

- ✔ Reduces fuel consumption up to 5%
- ✔ Reduced emissions
- ✔ Less environmental impact
- ✔ Forms a self repairing protective layer on interacting surfaces
- ✔ Longer lifetime of components



We, at 4TaKT Engineering & Diesel Components are proud to introduce our latest product!

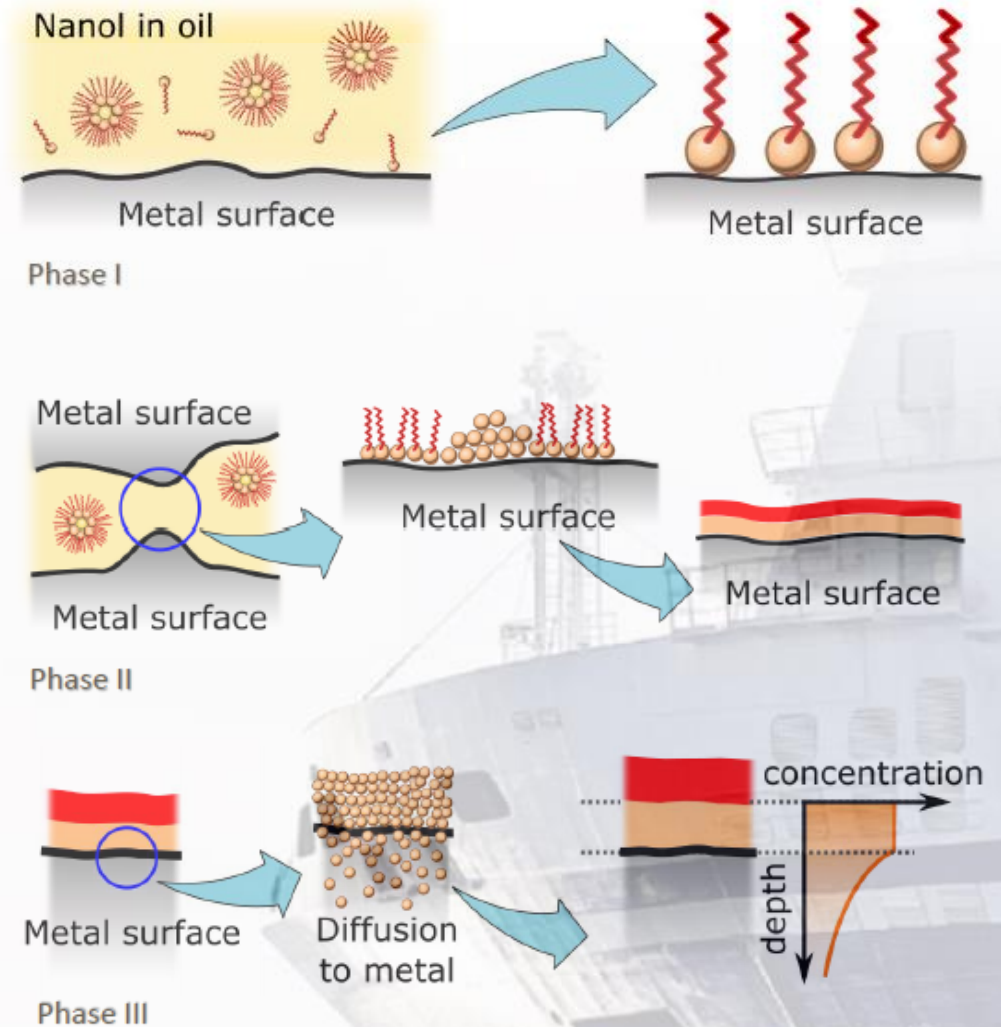
Nanol Marine Lubricant Oil Additive

It will help you to reduce fuel consumption by up to 5%.

What kind of product is it?

Nanol is a patented discovery and represents an innovative lubricant additive, which significantly reduces internal friction and wear of surfaces due to a thin protective layer formed by copper nanoparticles. Fuel and lubricant consumption are cut, and harmful emissions reduced.

