TENMAT
ADVANCED MATERIALS




RAILKO

A TENMAT Brand

ADVANCED COMPOSITES FOR PASSENGER RAIL

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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, high-performance, commitment to our customers, and the latest quality standards worldwide.

A Leading Supplier to the Railway Industry

TENMAT's proprietary self-lubricating composite materials RAILKO and FEROFORM are widely recognized as the industry standard for demanding applications within the railway industry.

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.

Composites in Motion

Material Benefits:

– Market-Leading Wear Performance

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

– Fully Certified to EU Fire Safety Regulation EN 45545

RAILKO JL31 and FEROFORM F21 grades are both fully certified, ensuring maximum passenger safety at all times.

– Low, Controlled Friction Levels

TENMAT wear parts not only protect passenger safety by eliminating stick-slip, their constant friction levels significantly improve ride comfort.

– Lower Operational Train Noise

Absorption of vibrations results in quieter running trains, greatly benefitting passengers on-board and people external to carriages.

– Excellent Reliability

Robust materials are reinforced with high strength fibres and keep design profile for longer, making high speed rail transport safer.

– Increased Safety *via* Superior Load Bearing Capacity

High strength RAILKO and FEROFORM components do not creep under load, enabling safer cornering at speed.

– Approved by All Major Rail OEMs and Authorities

FEROFORM and RAILKO components boast full approvals from the leading OEMs and national rail authorities worldwide.

– High Dimensional Stability for Improved Efficiency

The lightweight parts enjoy very low expansion/swell rates for tight tolerances, avoiding unnecessary maintenance and fuel usage.

– Components Designed, Tailored to Your Exact Needs

TENMAT designs components bespoke for any project, giving better protection. Thus rail solutions are fully integrated and operate to plan.

– Easy to Machine, Fit, and Install

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

– Lightweight

RAILKO and *FEROFORM* components are only 1/3 the weight of equivalent steel parts, giving significant reductions in fuel consumption.

– Taking the Heat

TENMAT manufactures rail components which maintain their high performance levels at operating temperatures up to 225 °C.

– High Corrosion Resistance

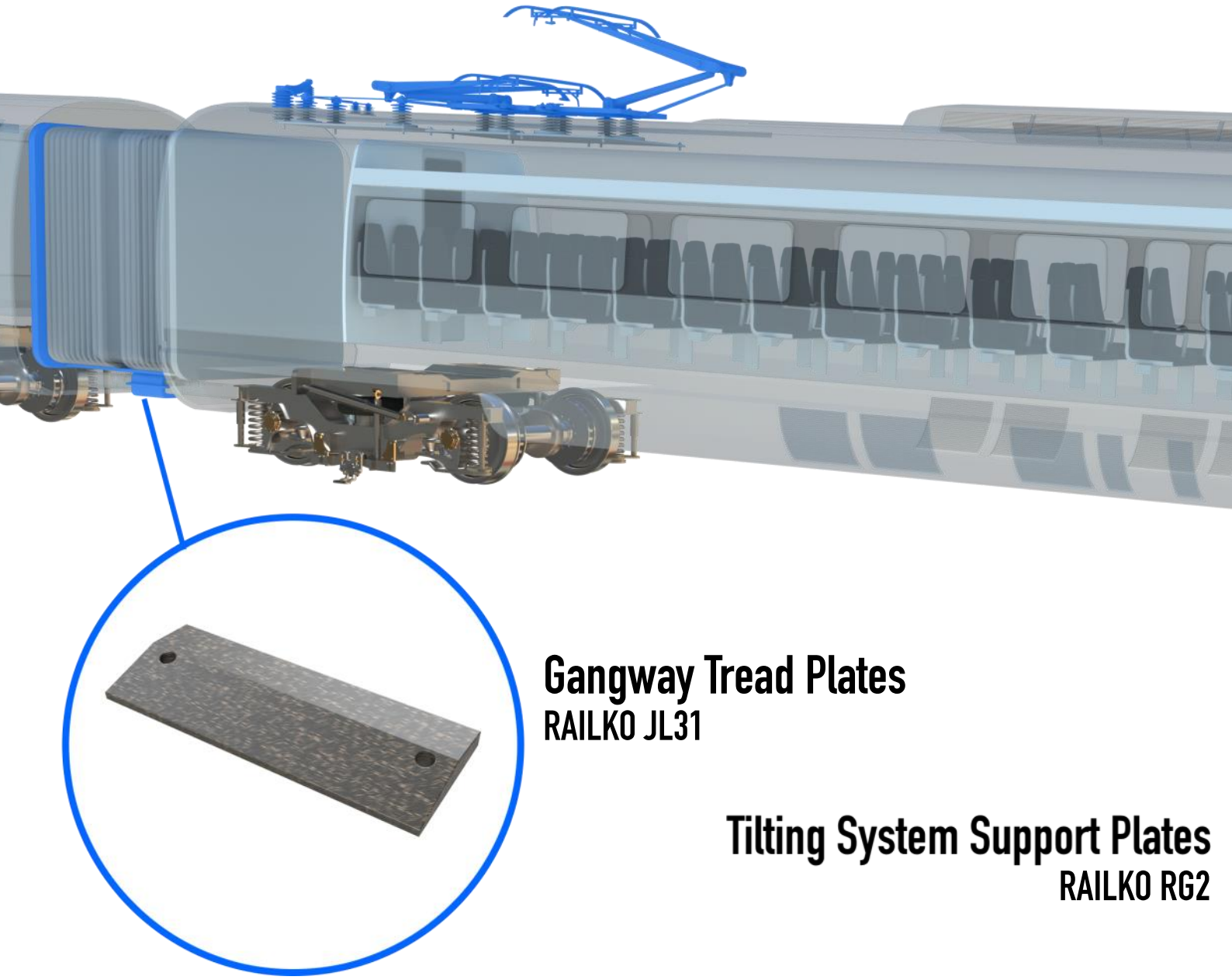
All of TENMAT composite material grades are non-metallic, and thus provide excellent protection against corrosion in harsh environments.

