



ESTER EXPERTISE AND  
LUBRICANT INNOVATION

# Industrial & Marine (Aero-derivative) Gas Turbines

OEM Approvals & Field Experience  
with NYCO  
**TURBONYCOIL® 600**



Version 7 – April 2009



## FIELD EXPERIENCE WITH TURBONYCOIL 600

### STATOIL - North Sea (Norway)

- 56 x General Electric LM 2500
- 9 x General Electric LM2500+ (DLE)
- 8 x General Electric LM 6000
- 4 x Rolls-Royce RB211
- 2 x Rolls-Royce Avon

on the off-shore platforms of Sleipner A & West; Gulfaks, Statfjord A, B & C, Veslefrikk, Norne, Snoviht, Asgard FPSO vessel, Heimdal & Heidrun, and gas purification plant of Korstoe. Utilisation is between 6,000 and 7,000 h/year.

At overhaul (TBO 24,000 to 28,000 h), oil-wetted parts of LM2500 usually exhibit only a slight varnish that is easily removed by washing with alkaline solvents. The pictures attached in Annex I show the excellent condition of one N°6 bearing after 24,000 h operation with Turbonycoil 600.

The oil condition monitoring in Annex over more than 6 years of operation shows a very good oil stability (no TAN or viscosity increase).

### NORSK-HYDRO – North Sea (Norway)

- 20 x General Electric LM 2500
- 5 x General Electric LM 2500+
- 8 x Rolls-Royce RB211

### OMV (Austria)

- 6 x General Electric LM 2500 at Baumgarten, Ruden and Grafendorf gas compression station

### GERMAN NAVY

- 17 x General Electric LM 2500 on "Brandenburg" , "Bremen" and "Sachsen" class frigates

### Johannesburg Electricity Board (South Africa)

- 6 x Rolls-Royce Olympus for peaking power generation (from 1992, now dismantled)

### FRENCH NAVY

- 11 x Rolls-Royce Olympus TM 3B used for the propulsion of the anti-submarine corvettes, type "Georges Leygues"



#### ONGC (India) – Mumbai offshore

- 8 x Rolls-Royce RB211
- 10 x General Electric LM 2500

#### TOTAL (Oil & Gas operations world-wide) – since 1992

- > 40 x Rolls-Royce RB211 & Avon

The oil consumption profile and oil condition of one RB211-24G operated by TOTAL ABK (Abu Dhabi) over a period of 12,000 h is shown in Annex II. After 3,160 h; 3,780 h and 4,493 h the oil condition retains a high level of anti-oxidants. The used oil after 4,493 h still meet the MIL-PRF-23699 specification for new oil.

#### Gaz de France – France

- 2 x Rolls-Royce/Allison KC (now decommissioned)

at the gas compression station of Taisnières since 1985. The oil monitoring in Appendix III over the period 1990-2001 shows a stable operation for the units. No trace of wear is detected throughout the period

#### TURBOMECA (France)

Turbonycoil 600 is used as standard oil for about 25 Allison 501 KB5/KB7S turbines “packaged” and maintained by TURBOMECA (France). CHP operation by utilities company Dalkia, Elyo and Cofathec (about 4,000 h/year) from 1998 to 2005.

#### COFATHEC (France)

- 2 x General Electric LM 6000 at Gardanne (CHP duty)
- 1 x General Electric LM 6000 at RHODIA Chalampé

#### ELYO (France)

- 1 x General Electric LM 6000 at Nanterre (CHP duty)

#### RETE GAS / SNAM – Italy

- 30 x General Electric LM 2500 on trans-mediterranean pipeline (gas compression).

#### E-ON (UK)

- 2 x LM 6000 at Sandbach and Thornhill

#### ENERGY DEVELOPMENT LTD (UK)

- 2 x Rolls-Royce/Allison 501KB5 using landfill gas at Mucking and Packington



## BRITISH SUGAR (UK)

- 2 x LM 6000 at Wissington sugar factory and Bury St Edmunds

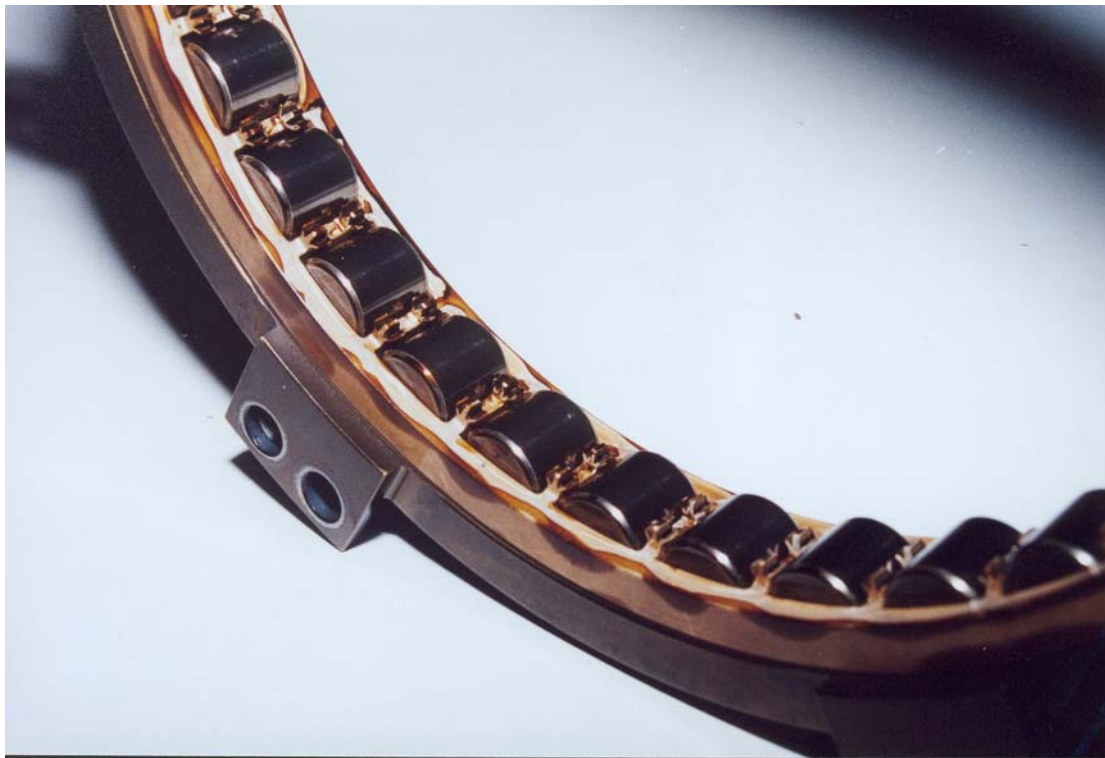
## KRAFTWERK GRENZACH – WHYLEN (Germany)

- 1 x Rolls-Royce RB211 at DSM chemical plant (CHP duty)

