

SPECIALTY CARBONS FOR RESIN BONDED FRICTION MATERIALS

TIMREX®
Graphite

TIMREX®
C-THERM™
Graphite

TIMREX®
Coke

ENSACO®
Carbon
Black





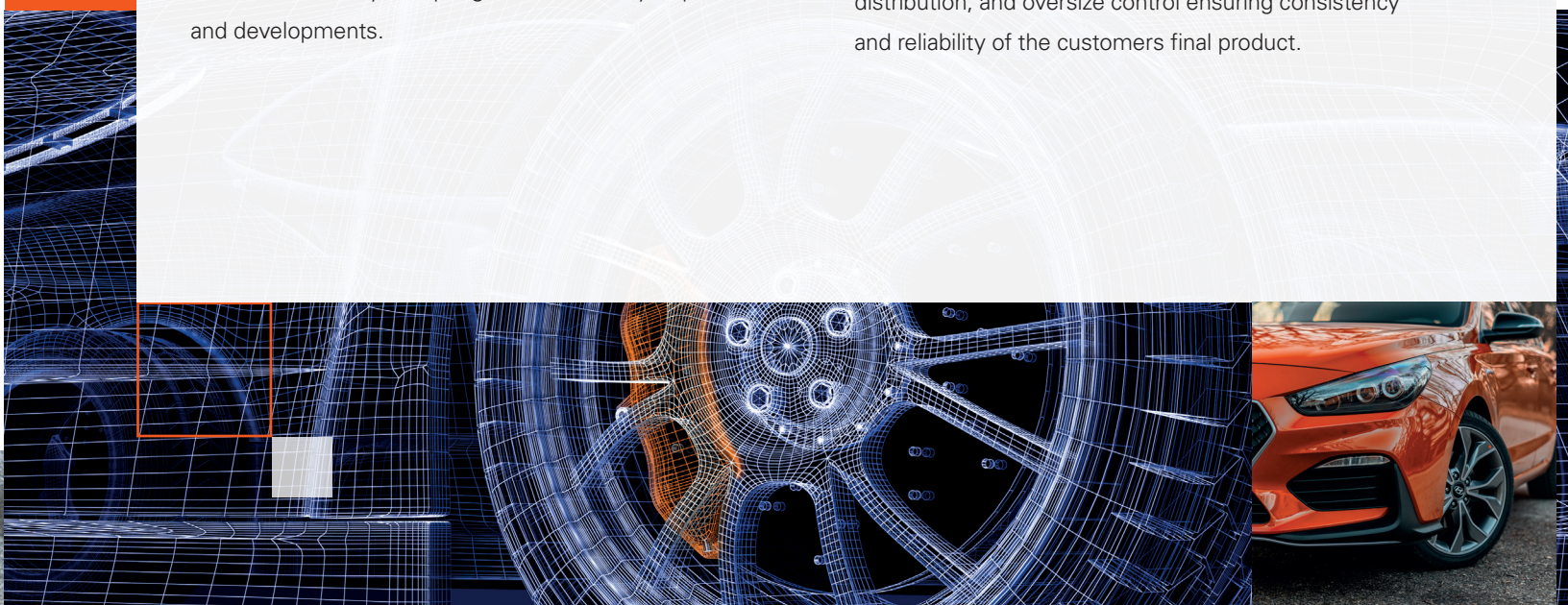
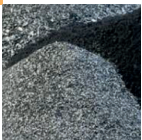
ADVANCED KNOWLEDGE
AND EXPERTISE – FOR
HIGH QUALITY, HIGH
PERFORMING SOLUTIONS

INNOVATIVE LEADERSHIP

Innovative leadership and competence make Imerys Graphite & Carbon the right partner for the development and optimization of solutions for friction materials.

Imerys Graphite & Carbon has been serving this market for decades, always adapting to new industry requirements and developments.

Close collaboration with customers allows us to tailor graphite based solutions that optimize their particular friction material formulation. Our proprietary production processes give full control over key product parameters such as purity, crystallinity, particle size distribution, and oversize control ensuring consistency and reliability of the customers final product.