– Full Protection for Diverse Train and Bogie Parts

TENMAT's high-quality components are fitted with tight clearances, giving better protection to mating parts to allow systems to work longer.

High Speed Rail

Highest Safety for the Highest Speeds

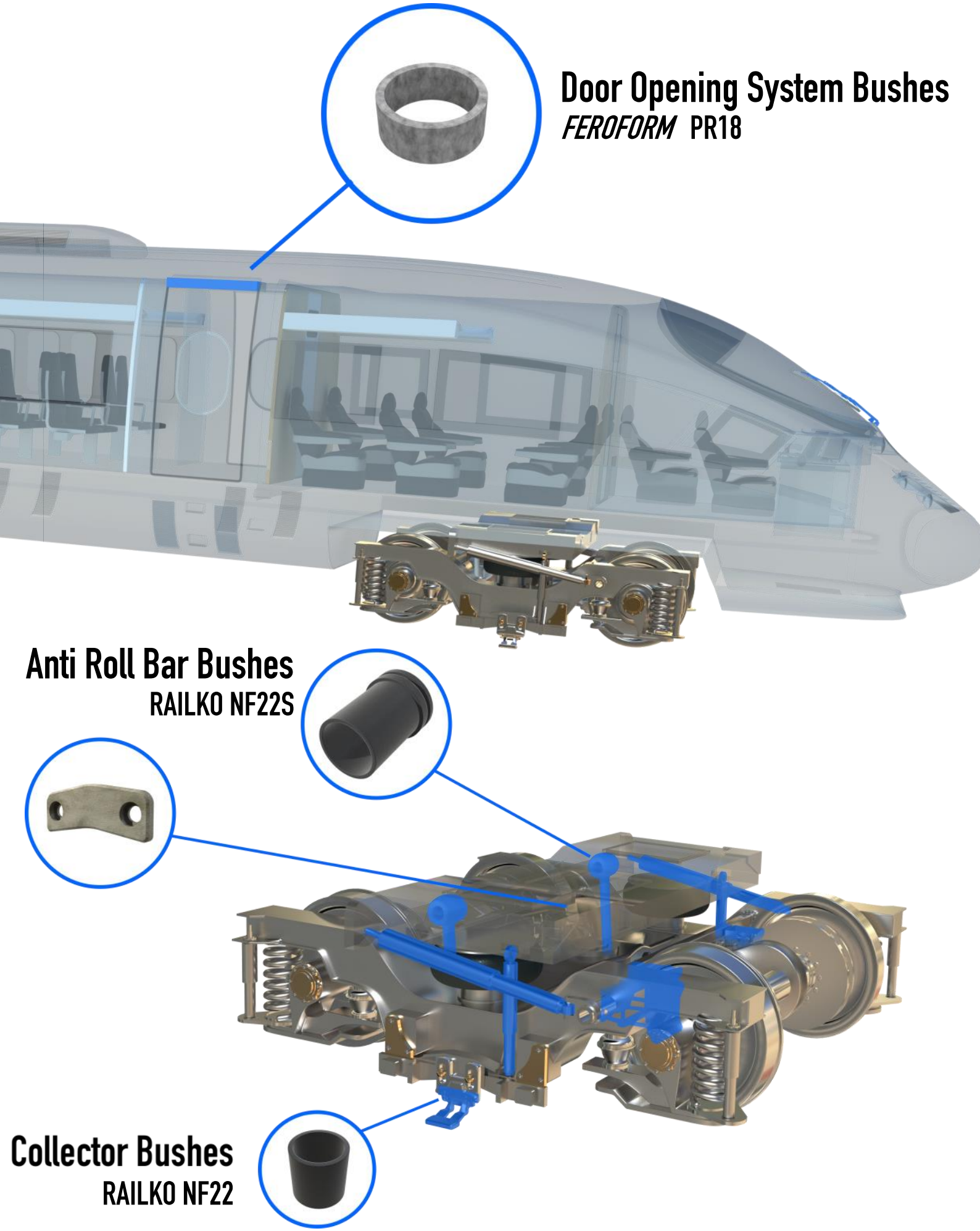


Gangway Tread Plates
RAILKO JL31

Tilting System Support Plates
RAILKO RG2

TENMAT is a key supplier of low noise, bespoke bearing components into many major high speed rail projects across Europe. These high-performance, durable products allow the industry to build upon its high levels of safety for the long term. Our impressive portfolio of previous projects includes flagship systems such as SNCF's TGV trains, Deutsche Bahn ICE trains, and Alstom Pendolino trains.