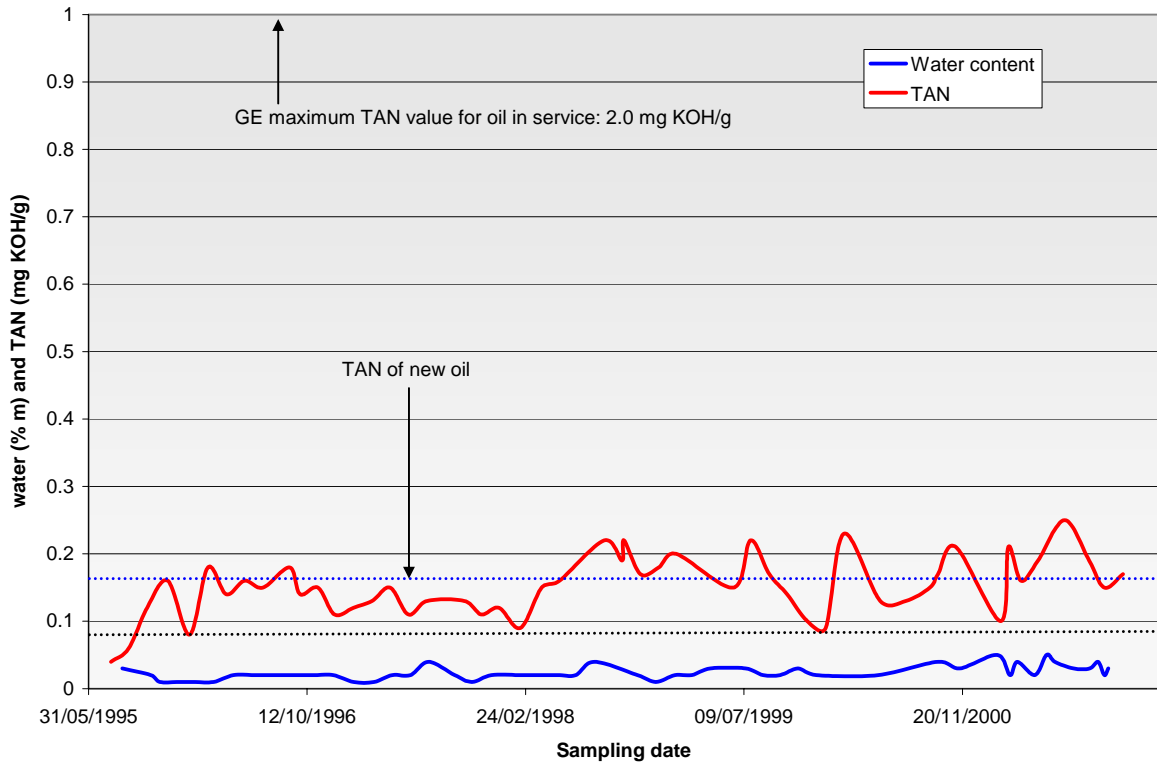
Note: Turbonycoil 600 is also used in North America and Middle-East on many unknown turbine models, the product being supplied through major oil companies or distributors.

TURBONYCOIL 600 has logged in excess of **20 million hours** on industrial gas turbines since 1985.

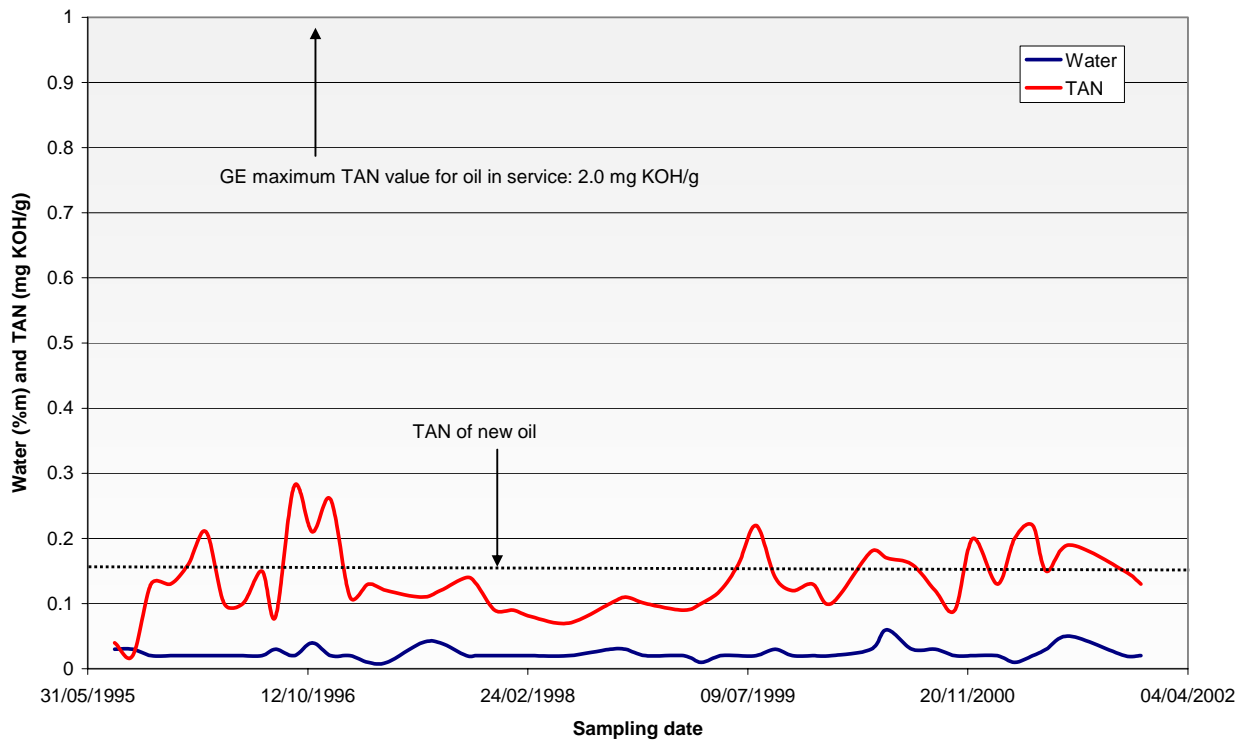
**GENERAL ELECTRIC LM 2500**  
Operated by **STATOIL** Norway



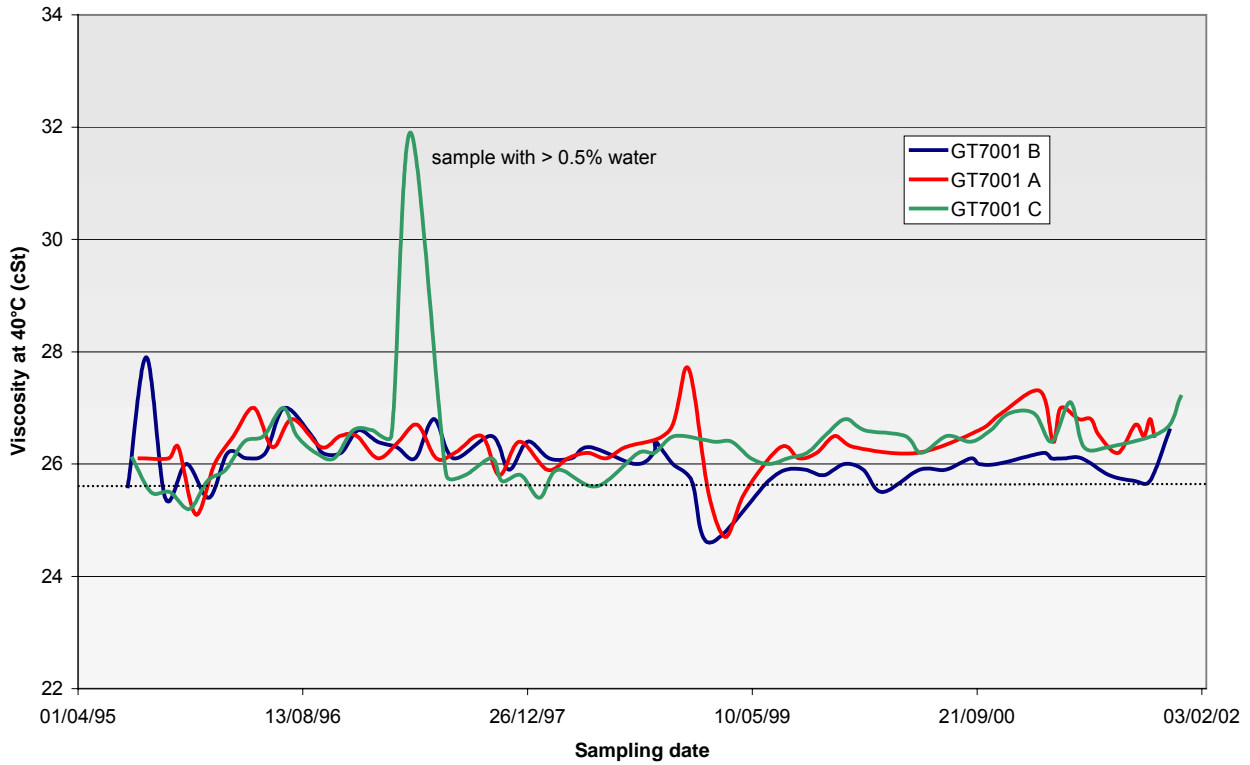
Statfjord C platform - GT7001 B (LM 2500 PC turbine)