IMERYS GRAPHITE & CARBON SOLUTIONS FOR RESIN BONDED MATERIALS

CUSTOMIZABLE SOLUTIONS

We work closely with customers to deliver tailor-made solutions for friction material applications with superior consistency of key product parameters: purity, crystallinity, particle size distribution, and oversize control.

Final applications for resin bonded friction materials include:

- ✓ Low-steel brake pads
- ✓ Non-asbestos organic (NAO) brake pads
- ✓ Copper-free brake pads
- ✓ Brake shoes
- ✓ Organic bonded clutch facings

KEY PERFORMANCE REQUIREMENTS (OF BRAKE PADS)	RELATED GRAPHITE PROPERTIES	RECOMMENDED GRAPHITE GRADES
Stable friction coefficient	High crystallinity High thermal conductivity	TIMREX® KS TIMREX®T TIMREX® C-THERM™
Low fading	High thermal conductivity	TIMREX® C-THERM™
Low wear, low dust emissions	High thermal conductivity	TIMREX® C-THERM™
Noise reduction, vibration damping & low disc drag	High spring-back	TIMREX®T
Copper-free (environmentally friendly)	High thermal conductivity	TIMREX® C-THERM™
Low corrosion	High electrical conductivity for electrostatic painting	TIMREX® C-THERM™



KEY BENEFITS

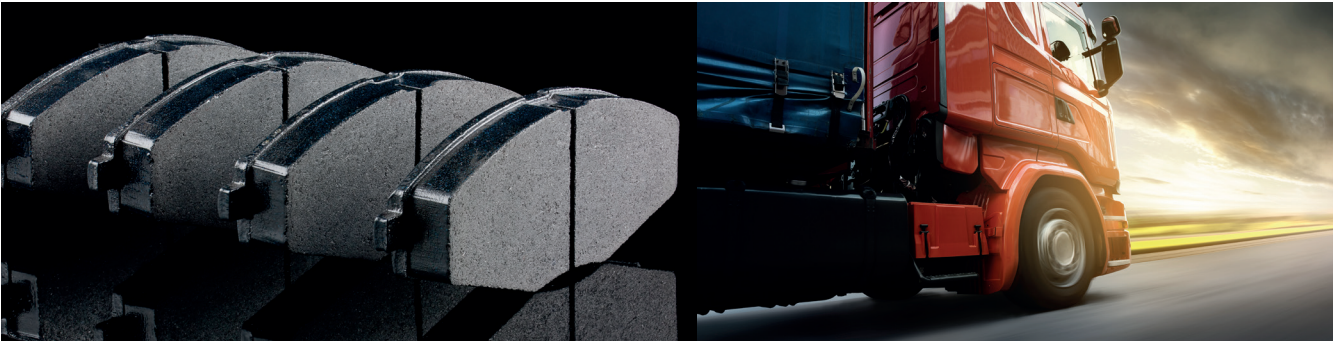
NOISE REDUCTION

The noise generated from brake systems is an important factor for the end consumer’s perception of the quality of the product, especially for electric vehicles with very quiet motors.

Test results show that **TIMREX® T-line** graphites are very effective in reducing noise as a result of its high porosity and high spring-back. Best results are achieved with a combination of **TIMREX® T150-600** graphite and **TIMREX® C-THERM™**, a thermally conductive lubricant, as shown in the table.

SIMPLIFIED Cu-FREE NAO FORMULA	CONSTANT SPEED	LINEAR DECREASING SPEED
Without Graphite	12700 Hz – 92 dB 9300 Hz – 106 dB 4600 Hz – 90 dB 1700 Hz – 96 dB	12700 Hz – 95 dB 9300 Hz – 106 dB 6200 Hz – 91 dB 1700 Hz – 86 dB
TIMREX® KS150-600 (8%)	9300 Hz – 92 dB 6200 Hz – 106 dB 3000 Hz – 90 dB	12700 HZ – 84 dB
TIMREX® T150-600 (8%)	6200 Hz - 91 dB	No Noise (<80 dB)
TIMREX® T800 (8%)	No Noise (<80 dB)	No Noise (<80 dB)
TIMREX® T150-600 (4%) + TIMREX® C-THERM™ (4%)	No Noise (<80 dB)	No Noise (<80 dB)

