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TurbWay SE GT
TurbWay SE GT LV

A new generation turbine fluids

ENERGY EFFICIENT
ECC (ENVIRONMENTALLY CONSIDERATE CHOISE)
FOR POWER INDUSTRY

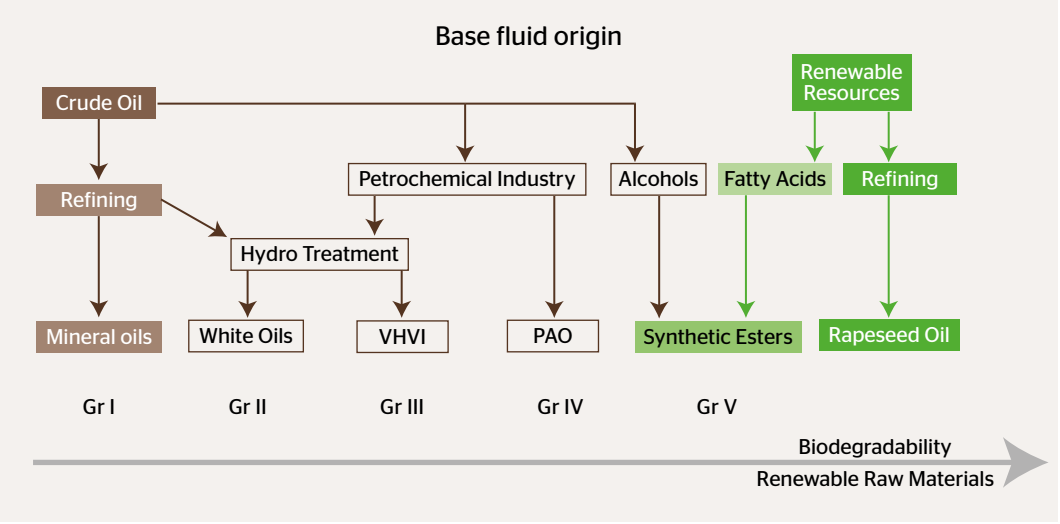
Content

Product introduction and application

TurbWay SE GT and TurbWay SE GT LV are a new generation turbine fluids which are recommended for gas and steam turbines within the power industry.

Using these products, we can demonstrate much lower losses with retained lubricating capacity.

In the early days the turbines were lubricated with products based on mineral oil (group I). The latest editions of turbines run with higher temperatures which results in an increased demand in oxidation stability of the turbine oil. To achieve this, turbine oils are moving towards Group II or Group III base oils and a higher amount of antioxidants.



The solubility of Gr. II and Gr. III oils is very poor which makes them more sensitive to varnish formation in the turbine system due to hot spots and/or static discharges. Varnish formation can lead to unexpected downtime and increased maintenance and oil change costs.

TurbWay SE GT and TurbWay SE GT LV are based on a special selection of saturated synthetic esters (Gr. V) to provide the optimal friction behaviour and at the same time they have very good solubility and high conductivity to minimize the risk of varnish formation and prolong service life in the systems. These features prevents machine downtime and saves time and money.

Energy efficiency and research

Increased energy efficiency

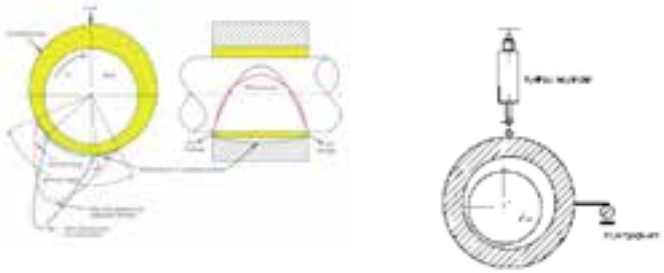
The research in lubricating journal and thrust bearings started at Luleå University of Technology 1997. The goal was to examine the increase in efficiency when comparing different lubricants and different bearing material.