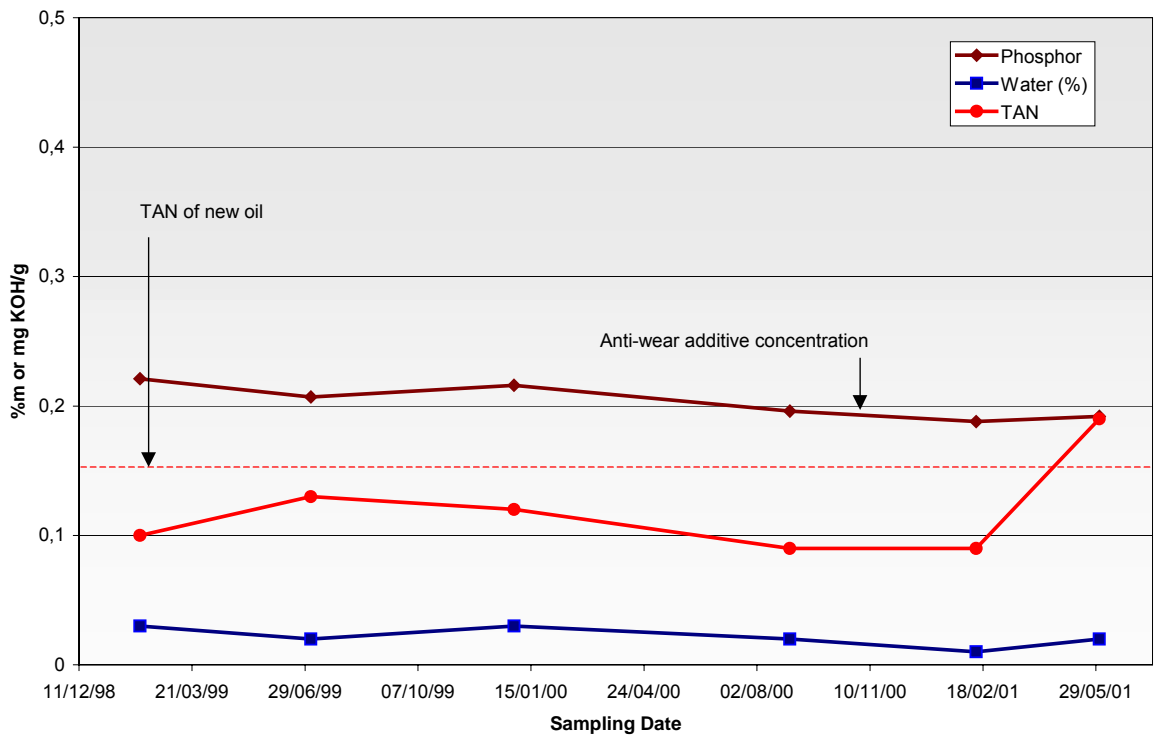
Statfjord C - GT7001 C (LM 2500 PC turbine)



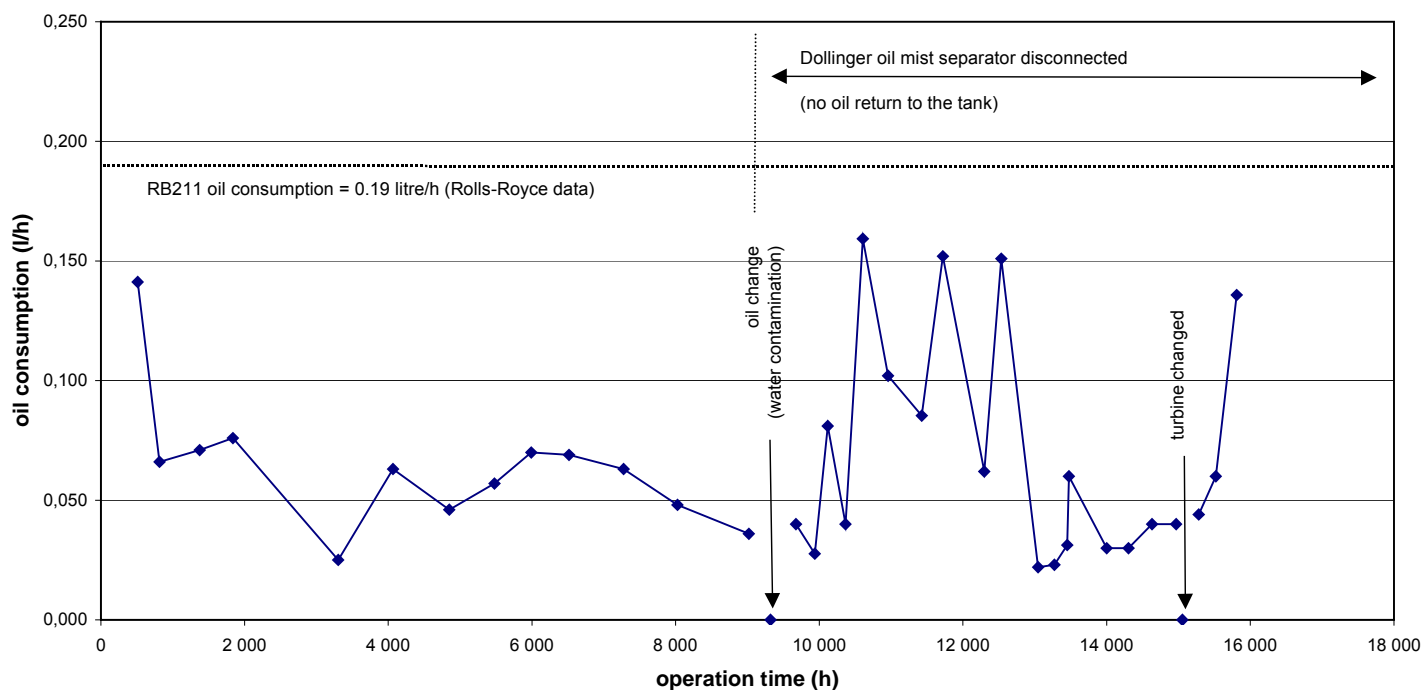
Stafford C - Evolution of oil viscosity for the 3 LM 2500 turbines of GT7001