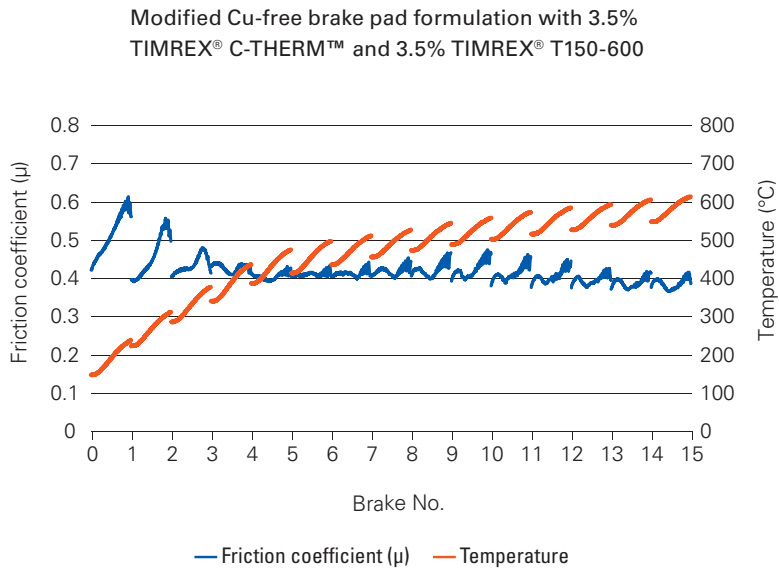
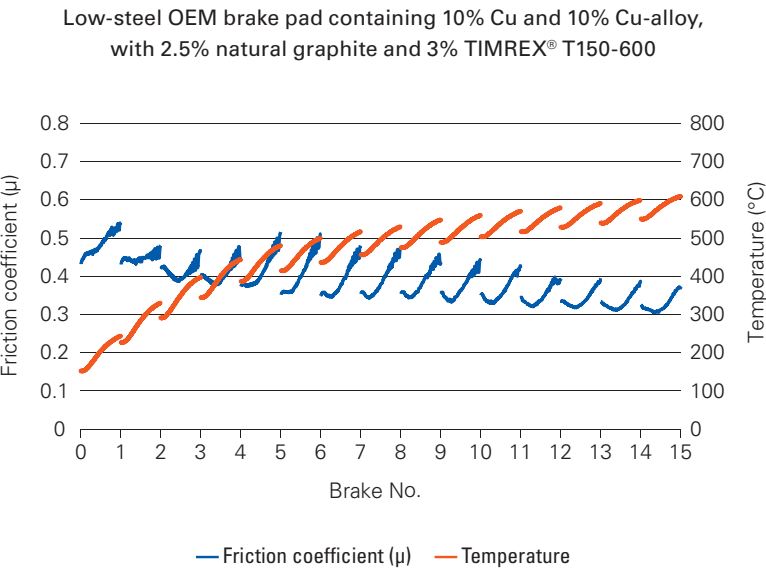
Details of the test can be found in ref [1]



KEY BENEFITS

FADE RESISTANCE

Safe friction materials must be able to maintain thermal stability in the harshest braking conditions in order to prevent the dangerous phenomenon of brake fade. As illustrated in the following table, tests prove that introducing **TIMREX® C-THERM™**, a thermally conductive lubricant, in friction materials produces a consistently high and stable friction coefficient.