Current



Door Opening System Bushes

FEROFORM PR18

Anti Roll Bar Bushes

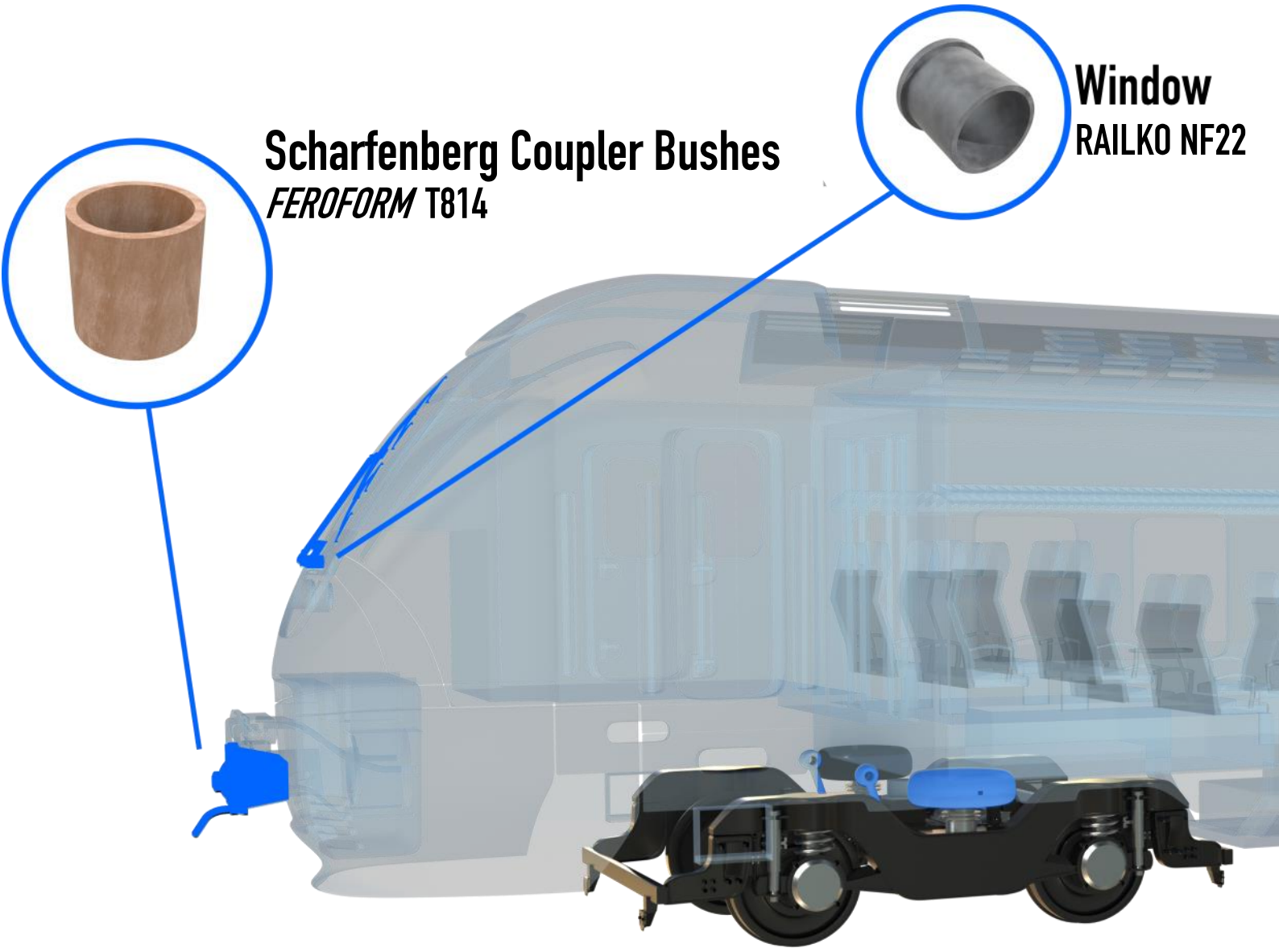
RAILKO NF22S

Collector Bushes

RAILKO NF22

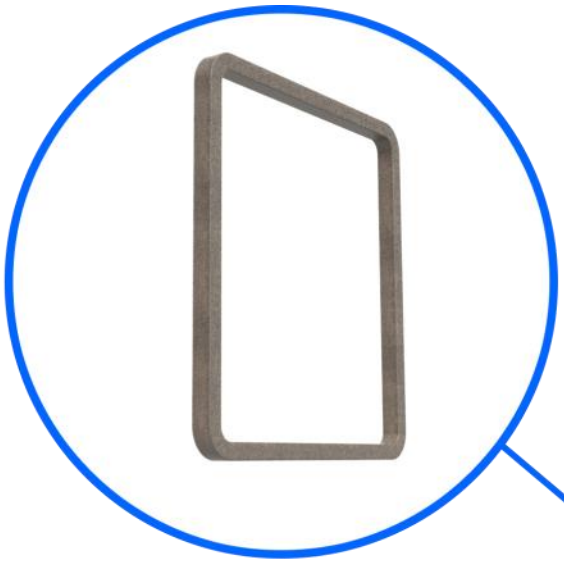
Intercity Commuter Rail

Advanced Materials for Enhanced Connectivity



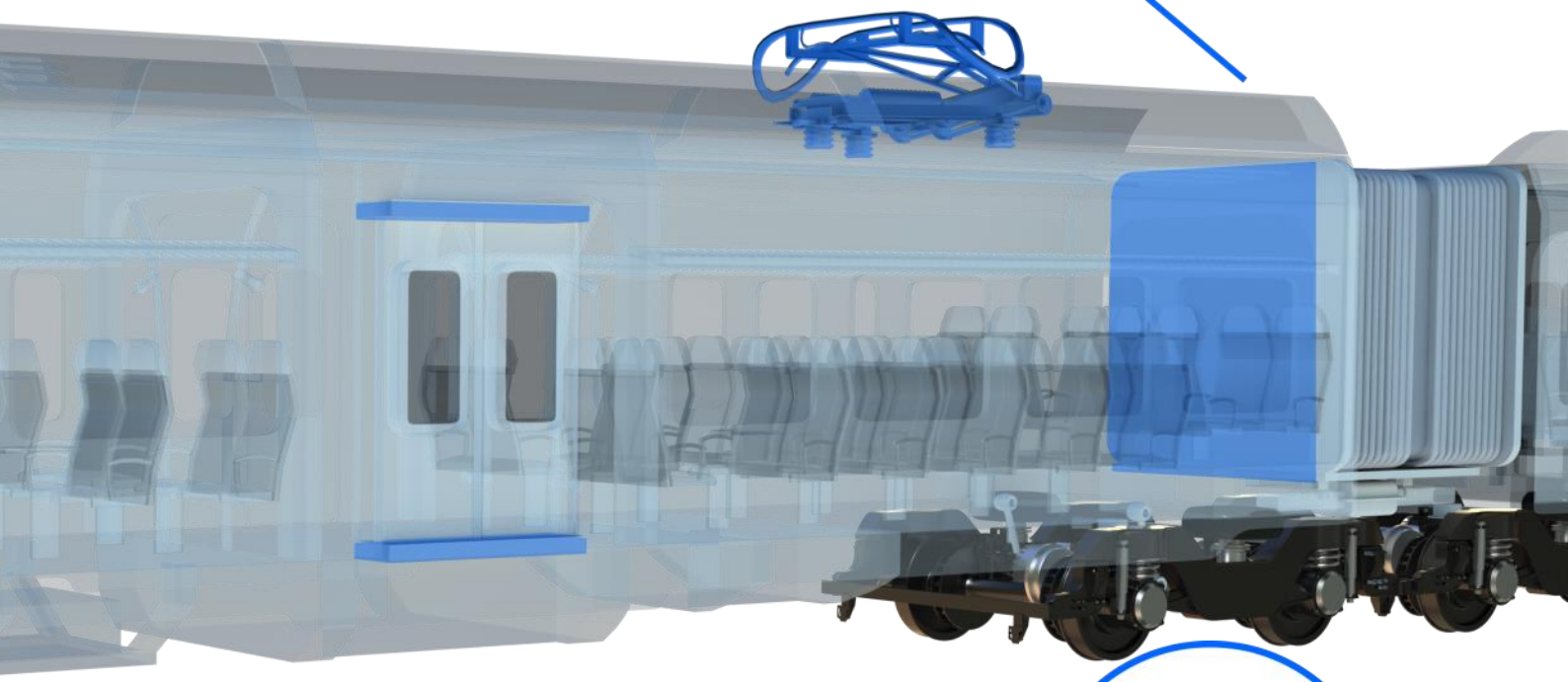
By installing **TENMAT** components, leading OEMs and rail operators are able to constantly increase capacity of modern networks. These reliable products offer better protection to keep rolling stock operating at high levels. Major systems benefit from our products, including Bombardier Aventra trains for UK Cross Rail, Bombardier AGC trains for SNCF, and Bombardier REGIO 2N double decker trains used by SNCF.