Bearings used in the research

PTFE bearings

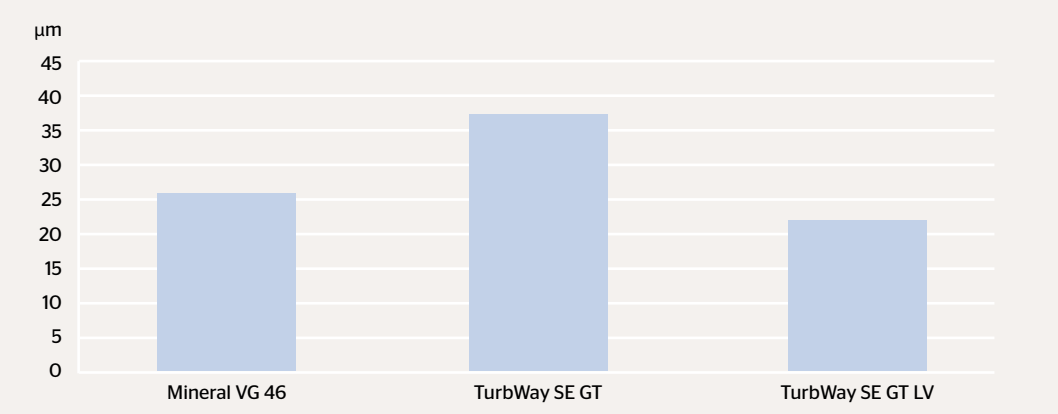
Babbitt bearing

"Energy efficient journal bearings lubricated by environmentally adapted lubricants" was a project supervised by Prof. Sergei Glavatskih. The purpose of the project was to find out the perfect conditions when testing different types of lubricants with different types of bearings.



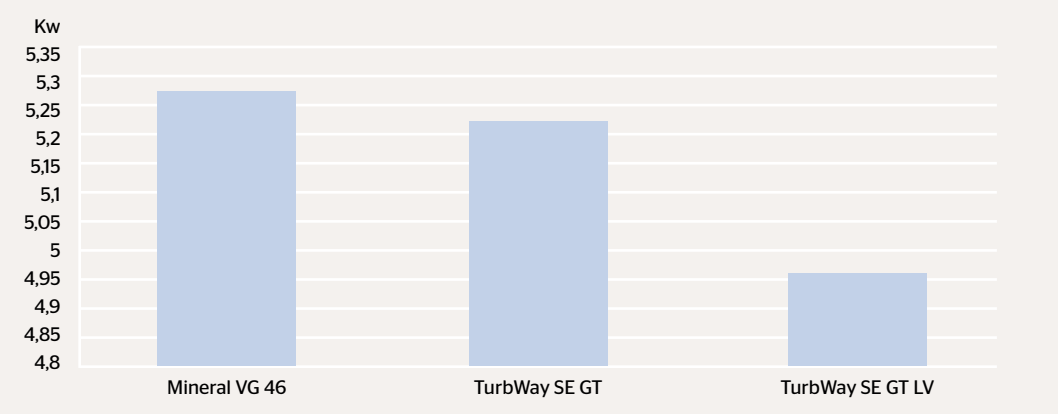
The project showed that an optimized fluid together with the best bearing material could improve the efficiency a lot. The results from the test rig shows that TurbWay SE GT and TurbWay SE GT LV builds much thicker oil film, due to their heat properties and significantly decreased Power Loss. See table 6, page 12.

Minimum Film Thickness



Turbway SE GT builds 41% thicker oil film compared to mineral oil VG 46
Turbway SE GT LV builds almost the same oil film as mineral VG 46

Power Loss



Turbway SE GT has lower losses compared to mineral oil VG 46 despite a 41% thicker oil film.
Turbway SE GT LV with almost the same oil film thickness as mineral oil VG 46 reduces the Power Loss with 30 %

Varnish formation / solubility

Machine downtime costs money, time and patience, while at the same time puts high demands on supply reliability. The importance of using quality products that don't clogg the machine parts is crucial for keeping the machinery in a good condition and preventing standstill. TurbWay SE GT and TurbWay SE GT LV has extremely good solubility which will have a cleaning effect in the system and keep particles and oxidation residues in solution and carry the contaminants to the filters.

Oxidized Oils
Mineral turbine oil VG 46 vs. TurbWay SE GT (ASTM D 943 (dry) / 120°C)

Min. oil VG 46

After = 950h

The pictures shows that the formation of sludge and other oxidation products is insignificant for TurbWay SE GT, while the mineral oil based product forms significant amounts of sludge. The mineral oil based product is completely blackening the test tube and catalyst that are being used. These black, sludge coatings also proved to be basically impossible to wash away.

TurbWay SE GT

After = 1850h

Solubility together with very high conductivity minimize the risk of producing varnish due to hot spots and/or static discharges. In the pictures below it is visible that varnish is a common problem in these systems that can lead to maintenance stop.