Courtesy of RAICAM Section 18 of ISO 26867

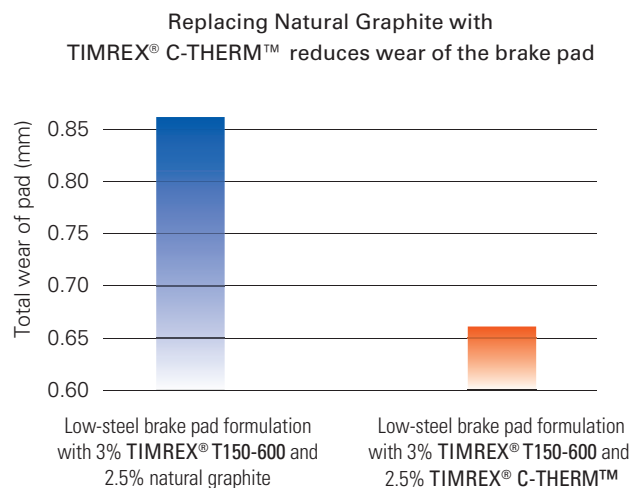


KEY BENEFITS

WEAR RESISTANCE

Thermal stability is not only significant with respect to improving safety, it is also an important factor in the reduction of wear in friction materials. The ability to withstand high-temperature braking conditions increases product longevity and reduces harmful dust emissions.

The chart shows that replacing natural graphite with **TIMREX® C-THERM™** reduces wear of the brake pad.



Wear test SAEJ2702 Courtesy of RAICAM



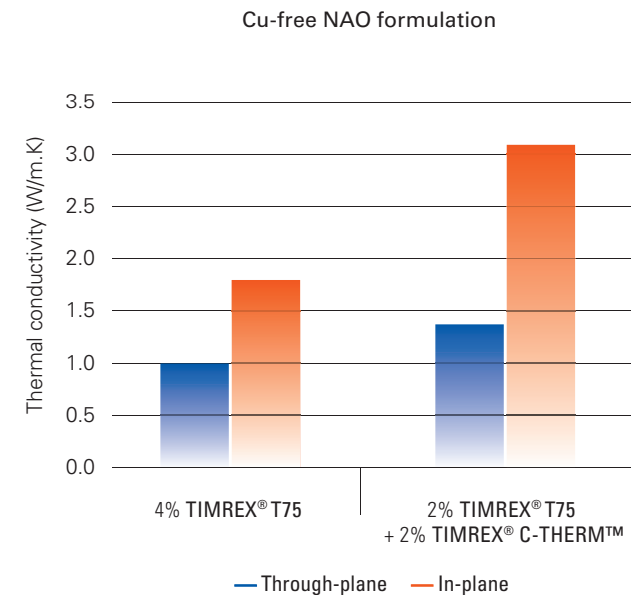
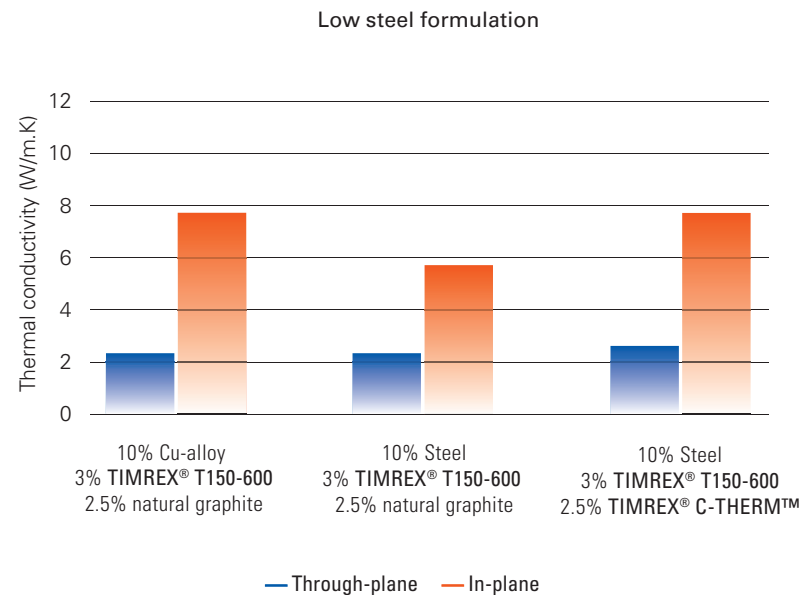
KEY BENEFITS

FADE RESISTANCE

TIMREX® C-THERM™ is an excellent additive in copper-free friction materials as it provides:

- ✓ High thermal conductivity
- ✓ Stabilization of the friction coefficient
- ✓ Wear reduction

The chart illustrates how TIMREX® C-THERM™ as a thermally conductive lubricant improves thermal conductivity significantly in friction materials.