Wiper Bushes



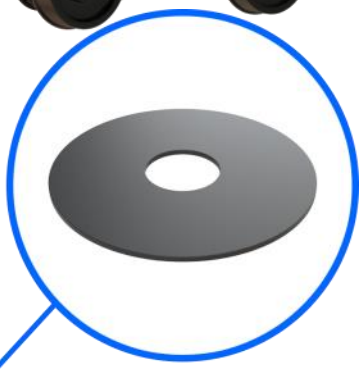
Corridor End Face Plates

FEROFORM F21



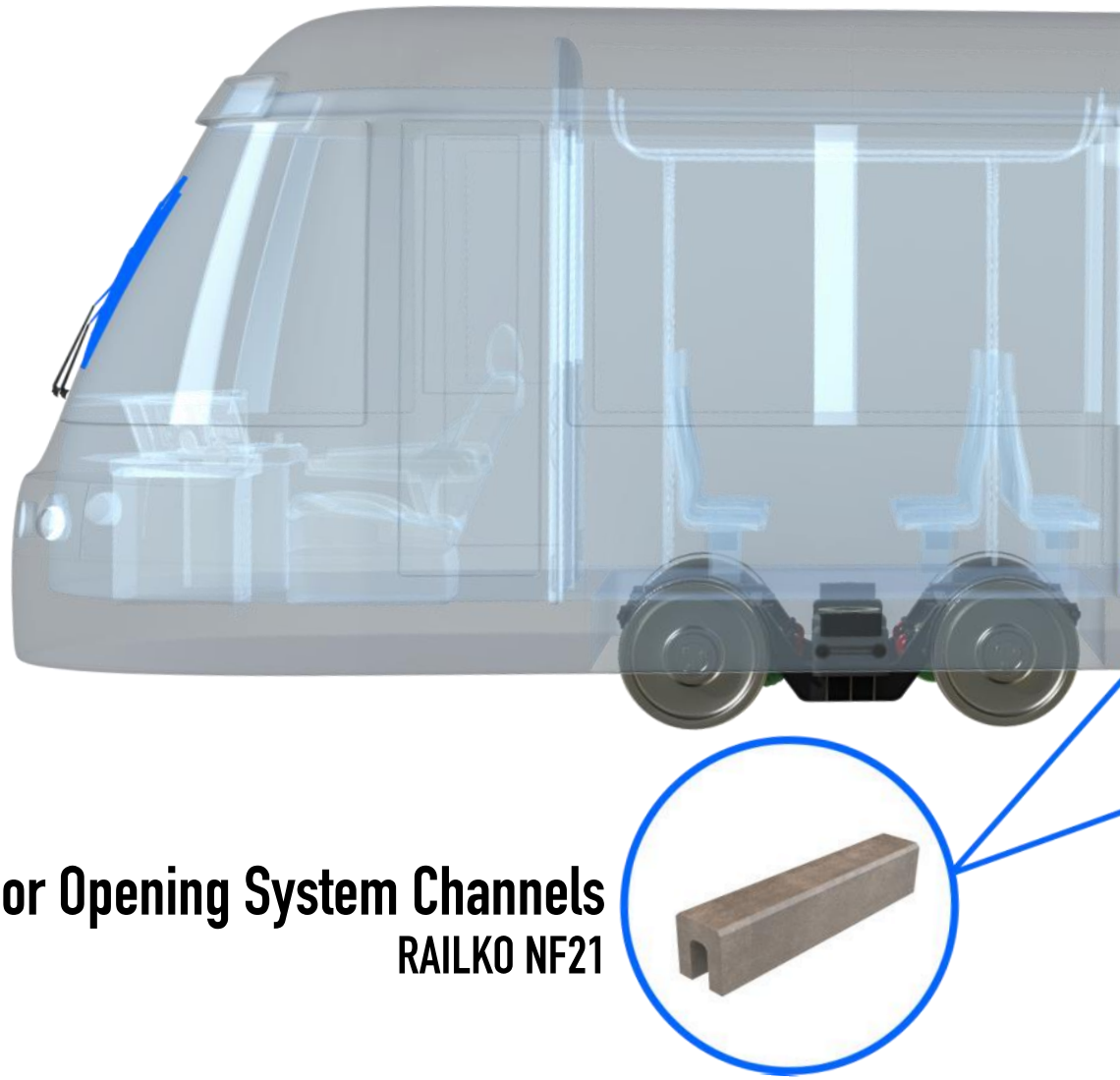
Air Spring System Plates

RAILKO JLX75



Metro, Tram, and Light Rail

Leading the Way Through Ingenuity



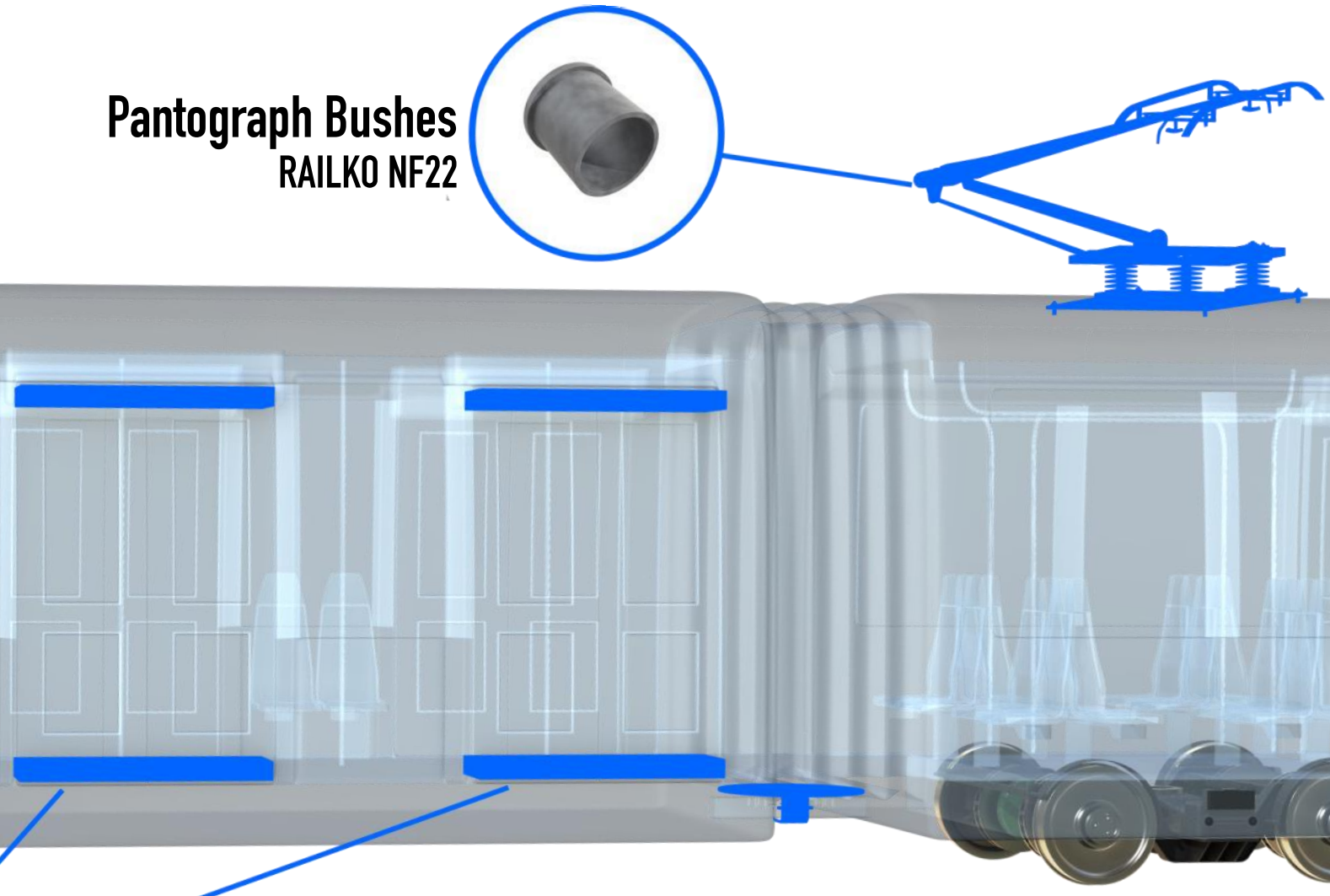
Sliding Door Opening System Channels

RAILKO NF21

Each **TENMAT** solution is bespoke manufactured to the exact requirements of the customer, application and infrastructure network they keep on track. We offer a full design service, and every project has tailor-made **TENMAT** components fit for purpose.