Norne B platform (North Sea) - LM 2500 turbine / TURBONYCOIL 600



## RB211-24G oil consumption (TOTAL ABK 1996-1998)



## Oil Monitoring on RB211-24G [mechanical drive]

Test	Unit	3,106 h	3,780 h	4,493 h	New TN 600 typical	MIL-23699 specification
Viscosity 40°C	cSt	28.0	27.5	27.8	25.4	mini 23.0
TAN	mg/g	0.59	1.21	0.83	0.19	max. 1.0
Water content	ppm	267	880	370	390	-
Oxidation-corrosion 72 h at 204°C						
Viscosity change	%	-	25.2	23.0	16.5	max. 25.0
Acidity change	mg/g	-	2.2	0.8	1.5	max. 3.0
Δm steel	mg/cm <sup>2</sup>	-	0.0	0.0	0.0	max ±0.2
Δm copper	mg/cm <sup>2</sup>	-	-0.17	+0.2	0.0	max ±0.4
Δm silver	mg/cm <sup>2</sup>	-	-0.02	0.0	0.0	max ±0.2
Δm aluminium	mg/cm <sup>2</sup>	-	-0.02	0.0	0.0	max ±0.2
Δm magnesium	mg/cm <sup>2</sup>	-	-0.10	0.0	0.0	max ±0.2
Deposits	mg/100 ml	-	2.5	1.9	0.0	max. 50.0
Anti-oxidant N°1	% initial	90	95	90	100	-
Anti-oxidant N°2	% initial	75	40	75	100	-
Sulphur content	ppm	7	5	6	0	-

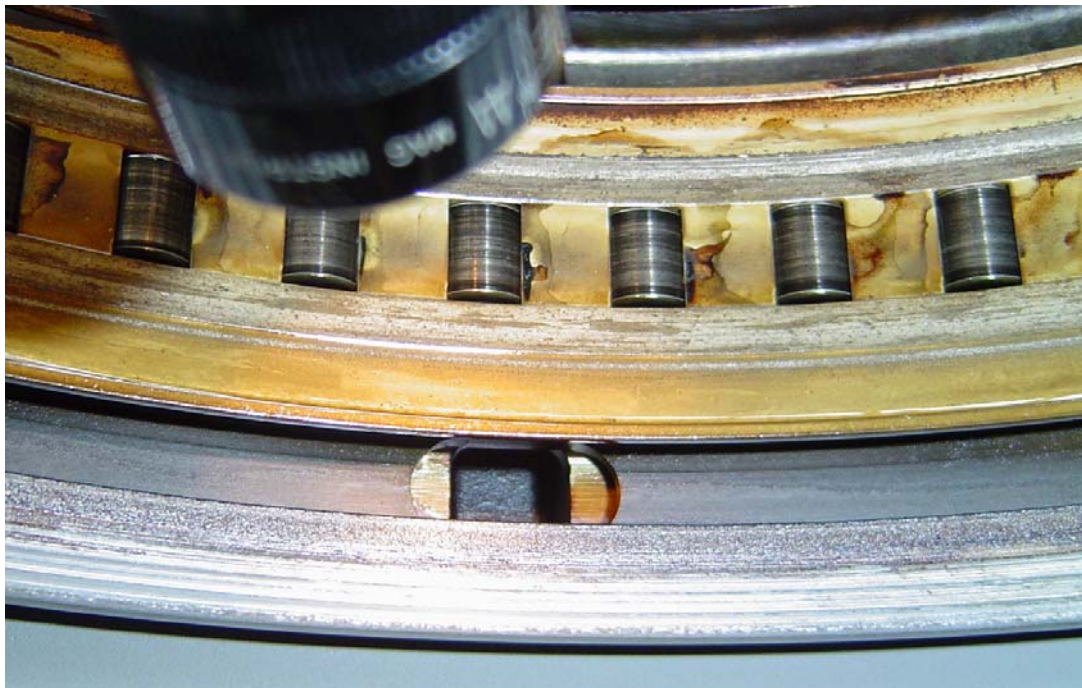
Rolls-Royce limit for oil in service: **2.0 mg KOH/g max.**

## Rolls-Royce RB211-24C

25,954 h since last overhaul, inspected at Rolls-Wood, Aberdeen

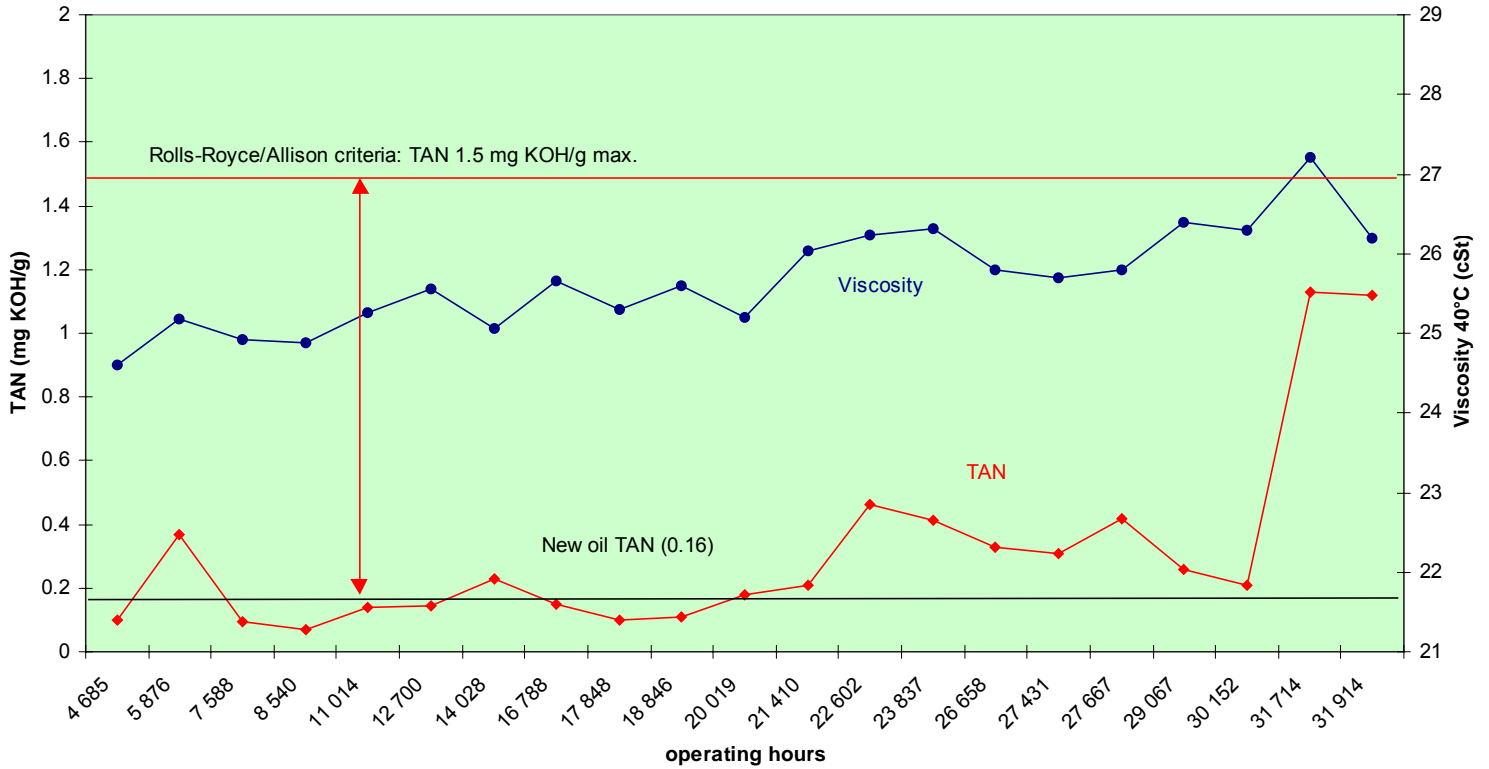


RB211-24C 05 module view (IP turbine top, HP turbine bottom)