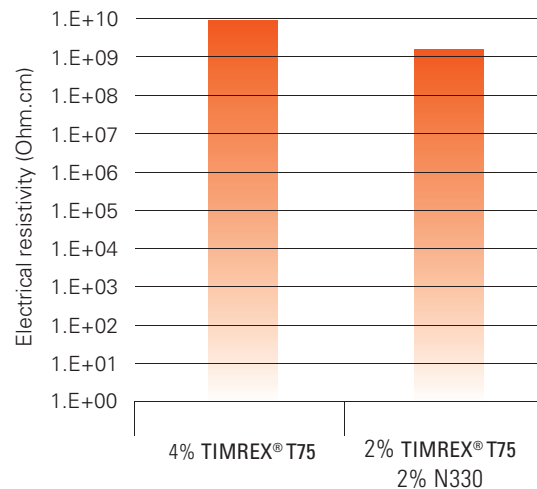
KEY BENEFITS

CORROSION RESISTANCE

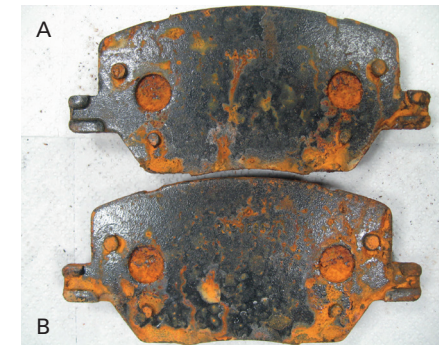
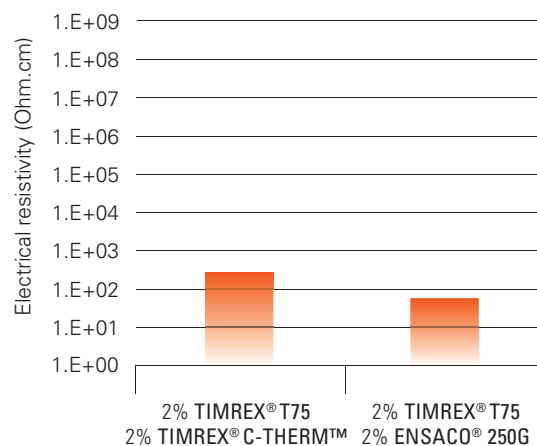
Painting of the brake pads is mandatory in order to increase the corrosion resistance of the metal backing plate. In copper-free and NAO formulations the electrical conductivity of brake pads is strongly reduced which makes electrostatic painting more difficult. As shown in the images, even the slightest percentage replacement of graphite with **TIMREX® C-THERM™** or **ENSACO®** carbon black can drastically improve the quality of painting due to the improved electrical conductivity of the brake pads. The end result is improved corrosion resistance.

The brake pads have been painted electrostatically using standard industrial equipment. The corrosion test has been performed according to ISO9227 (Courtesy of RAICAM), see more details in ref [2].

Electrical resistivity measurements of brake pads



Electrical resistivity measurements of brake pads



A Cu-free NAO formulation with competitor carbon black 4% **TIMREX® T75**

B Cu-free NAO formulation with competitor carbon black 2% **TIMREX® T75** and 2% N330