Examples of our design expertise is seen on Kinkisharyo Light Rail in New Jersey, Bombardier Trams in Cologne, and the Alstom-built Paris Metro.

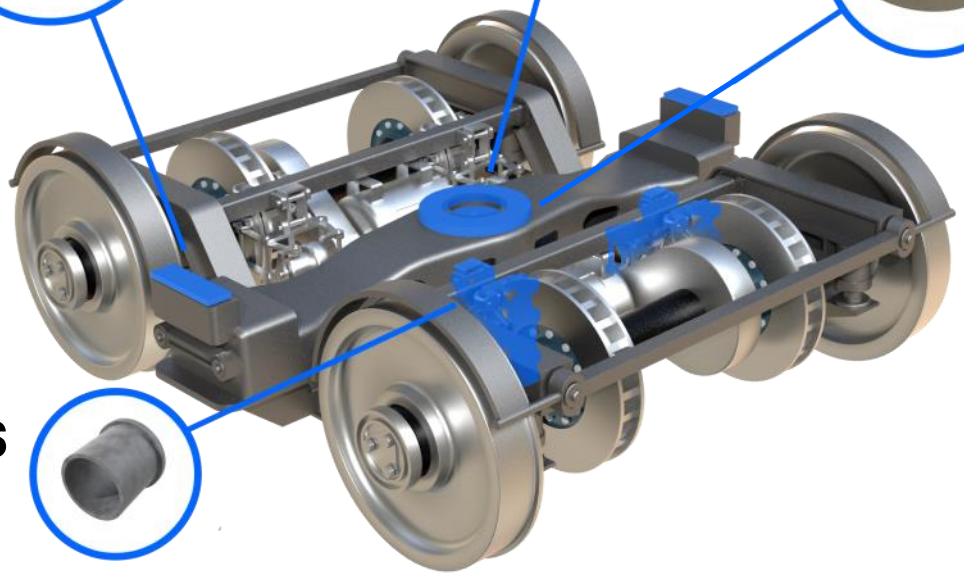
Pantograph Bushes
RAILKO NF22



Centre Pivot Liners
FEROFORM F21

King Pin Bushes
FEROFORM T11

Side Plates
FEROFORM F21



Brake Bushes
RAILKO NF22S

Locomotives

Driven by Innovation

Applications:

- Suspension Bushes
- Suspension Washers
- Centre Pivot Plates
- Side Sliding Plates
- Engine Coupling Washers

Materials

- *FEROFORM* F21
- *FEROFORM* T814
- RAILKO NF21

TENMAT high-performance bearings are lightweight and thus widely used by all leading locomotive manufacturers, including full approvals on G.E. Locomotives. RAILKO and *FEROFORM* materials excel in very difficult working environments, even in high salt and dust concentrations along coastal lines and in arid desert.

TENMAT components give full protection to vital parts in locomotives, helping to maintain high efficiency and performance levels across the 40 year lifetime of a locomotive. Moreover, they are lightweight , 1/3 the weight of steel parts, and thus greatly reduce fuel consumption.