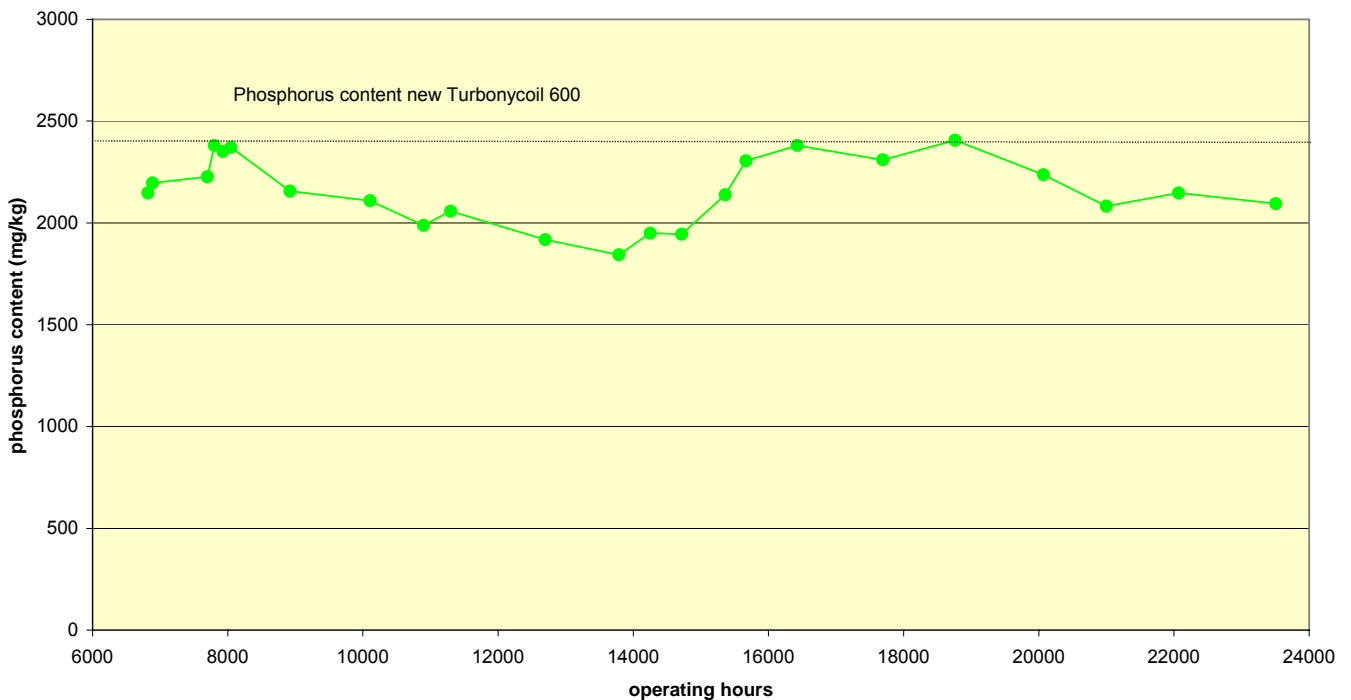


Venting line (HP turbine side), free of coke and deposits

**Allison 501KC (GT3H) Gaz de France compression station  
Oil viscosity and Acid Number monitoring**



**Allison 501 KC (GT4H) Gaz de France Taisnières compression station  
Anti-wear additive depletion monitoring**



## SUMMARY OF TURBONYCOIL 600 MAIN FEATURES

Turbonycoil 600 is approved against the specification MIL-PRF-23699 F Class STD. It is therefore of the same level of performance as Mobil Jet II, BP Turbo Oil 2380 or AeroShell Turbine Oil 500/560. However, it has some distinctive features:

- **Health & Safety**

Aviation turbine oils contain 1-3% of organic phosphate additives (anti-wear). Turbonycoil 600 contains tri-aryl-phosphate (TAP); while competitor oils contain tri-cresyl-phosphate (TCP).

- TAP (CAS 68937-41-7) is not subject to labelling **Xn** (R21/R22 - Harmful)
- TCP (CAS 1330-78-5) is classified as dangerous compound by the European regulations and is subject to the labelling **Xn** (R21/R22 - Harmful) and **N** (R51/R53 – Dangerous for the environment).

As a consequence, Turbonycoil 600 exhibits a significantly better health and safety profile compared to competitor oils.

- **Engine cleanliness/ Coking performance**

The ERDCO Bearing Test is a key test for the assessment of turbine oils. The US Navy has accumulated hundreds of results – which also show a good correlation with the experience in service.

The test includes an actual engine bearing, run at 10,000 rpm and 260°C (bearing temperature) for 100 hours. The bulk oil temperature is 199°C. At the end of the test, the bearing is inspected and each part is rated for deposits/varnish.

Comparative results of Mobil Jet II and Turbonycoil 600 in the ERDCO bearing test are shown in Annex IV. It can be concluded that Turbonycoil 600 is at least as good as Mobil Jet II in coking performance.

The same excellent results are obtained in the **Allison 250 (T63) engine test**, under high cycle conditions with a severe heat soak-back. Once the engine is shut-down, the temperature increases up to 315°C in the hot parts of the engine (N°6/7 and 8 bearings).

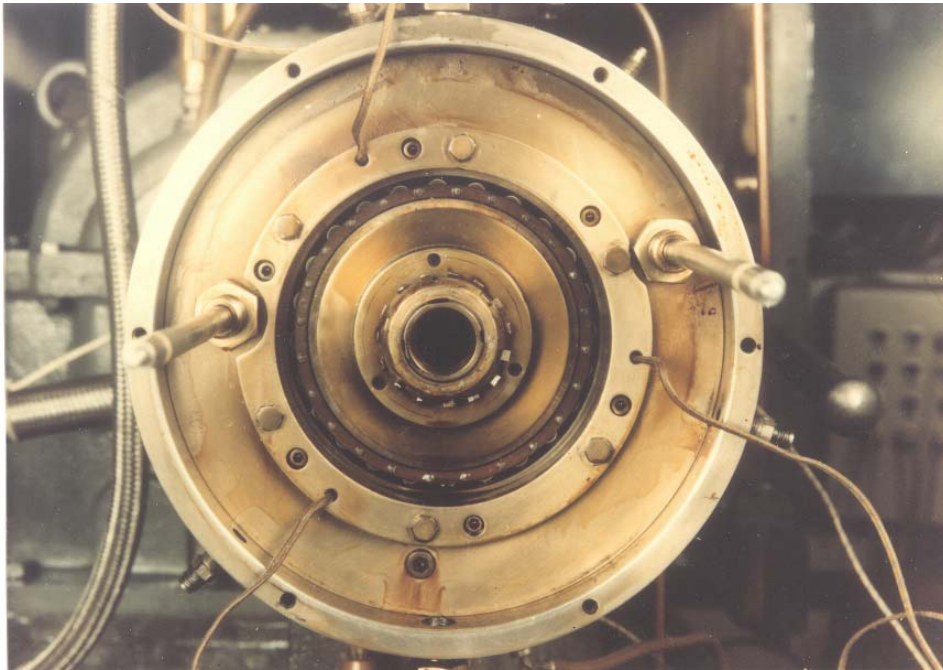
The pictures of Annex V show the cleanliness of the N°8 bearing after 131 cycles (175 h) compared to a reference oil.