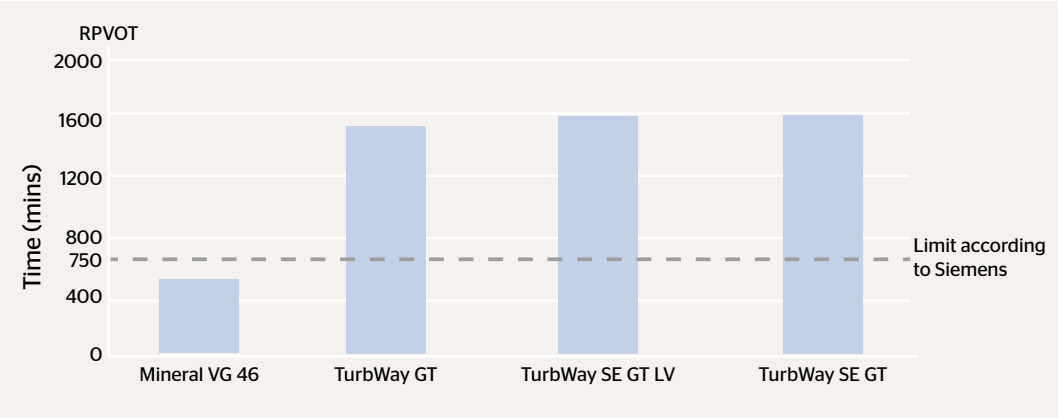
Varnish on the pad

Clogged machines parts by varnish

Oxidation stability

The service life of the oil is dependent of the oxidation stability. Generally syntetic products has better oxidation stability compared to products based on mineral oil.

We have tested the turbine oils according to the Siemens specifications which are highly demanding. The aging of the oil is tested under extremely hot conditions.



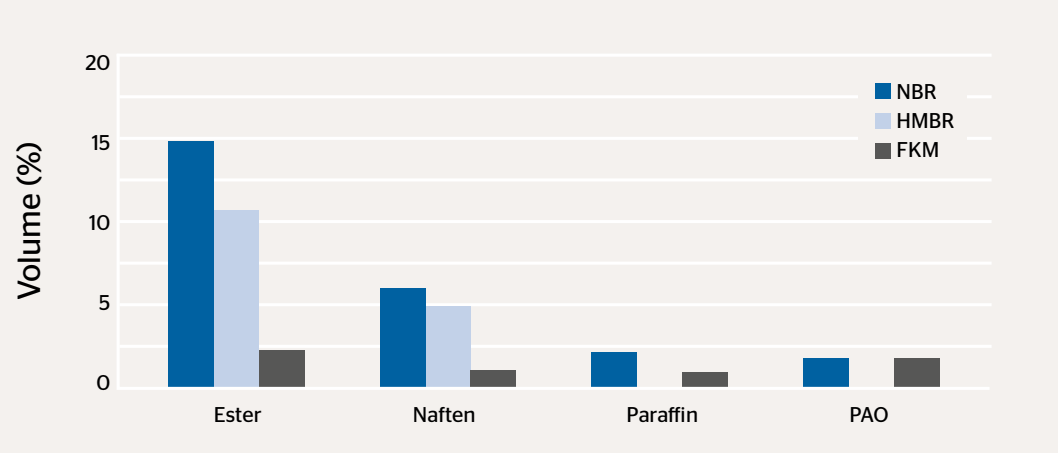
	TurbWay SE GT	TurbWay SE GT LV
RPVOT (mins)	1600	1600
RPVOT mod. (%)	99	99
Dry TOST (h)	> 8000	> 8000

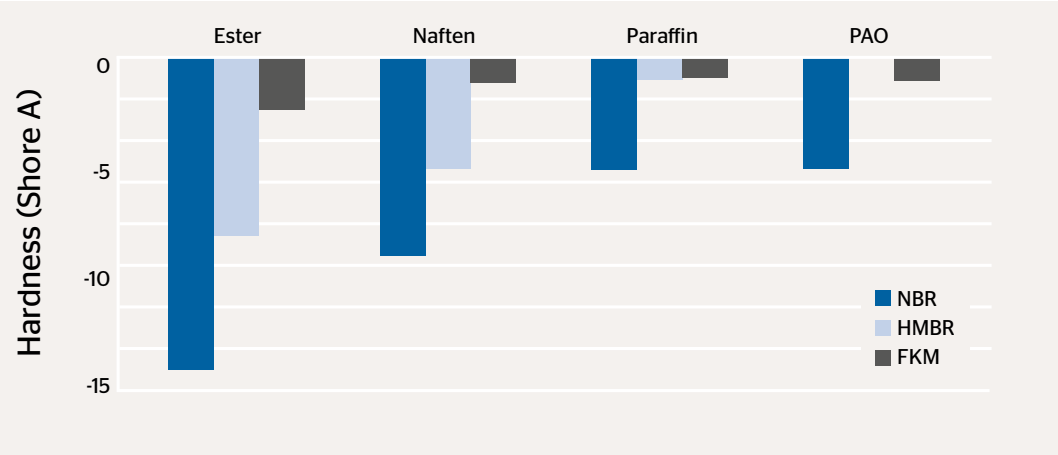
Table 1

The results show a significant higher oxidation stability for the TurbWay SE GT products compared to the mineral oil. The RPVOT values indicates that they have more than tree times longer service life than the mineral oil.