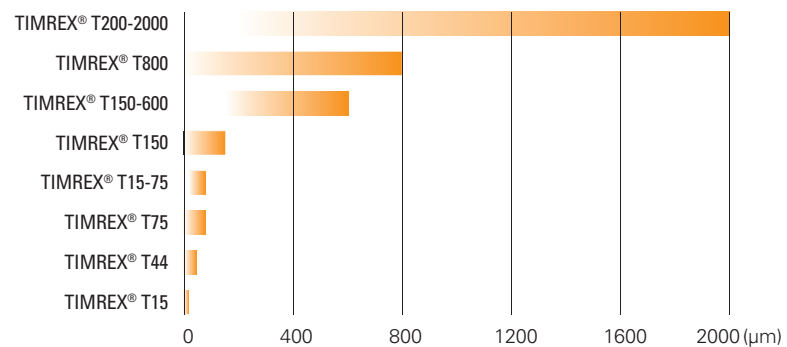


C Cu-free NAO formulation with conductive carbon black 2% **TIMREX® T75** and 2% **TIMREX® C-THERM™**

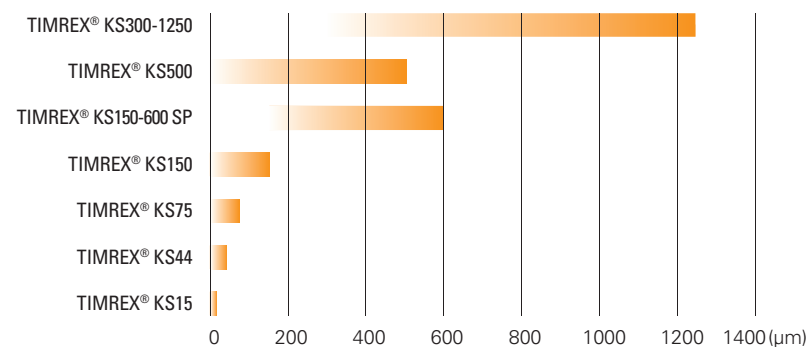
D Cu-free NAO formulation with conductive carbon black 2% **TIMREX® T75** and 2% **ENSACO® 250G**

IMERY'S GRAPHITE & CARBON PORTFOLIO OF SOLUTIONS FOR COPPER-FREE FRICTION MATERIALS

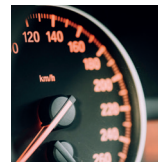
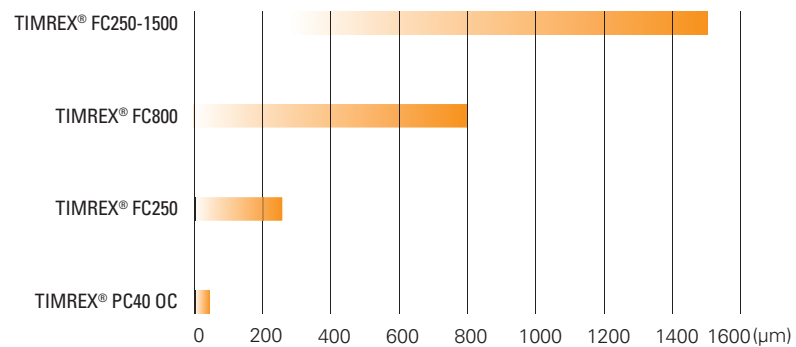
TIMREX® T line primary synthetic graphite



TIMREX® KS line primary synthetic graphite



TIMREX® calcinated cokes



IMERYS GRAPHITE & CARBON
PORTFOLIO OF SOLUTIONS FOR COPPER-FREE FRICTION MATERIALS

TIMREX®
C-THERM™ 412

Form	High aspect ratio graphite	
Ash [%]	2.5 max	
BET [m²/g]	25	
Scott Density [g/cm³]	0.067	
Particle Size Distribution [µm]	d10	56
	d50	150
	d90	294

References:
[1] Gilardi, R., *Materials* 5 (2012) 2258-2269 doi:10.3390/ma5112258
[2] Gilardi, R., Sarocchi, D., and Bounous, L., “Copper-Free NAO Brake Pad Formulation with Improved Electrostatic Paintability Based on Conductive Carbon Powders,” *SAE Technical Paper* 2016-01-1916, 2016, <https://doi.org/10.4271/2016-01-1916>.



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