# HIGH TEMPERATURE ERDCO BEARING TEST

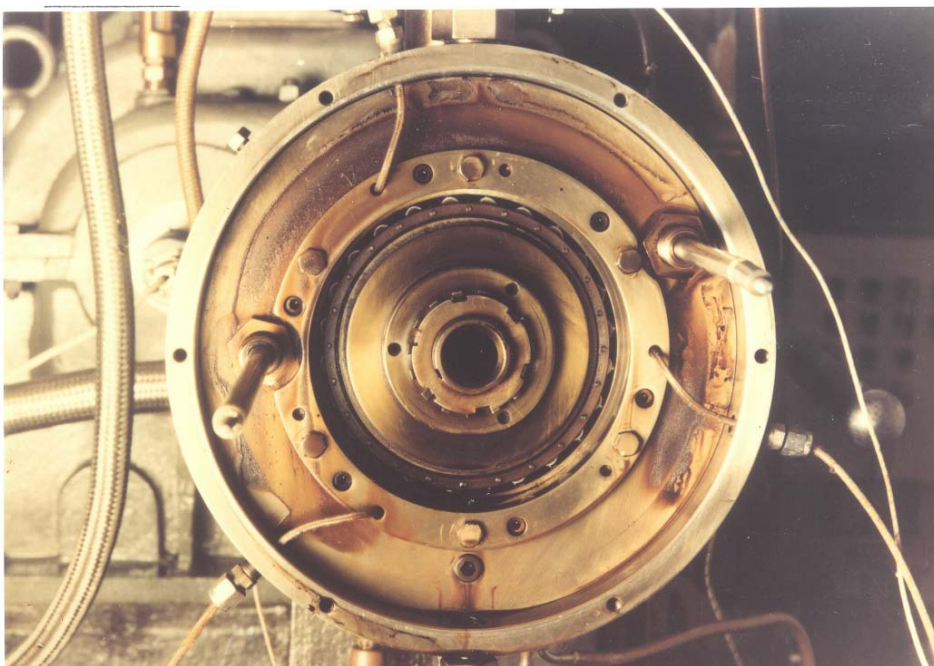
Bearing mount installed, end cover removed

