> )		90	72	109	83	33	32
Hardness (Brinell)		38	18	15	17	18	23
Density (g/cm <sup>3</sup> )		1.54	1.30	1.29	1.31	1.28	1.64

\*A Typical friction during normal operation wet  
\*B Typical friction tested dry

\*C Tested on BS2782 on 25 x 25 x 25 sample  
\*D Tested on 50 x 50 x 5 sample, 400 MP is limit of test equipment  
Tested on sheet samples, PR18 tested on tube samples

The information contained in this data sheet is presented in good faith. They are typical test results tested generally in accordance with BS 2782 and ASTM test methods and should not be used for specifications. TENMAT does not warrant the conformity of its materials to the listed properties or their suitability for any particular purpose. For further information please contact our Technical Sales Department on +44 161 872 2181.



# EASY MACHINING

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TENMAT materials are readily machinable by conventional machine shop techniques. It is preferable to use tungsten carbide tools.

Please request a TENMAT machining manual for full details.

# EASY INSTALLATION

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TENMAT marine bearings are preferably interference fitted into the housing. This is most readily achieved by freeze fitting the bearing into the housing. Interference fitting prevents bearing rotation or axial movement and is easily achieved using liquid nitrogen.

*FEROFORM* and *RAILKO* bearings can be retained mechanically. Most common methods are suitable: anti-rotation keys, keeper-bars, retaining rings, flanges and stepped housings.

Chocking is another widely used method of bearing retention. It is particularly good for ensuring bearing to shaft alignment.

Please request a TENMAT installation manual for full details.



# HEALTH AND SAFETY

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TENMAT bearing materials are made without the use of hazardous products. Comprehensive Material Safety Data Sheets are available for all products detailing recommended procedures on request.

It is important that all national, state & local health & safety legislation are complied with.

# LEADERS IN INNOVATION

TENMAT is committed to the ongoing development of new products and solutions in the field of composite and engineering materials. This dedication has been recognised in 2012 and 2013 by receiving the highest official award in Great Britain, the prestigious Queen's Award for Enterprise in the categories Innovation and International Trade.

## Custom Component Manufacture

TENMAT materials can be supplied as semi-finished products or, if required by the customer, our ISO 9001-2008 certified machine shop can produce fully machined items to specification.

## Materials Expertise

With over 100 years of experience in Composite Engineering Materials, TENMAT offers customers information on material developments, characteristics, suitability and applications.

## Technical Ingenuity

TENMAT has been proven to consistently produce industry leading advanced composites, developed in our in-house R&D Technical Laboratories.

## Problem Solvers

The diverse range of high performance composite materials manufactured by TENMAT offer the engineer a wide array of solutions to improve wear resistance, withstand extreme temperatures, resist high impacts and survive in harsh, corrosive environments.

## Component Design

If design services, drawings and fitting instructions are required, TENMAT will work with customers in developing the most suitable solution to their particular problem.



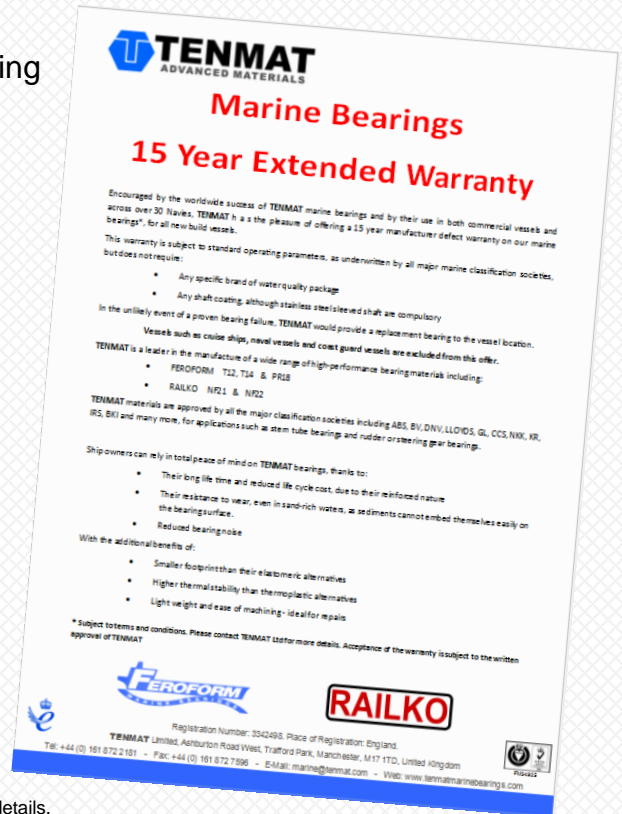
# 15 YEAR WARRANTY

TENMAT offers a 15 year manufacturer's defect warranty on *FEROFORM* and *RAILKO* marine bearings\*. This ensures complete peace of mind when specifying TENMAT advanced marine bearings.

This warranty is subject to standard operating parameters, as underwritten by all major marine classification societies, and is applicable to :

- Any specific brand of water quality package.
- Any shaft liner.

In the unlikely event of a proven bearing failure, TENMAT will provide a replacement bearing free of charge.



\* Subject to terms and conditions, please contact TENMAT Ltd for more details.

## SPECIFIED AND APPROVED

TENMAT marine solutions have been at the forefront of marine transportation for decades and continue to be trusted for diverse, challenging, safety-critical applications.

This is proven by the fact that *FEROFORM* and *RAILKO* marine bearings boast full approvals from all leading marine classification bodies worldwide.

This adds to the significant number of full Naval approvals, alongside the exclusive specifications which *FEROFORM* and *RAILKO* marine bearings have on commercial fleets.





*FEROFORM* **RAILKO** *FEROGLIDE* *FEROBIDE*

*REFRAVER* *REFEL* **ARCLEX**

***FIREFLY*** **NITRASIL** *SINDANYO*

TENMAT is committed to the highest standards in customer service and our international staff is looking forward to assist you.

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