- **Phase I:** Adsorption of polar head groups to the friction surface
→ instant friction reduction
- **Phase II:** Shear-induced disruption of micelles
→ formation of additional free polar head groups and copper nanoparticles
→ redox reaction: Cu^{2+} interacts with the iron of the surface and forms Cu^0
→ reinforced multi-layer tribofilm
- **Phase III:** Diffusion to metal (intermixing)
Plastic flow of asperities → mechanical intermixing, tribo-chemical reactions, Cu, Zn, P, S, Ca, ... become constituents of the third body
→ third body as self-regulating solid lubricant



Reference Case: Ålands Landskapsregering

- Nanol® lubricant additive is in use onboard the ferries of Ålands Landskapsregering
- Vessels where Nanol is in use:
 - M/S Skarven
 - M/S Viggen
 - M/S Alfågeln
 - M/S Skiftet
 - M/S Gudingen
- All vessels have Wärtsilä diesel engines

- > 3% Fuel reduction
- > 5 Years operating with Nanol
- Recurring customer since 2016



* All testimonials from customers using Nanol top treat solution.

Reference Case: Ro-Ro Vessel

- Nanol® lubricant additive is in use onboard Rederi Ab Lillgaard's vessel M/S Fjärdvägen.
- M/S Fjärdvägen facts:
 - Built: 1972
 - Main engines: 2 x 4000 Pielstick 8L
 - Fuel: MDO
 - Daily route between Långnäs (Åland) and Naantali (Finland) since 1995.



- **4% Fuel reduction**
- **> 10 000h operating with Nanol**
- **Regular customer since 2012**

* All testimonials from customers using Nanol top treat solution.



Wärtsilä Corporation

Technical statement

27 December 2016

1 (1)

Nanol[®] lubricating oil additive

The Nanol[®] lubricating oil additive has been tested in a Wärtsilä 6L32E PAAE186215 engine in the Wärtsilä's Engine Laboratory in Vaasa, Finland in 2016.

After the 80 -hour engine test, no observations could be made on wear protection or other performance enhancements. No negative effect on engine performance or emissions was registered during the test.

Based on the engine operating data readings taken during the test, the measured changes were within the measuring accuracy of the instrumentation and test procedure.

On behalf of Wärtsilä Finland Oy

A handwritten signature in blue ink, appearing to read 'Ilari Kallio'.