FEROFORM T814 is the leading bearing solution for replacing metallic bearings with a lubricant free solution for locomotives. *FEROFORM* T814 will not seize or pressure weld. Its dry running capability minimises maintenance requirements.

Specified and Approved

TENMAT's range of technically advanced wear parts materials include world renowned composites such as RAILKO™ and FEROFORM®.

TENMAT materials are extremely versatile and suitable for the most demanding applications in the most arduous environments.

TENMAT's RAILKO and *FEROFORM* products are THE industry standard for railway applications worldwide and specified by all passenger railway OEMs such as:

Bombardier
Alstom
Siemens
CAF
Kinkishoryo
Contitech
Paulstra
Knorr-Bremse
Brecknell Willis
Mersen
Tube Lines

TENMAT also boasts full approvals from the leading rail authorities worldwide, including: UIC, Deutsche Bahn, SNCF, SBB, ÖBB, Renfe, Trenitalia, Network Rail, the Irish Rail and many others.

Material Properties

TENMAT		JL31	JLX75	NF21/NF22	NF21S/NF22S	RG2	F21	PR18	T11	T814
Coefficient of Friction (DRY)		0.17 - 0.23	0.04 - 0.07	0.04 - 0.08 *A 0.36 - 0.4 *B	0.04 - 0.08 *A 0.09 - 0.13 *B	0.14	0.17 - 0.23	0.08 - 0.12	0.09 - 0.12	0.07 - 0.10
% Swell in Water @20 °C		0.5	0.5	0.2	<0.3	0.5	0.5	0.05	0.2	0.25
Ultimate Compressive Strength (MPa)		180	130	192 *C >400 *D	200	230	180	259 *C 395 *D	300	310 *C >400 *D
Compressive Yield @ 68.9 MPa (%)		2.3	N/A	2.4	2.2	2.1	2.3	2.7	4.5	4.3
Normal Working Pressure (MPa)		48	45	55	50	62.5	48	87.5	75	75
Thermal Expansion (10^{-6}/°C)	Normal	15	15	35	50	15	15	93	50	43
	Parallel	19	N/A	60	N/A	25	19	N/A	33	31
Maximum Operating Temperature (°C)	Continuous	130	120	120	120	200	130	100	100	100
	Intermittent	150	140	140	140	225	150	120	120	120
Shear Strength (MPa)		4.6	N/A	41	41	68	4.6	N/A	75	72
Impact Strength (kJ/m^2)		6.3	N/A	32	35	40	6.3	33	73	83
Hardness (Brinell)		30	N/A	23	29	30	30	18	16	17
Density (g/cm^3)		1.36	1.46	1.64	1.64	1.35	1.36	1.28	1.32	1.31

*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 Installation

TENMAT products 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.

TENMAT products are often fitted using stepped dolly plates and this will yield best fitment results without damaging the component on installation. The use of hammers in fitting should be strictly avoided.

Please request a **TENMAT** installation manual for full details.

Quality

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

Here at **TENMAT**, we have always made the quality and consistency of our products a top priority and are working continuously on exceeding our customers' expectations.

TENMAT's product quality is consistently monitored by our in-house quality control engineers and regularly tested and qualified by independent third party testing facilities and classification authorities.

In 2012 and 2013 **TENMAT**'s commitment to the development of high quality products and materials was awarded with the prestigious Queen's Awards.

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2012

THE QUEEN'S AWARDS FOR ENTERPRISE INTERNATIONAL TRADE 2013

Over 100 Years of Development

The **TENMAT** success story began more than 100 years ago in Trafford Park, one of the first planned industrial estates in the world.

It has been here at **TENMAT**, where some of the world's first non-asbestos composite materials were developed, manufactured and supplied around the globe.

Since the 1990's the company has experienced unparalleled growth, expanding to become a multinational corporation with presence in the United Kingdom, Italy, Sweden, the USA, Germany, and France.

In 2006 **TENMAT** acquired Railko Ltd., further strengthening its leading position in the rail and marine markets.

Today, **TENMAT** is part of Diamorph AB and employs over 300 people worldwide in the manufacturing and distribution of technically advanced materials and components.

To meet tomorrow's needs for innovative solutions, **TENMAT** operates a state-of-the-art in-house R&D laboratory and continuously develops highest quality products.

You can count on **TENMAT** to deliver the next generation of advanced materials for the world's most demanding applications.

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 through 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.

TENMAT
ADVANCED MATERIALS

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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