Elastomer compatibility

A study has been carried out looking at how various types of base fluids influence on the properties of elastomers. Circular test specimens, made of different elastomers, are placed into the oil at a temperature of 125°C for 7 days. The evaluation is performed by measuring the change in volume and hardness.





Elastomer		TurbWay SE GT
NBR 28	Δ vol % Δ shore A	18 % -9
NBR 1	Δ vol % Δ shore A	20 % -10
NBR 34	Δ vol % Δ shore A	8 % -5
HNBR 35	Δ vol % Δ shore A	16 % -8
FKM	Δ vol % Δ shore A	2 % -2

Table 2

10 years of experience with compatibility between this type of baseoil/type of lubricant and NBR-elastomers tells us that they are compatible with all elastomers made for lubricating systems.

Metals Compatibility

Metals	TurbWay SE GT	TurbWay SE GT LV
Cu corrosion (100°C,3h)	1b	1b
Rust prevention (ASTM D 665A+B)	Pass	Pass
Brass compatibility (120°C,48h)	Pass	Pass
FTMS corrosion & oxidation Al Cu Fe Mg Cd ΔTAN	 -0,08 (shiny) 0 -0,015 (shiny) -0,015 (shiny) -0,031 0,00 mgKOH/g	 -0,08 (shiny) 0 -0,015 (shiny) -0,015 (shiny) -0,031 0,00 mgKOH/g

Table 3

OEM specifications

OEM´s specifies the properties needed to assure the right quality of the turbine oils. Turbine oils must lubricate the bearings and gears but at the same time handle the hot conditions in the system. TurbWay SE GT and TurbWay SE GT LV passes and exceeds the properties of the main OEM specifications.

Analysis	Methods	Siemens MAT812108	GEK 107395A	Alstom HTGD 90117V0001S
Viscosity at 40°C (cSt)	ISO 3104	29-35	29-35	29-35
Pour Point (°C)	ISO 3016	max -9	max -12	max -9
Air Release (min)	ISO 9120	max 4	max 5	max 4
Water Separation (min)	ISO 6614	<30	<30	<30
Foam at 50°C (ml/ml after 1 min) Foam at 25°C (ml/ml after 7,5 min)	ISO 6247 mod.	max 200/10	max 50/0	max 300/0
Corrosion (Cu Strip 100°C,3 hrs)	ISO 2160	max 2	max 1b	max 2
Rust Prevention	ASTM D 665 A ASTM D 665 B	Pass Pass	Pass	Pass Pass
RPVOT (min) RPVOT – N2-treated (% of new oil)	ASTM D 2272 ASTM D 2272 mod	>750 >80	>1000 >85	>300
FZG – A/8,3/90 (FLS)	CEC -L-07-95	min 8	(min 8)	min 8
Impurities	ISO 4406	20/17/14	--/17/14	--/18/15

Table 4

In the table you can see some of the most important properties specified in the OEM specifications.

Formulation and properties

Base fluid

The base fluid is a special selection of saturated esters with natural high VI to provide the optimal friction behaviour and at the same time thermally stable with very good oxidation stability. They also have good solubility and high conductivity. The base fluid also builds thicker oil films than group I-III base oils.

Additives

A small amount of taylor made additives is needed to improve the oxidation stability and protect the system against corrosion, wear and foam.

Properties

Metals	TurbWay SE GT	TurbWay SE GT LV
Dynamic viscosity at -20°C (mPas) Kinematic viscosity at -20°C (cSt)	1130 1180	770 800
Dynamic viscosity at 40°C (mPas) Kinematic viscosity at 40°C (cSt)	29,4 32	20,4 22
Dynamic viscosity at 100°C (mPas) Kinematic viscosity at 100°C (cSt)	5,4 6,2	4,2 4,8
Hydrolytic stability (ΔTAN)	0,17 / 0,35	0,17 / 0,35
Conductivity at 20°C (pS/m) Conductivity at 50°C (pS/m)	510 1310	510 1310
Pour Point (°C)	< -60	< -60

Table 5

	β - " VI invers"	λ - Therminal conductivity	Cρ - Heat capacity
SE GT	0,044	0,170	1,95
PAO	0,054	0,139	1,80
Gr. I - III	0,058	0,126	1,75

Table 6

TurbWay SE GT and SE GT LV are formulated to build at least the same oil film as Gr. I oils with a higher ISO VG.