Ilari Kallio

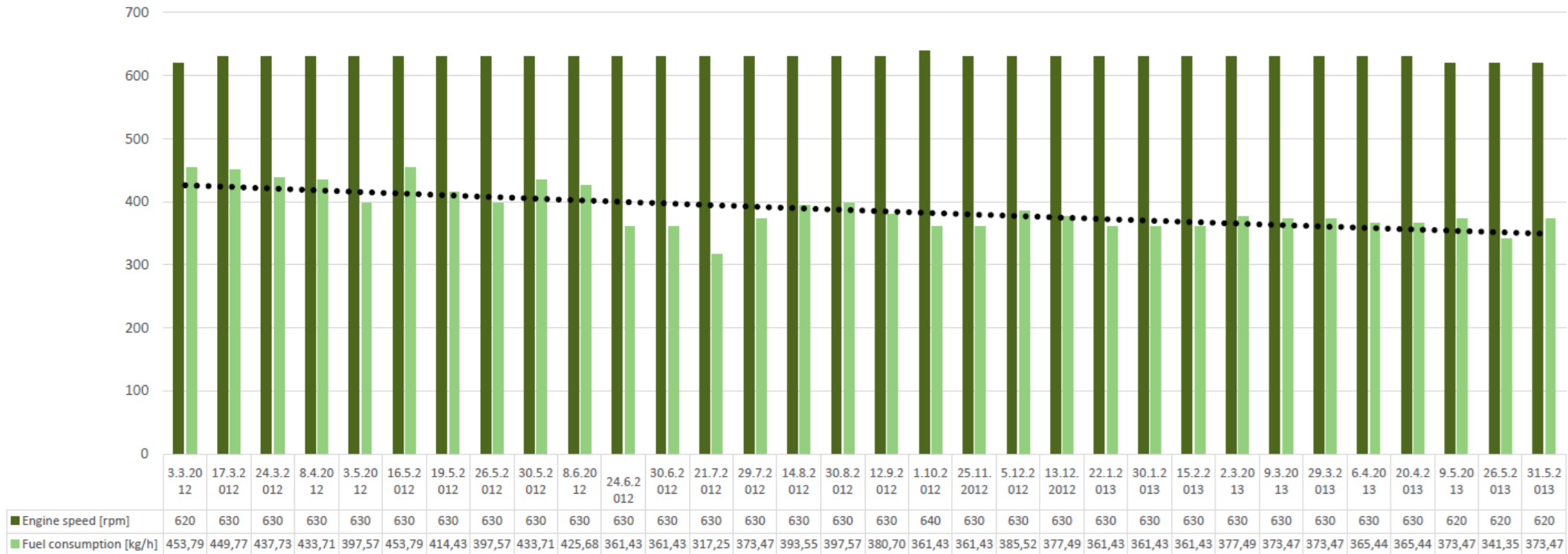
Vice President, Technology



Reference Case: Cargo Vessel

Average hourly fuel consumption down by 5 % during observation a period of 14 months

March 2012 - May 2013
Engine speed



* All testimonials from customers using Nanol top treat solution.

Is it safe?

No impact on oil condition after 6 months of operating

- Copper from Nanol: 200-250 ppm
- Copper content stable over 6 months
- No wear metals detected
- No increase in oxidation, nitration, sulfation or base number (TBN)

Engine: Wärtsilä 16V46B Lubricant: Chevron Taro 40 XL 40		Operating hours with Nanol						
WEAR		0 h	889 h	1203 h	1445 h	1776 h	2014 h	2272 h
Iron	mg/kg	20	20	20	19	18	20	19
Chrome	mg/kg	0	0	0	0	1	1	0
Tin	mg/kg	0	1	3	2	0	1	1
Aluminium	mg/kg	4	2	3	3	2	2	2
Nickel	mg/kg	30	27	27	26	25	28	27
Copper	mg/kg	2	205	227	222	205	226	220
Lead	mg/kg	0	0	1	0	0	0	0
Manganese	mg/kg		2	2	2	2	2	2
PQ index	-		<25	<25	<25	<25	<25	<25
CONTAMINATION								
Silicon	mg/kg	10	9	9	9	8	9	9
Potassium	mg/kg		3	2	2	2	2	1
Sodium	mg/kg		30	32	28	28	33	32
Vanadium	mg/kg	90	83	82	76	73	84	76
Water	%	negligible	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Diesel fuel	%		<0,3	<0,3	<0,3	<0,3	<0,3	<0,3
Soot content	%	0,14	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
OIL CONDITION								
Viscosity at +40C	mm ² /s	136,05	130,52	132,37	132,31	134,6	136,14	135,22
Viscosity at +100C	mm ² /s		14,06	14,19	14,11	14,29	14,37	14,21
Viscosity index	-		105	105	104	104	104	103
Oxidation	A/cm		1	1	1	1	1	1
Nitration	A/cm		4	4	4	4	5	4
Sulfation	A/cm		11	12	11	12	12	12
Dispersancy	%		89	92	88	94	94	92
ADDITIONAL TESTS								
BN	mgKOH/g	26,6	27,37	28,17	27,98	27,21	27,29	27,36

Protecting the Surface

- Nanol® additive tested in M/S Knipan's main engine
- Run with Nanol® for 3 months as a component in Shell Argina X40

A protective Copper layer is clearly visible on the surfaces

At cylinder overhaul, after 3 months running, copper was clearly visible on all cylinder liners, no wear, extended lifetime of components expected.

M/S Knipan facts:

- Built: 1985
- Main engine: 1 x Wärtsilä 12V 22 MD



- * Nanol top treat additive poured directly into the engine oil sump onboard your vessel
- All testimonials and track record of Nanol's heritage business have been achieved with a top treat blend
- 3% Nanol to lubricant ratio
- Ease of trial on single vessel
- Short time to benefits



Conclusion?

- Less friction -** Improving engine performance, reducing fuel consumption by up to 5% and lessening environmental impact.
- Less wear –** Nanol’s seal-repairing protective nano-layer cuts wear and prolongs the lifetime of components.
- Less consumption –** Reducing global fuel consumption and emissions using our revolutionary additive in lubrication oils promises financial and environmental rewards.
- Less –** Ships consume about 15% of world transport fuels, and new IMO requirements increase the pressure to cut emissions

Backed by several test cases which are available to review, we trust this addition to our delivery program can make a difference in the worldwide fuel consumption.

Consume less, save more.

Interested? Then we go to the next step.
Our 4TaKT Sales Team is ready to assist you.