## FRONT VIEW

**TURBONYCOIL 600**



**MOBIL JET OIL II**

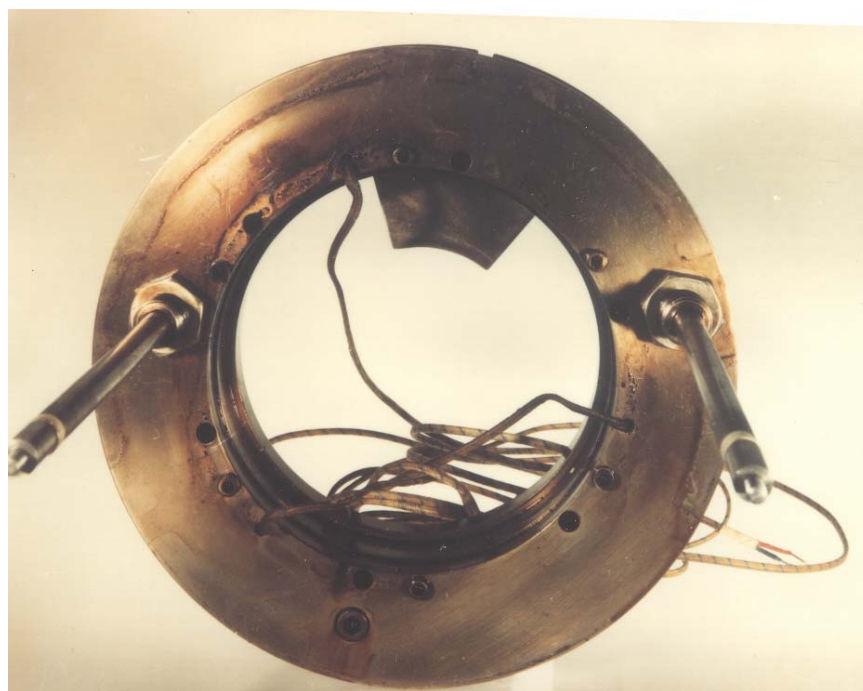


# HIGH TEMPERATURE ERDCO BEARING TEST

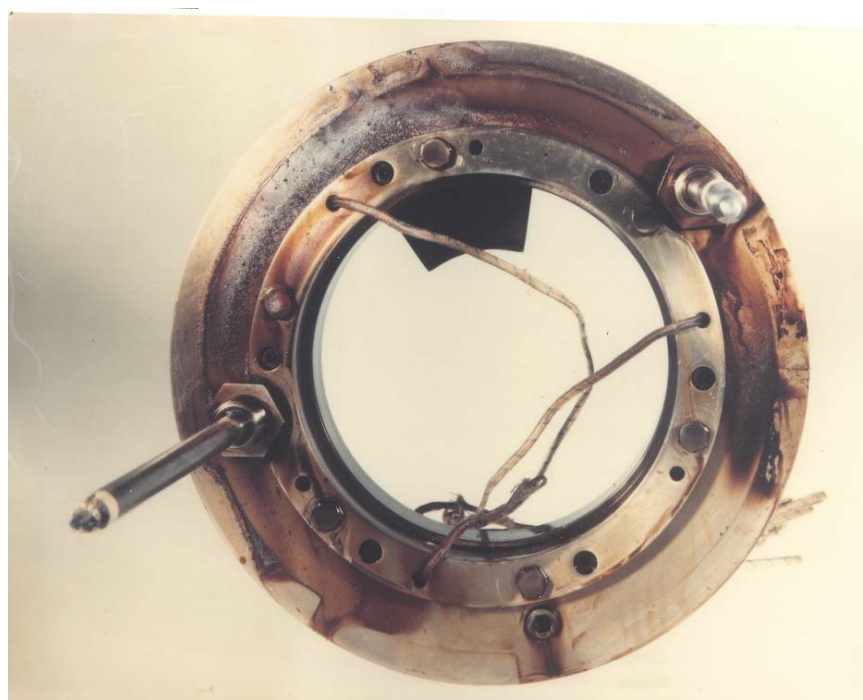
Heater mount

**FRONT VIEW**

**TURBONYCOIL 600**



**MOBIL JET OIL II**



# HIGH TEMPERATURE ERDCO BEARING TEST

Heater mount

**REAR VIEW**

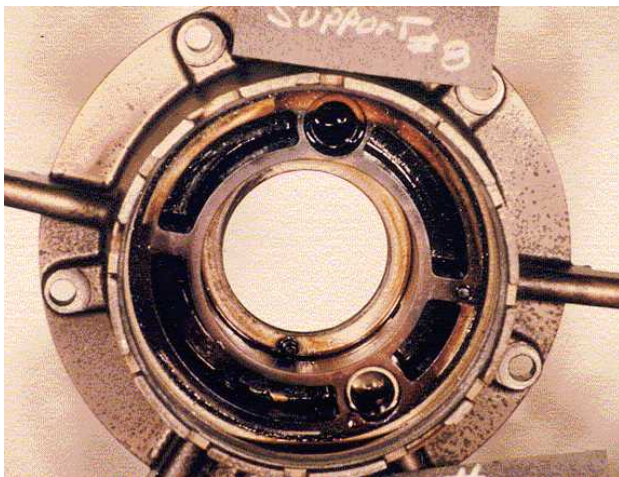
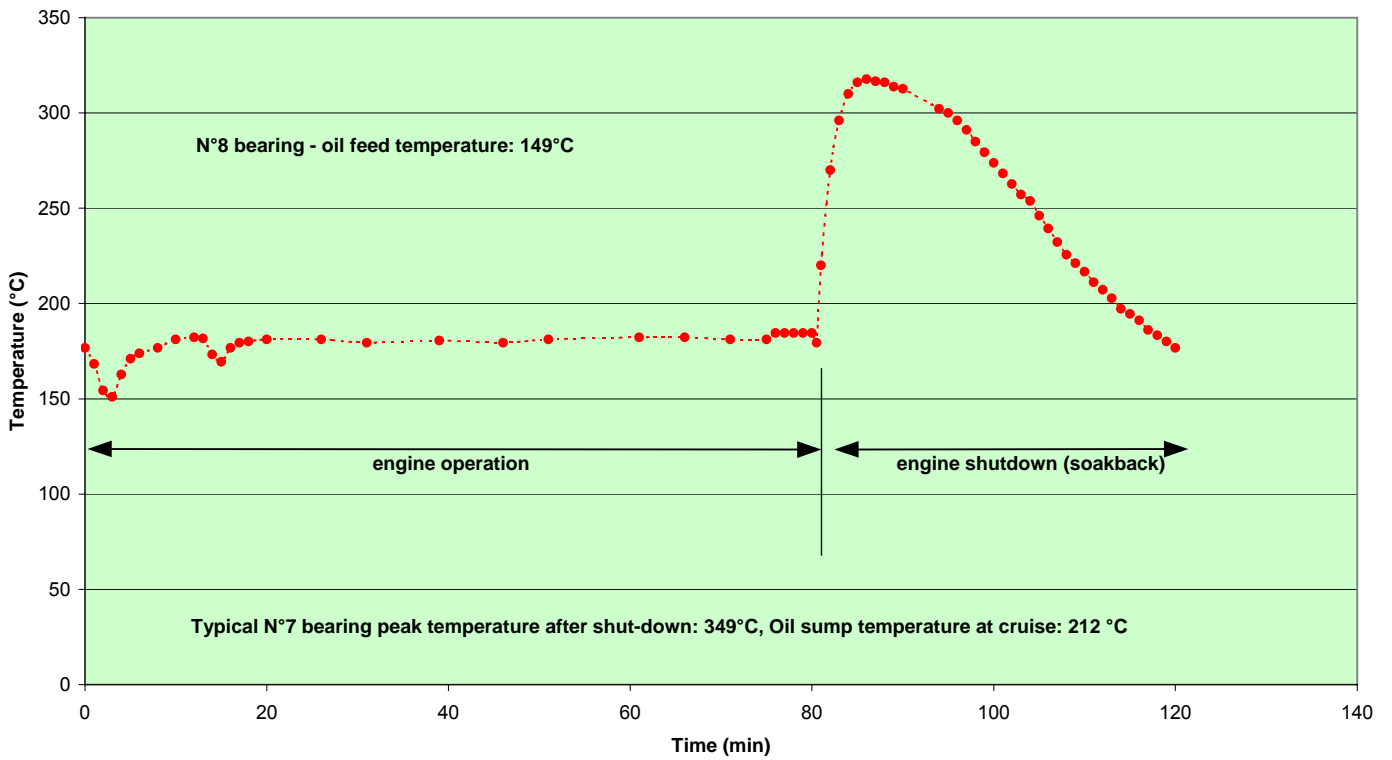
**TURBONYCOIL 600**



**MOBIL JET OIL II**



Allison 250 (T63) - N°8 bearing temperature profile

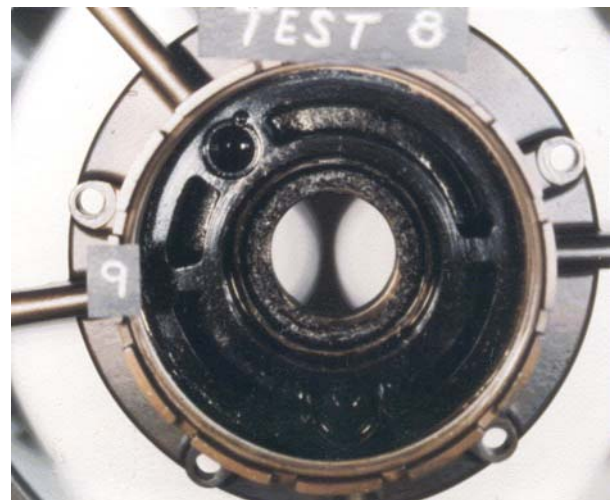


TURBONYCOIL 600

N°8 bearing support (aft view)

REFERENCE OIL

N°8 bearing support (aft view)



30 SEPT. 1985

GENERAL  ELECTRIC

AIRCRAFT ENGINE BUSINESS GROUP

GENERAL ELECTRIC COMPANY • 1 NEUMANN WAY • CINCINNATI, OHIO 45215-6301 • (513) 243-2000

September 19, 1985

Mr. J. Szydywar  
NYCO S.A.  
66, avenue des Champs-Elysees  
51, rue de Ponthieu  
75008 PARIS, France

Subject: TURBONYCOIL 600 (TN600) for GE Marine and Industrial Engines

Dear Mr. Szydywar:

This is in reply to your letter of September 9, 1985. Any lubricating oil listed as **fully qualified to MIL-L-23699C** is thereby considered **as fully approved for all models of General Electric Marine and Industrial derivative aircraft engines** such as the LM1500, LM2500 and LM5000 model engine and others. Therefore, TURBONYCOIL 600 successfully having passed the MIL-L-23699C requirements and listed on the Qualified Product List of MIL-L-23699 is considered as fully approved for these engines. It is strongly urged however, that any operator desiring to use this brand first notify the GE Customer Service representative in advance so that we may maintain cognizance during any controlled introduction and changeover of existing engines to this product.

Sincerely,

*David B. Hester*

David B. Hester

cc: M. Giuliani

kh

A.D. Hynd

GE Industrial AeroDerivative Gas Turbines

Low Emission  
Advanced Lubrication Technologies  
36, Bethlehem Plaza  
Bethlehem, PA 18018

GE Power Systems  
One Northway Way, N155  
Schenectady, NY 12303-1988  
Phone: (513) 552-5704  
Fax: (513) 552-5008

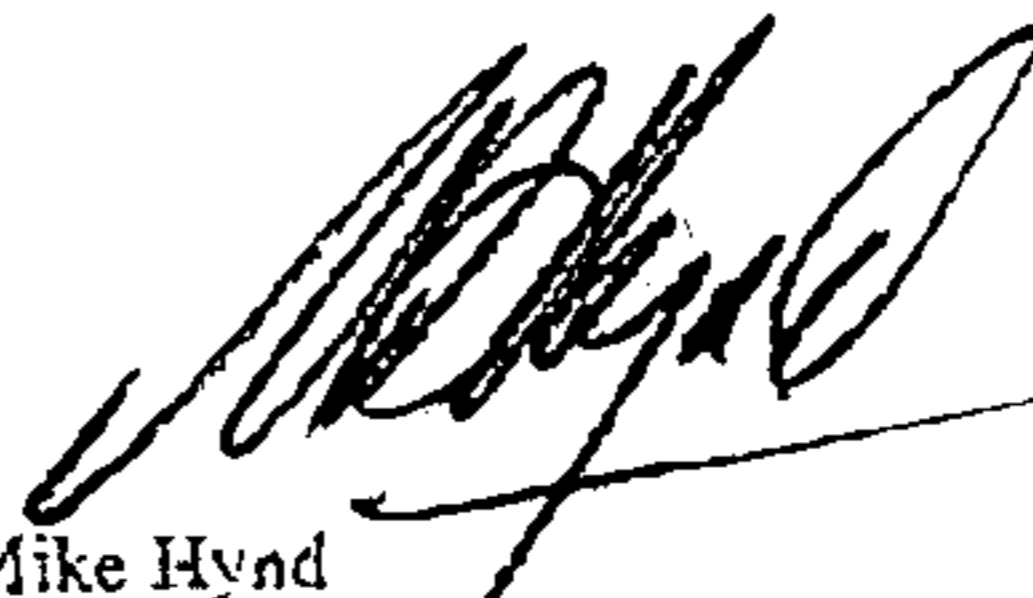
January 23, 2000

Dear Sir,

The attached extracts from the GE IAD (M&I) Installation Design Manuals define the acceptable lubricating oils for the LM2500, LM5000 and LM6000 engine lines. As you can see, lubricants that are listed on the current revision of the Qualified Products Lists for Military Specifications MIL-L-23699 and MIL-L-7808 are acceptable. The same applies to the LM1600 engine except that this engine product line only uses MIL-L-23699. Nyco brand oils are of course listed on those QPL. Re-brands of European qualified lube oils (including Nyco) that are not listed separately on the QPL have been approved for LM engines on a case by case basis when certified by the original manufacturer.