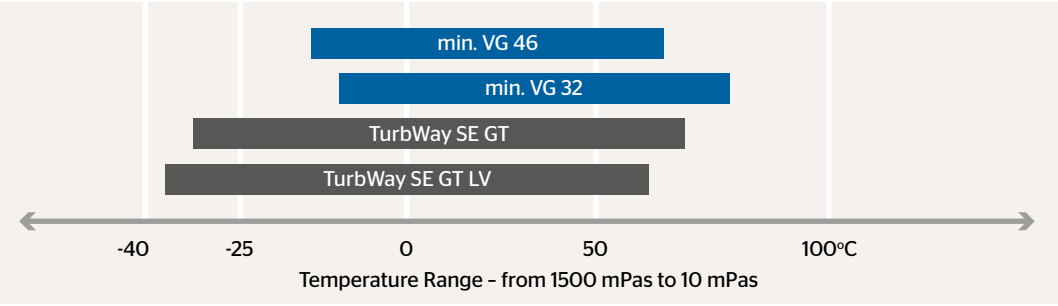
Miscibility

When testing new oil, the tests show the following miscibility properties:

- TurbWay SE GT och TurbWay SE GT LV are miscible with previous Statoil turbine oils.
- When mixing two oils, there will be a mixture of the properties and better performance of the new oil can´t fully be used.
- Always test the miscibility when topping up with new oil. Contaminations from the system can contribute to changes in oil properties.

Temperature

The good low temperature property together with the high viscosity index gives TurbWay SE GT and TurbWat SE GT LV a larger temperature range to work in. This makes it possible to use them also as hydraulic fluids indoors as well as outdoors.



Temperature Range – from 1500 mPas to 10 mPas

Filterability

The Filterability is extremely good. Together with the quick air release and good water separation there is an opportunity to prevent particles, air and water to enter the lubricated contacts.

Properties	TurbWay SE GT	TurbWay SE GT LV
Flash Point COC (°C)	244	256
Filterability – 1,2µ (ml/cm²) Filterability – 0,8µ –dry (%/%) Filterability – 0,8µ –wet (%/%)	104 100/100 95/92	104 100/100 95/92
Air release (mins)	3	2
Demulsibility (mins)	15	10
Foaming at 50°C (ml)	20/0	10/0

Table 7

Wear protection

Good wear protection is needed to lubricate gears, bearings and hydralic pumps. TurbWay SE GT and TurbWay SE GT LV can also be used as hydraulic fluid which can rationalize the number of products in the plant.

	TurbWay SE GT	TurbWay SE GT LV
Vickers V-104C (mg)	55	55
FZG - A/8,3/90 (FLS)	10	10

Table 8

Energy savings

By using TurbWay SE GT LV instead of mineral oil VG 46 it gives an opportunity to decrease the losses by 30% with the same oil film thickness.

Calculation example

Let´s say the losses is 1500 kW (1,5%) in a 100 MW turbine and 1 kWh costs SEK 0,50 on the Swedish spot market.
30% x 12.000.000 kWh (86% running time) x 0,50 SEK = 1.800.000 SEK/annum
= aprox 205.000 Euro - savings

Technical benefits

- Better energy efficiency
- Very good solubility
- High conductivity
- Very good Heat Properties
- Very good Air Release
- Low Pour Point
- High Viscosity Index
- High Flash Point
- Very good Oxidation Stability
- Very good Wear Protection

Environmental benefits

- Energy savings both in HD- and EHD-lubricated contacts
- Contain renewable raw materials
- Biodegradable
- Offers the potential for environmental improvements according to e.g. ISO 14 000 and EMAS

Benefits for the end user

- Reduced power loss (environment and economy)
- Minimizes the risk of building up varnish (economy - less downtime)
- Transition to EAL (environment)
- Better boundary lubrication at start-up (technology)

Recommendations

Bearing lubrication:

TurbWay SE GT or
TurbWay SE LV GT

Gears:

TurbWay SE GT or
TurbWay SE LV GT

Hydraulics:

TurbWay SE GT or
TurbWay SE LV GT

Grease Lubrication:

UniWay Bio LiX 62
GreaseWay Bio Lix Ultra 400
(Open Gears) GreaseWay LiCaX 90

Transformers:

VoltWay N 8 X