Change over from one approved brand to another within a specific oil viscosity type is acceptable and should be accomplished by "topping up" rather than a complete drain of the system whenever possible. Changing over from MIL-L-23699 to MIL-L-7808 and vice-versa would, however, require a complete drain, flush and replenishment procedure.

I trust that this explains the current GE IAD process for using approved oils in the field, if you have any further questions do not hesitate to ask.



Mike Hynd  
Technical Program Manager  
LM2500/LM2500+ Projects

Ph: 513-552-5704  
Fax: 513-552-5008



INDUSTRIAL POWER GROUP

## ROLLS-ROYCE INDUSTRIAL & MARINE GAS TURBINES LIMITED

Ansty, Coventry CV7 9JR  
Telex: 37645, Fax: 01203 624666  
Telephone: 01203 624000

*Direct Dial* 01203-623210

26th November 1996

*Fax:* 01203-623047

NYCO S.A,  
51, rue de Ponthieu,  
75008,  
Paris,  
FRANCE.

For the attention of Mr. J. Szydywar

Dear Mr. Szydywar,

### TURBONYCOIL 600

I can confirm that **TURBONYCOIL 600** has now been formally approved for use in all marks of Industrial RB211 and AVON engines.

The Rolls-Royce "Fuels and Oils Guidance Notes" will be up-issued in due course to reflect the above additions.

Yours faithfully,  
for Rolls-Royce Industrial & Marine Gas Turbines Limited,

*N. Suthar*

NILASH SUTHAR  
RELIABILITY ENGINEERING.

# INDUSTRIAL SERVICE LETTER



## APPROVED LUBE OILS FOR INDUSTRIAL ENGINES

## EFFECTIVITY:

This letter applies to all Rolls–Royce Corporation industrial gas turbine engine models. Note to all Authorized Maintenance Centers and Distributors: Please ensure that this letter is distributed to all affected operators.

## REASON:

The following oils have been laboratory approved and service evaluation qualified for use in the Rolls–Royce Corporation Industrial engine model(s) designated below.

## DESCRIPTION:

The following lube oils are listed for use in the Rolls–Royce Corporation industrial gas turbine engine models indicated:

Vendor	Oil Brand Name	Engine Models		
		501–K	601–K	570/571–K
Air BP	BP Turbo Oil 2380 (Formally “Exxon Turbo Oil 2380”)	X	X	X
	BP Turbo Oil 2197** (Formally “Exxon Turbo Oil 2197”)	X		
Anderol Inc. Box 518 215 Merry Lane East Hanover, NJ 07936	ROYCO 500	X	X	X
Caltex House, Las Colinas P.O. Box 619500 Dallas, TX 75261–9500	Caltex Sato 5S	X	X	X
Castrol Industrial North America Specialty Products Division 1001 West 31st Street Downes Grove, IL 60515	Castrol 5000	X	X	
	Castrol 5050	X	X	X
	Castrol Aerojet 5*	X		
	Perfecto GT5 (2)	X (2)		
Conoco, Inc. 600 N. Dairy Ashford Houston, TX 77079 Attn: Lubricants Customer Service Group	Conoco SynXPA Jet II Turbine Oil		X	X
ELF Lubrifiants Tour ELF – Place de la Coupole Cedex 92078 Paris–la–Defense, France	ELF Turbojet II (1)	X (1)		
Exxon Company, USA P.O. Box 2180 Houston, TX 77001	Esso Turbine Oil 2380	X	X	X
	Exxon ETO 2197**	X		
	Exxon Turbine Oil 2380	X	X	X

# Rolls–Royce Corporation Industrial Service Letter

<u>Vendor</u>	<u>Oil Brand Name</u>	<u>Engine Models</u>		
		<u>501–K</u>	<u>601–K</u>	<u>570/571–K</u>
FINA Europe Lubricants Bombardementstraat, 15 9940 Evergem Evervelde, Beligique	FINA BAKOLA SE (1)	X (1)		
Hatco Corp. King George Post Road Fords, NJ 08863	Hatcol 3211		X	X
	Hatcol 3611	X	X	X
ExxonMobil Oil Corp 3225 Gallows Road Fairfax, VA 22037  (Oils formally sold by Mobil)	Mobil Jet Oil II	X	X	X
	Mobil Jet Oil 254**	X	X	X
	Mobil SHC 824 (3)	X(3)		
NYCO S.A. 66, Avenue des Champs–Elysees 75008 Paris, France	NYCO Turbonoycoil 600	X		
Shell Aviation , Ltd. Shell–Mex House Strand London WC2R OZA	Aeroshell 500	X	X	X
Texaco Technology Ghent Technologiepark – Zwijinaarde 2 B–9052 Gent, Belgium	Texaco Regal SGT 22	X		

\*Oils with high detergent action, conforms to MIL–PRF–23699 Grade CI (Corrosion Inhibiting).

**NOTE:** Corrosion inhibiting oils provide increased corrosion protection to engine bearings and components. This may provide beneficial protection in marine, coastal and offshore applications. High detergent action oils will loosen carbon deposits present in the engine and skid oil system, causing potential blockage of oil passages, possibly leading to failures due to loss of lubrication. New installations may utilize a high detergent oil on initial fill. Existing installations require that the engine be new or newly overhauled (no carbon deposits in the engine) and changed by topping off only. Close monitoring of the skid lube oil filter pressure drop and frequent changeout of dirty filter cartridges is required.

\*\*Oils that conform to MIL–PRF–23699 Grade HTS (High Thermal Stability). Recommended for use in the 501–KB7, 501–KB7s, and 501–KC7 models of Rolls–Royce engines.

**NOTE:** Rolls–Royce strongly recommends the use of HTS oils in 501–KB7S, 501–KB7 and 501–KC7 engines due to the severity of service. Rolls–Royce recommends the use of HTS oils for all other engines, such as the 501–KH5, where standard oils have not provided satisfactory service. HTS oils provide added thermal protection and reduced deposition. New installations may use an HTS oil on initial fill. Existing installations should be changed by draining, flushing and refilling with new oil. It is important to remove as much of the standard oil from the system as is possible. Mixing an HTS oil with a standard grade oil will diminish the capabilities of the HTS oil to the point where it will perform at the standard oil level. Therefore it is not recommended to change to an HTS oil by topping off. While these oils do not have high detergent action, there is always some risk that existing engine deposits could become loosened by the new oil and plug an oil passage or vent line. Therefore it is recommended that a change to an HTS oil be made in conjunction with the installation of a new or newly overhauled engine.

## Rolls–Royce Corporation Industrial Service Letter

- (1) Withdrawn from market.
- (2) May only be used for 501–KA, KB, and KC model of Rolls–Royce engines. These specific engine models are operated at a maximum firing temperature of 1800° F Turbine Inlet Temperature.
- (3) Polyalphaolifin based oils are not compatible with and can not be mixed with any other oil on this list. This oil may only be used for 501–KA, KB, and KC model of Rolls–Royce engines. These specific engine models are operated at a maximum firing temperature of 1800° F Turbine Inlet Temperature.

### INTERCHANGEABILITY:

Other than noted above, changing from one brand of approved and qualified oil to another can be accomplished by topping off with the new oil as oil is used by or lost from the oil system. You may wish to consult with the oil vendor if you have a concern about compatibility. The changeover may also be made by draining, flushing, and refilling with new oil.

CUSTOMER SUPPORT  
ROLLS–ROYCE