

Revolution
in
Revolutions

DESIGNED TO MEET CHALLENGES



Shell Lubricants



Industry needs reliable and affordable power

The power industry is changing, driven by the need for technical innovation and increased competition. But some things remain constant - such as the continued need for reliability, capacity and profitability. Reliable output requires reliable input, so your choice of turbine lubricating oil can make a real difference. It needs to be able to cope with more stresses than ever, including:

- Increases in power output
- Higher firing temperatures on gas turbines
- Single shaft configurations

- Changes in reservoir design
- Smaller gear sizes
- A move more towards peaking rather than base load power

The ability of turbine oils to perform effectively depends largely on the fluid type, the base oil quality and the exact formulation. Using a high-performance and specifically designed turbine oil will enable your turbines to operate with greater reliability in today's tough operating environments.

Turbine lubrication requirements

Turbine Feature	Lubricant Performance	Lubricant Feature	Lubricant Technology
Bearings	Hydrodynamic lubrication	Viscosity, Viscosity index	Base oil
Steam/water	Corrosion resistance, Water-shedding	Anti corrosion	Rust inhibitors, Base oil
Heat	Cooling	Oxidation stability	Base oil, Anti-oxidant
Gears	Anti-wear	Extreme-pressure performance	Anti-wear additives
Design	Release trapped air, Low foaming	Air-release value, Foaming	Base oil, Defoamer
Hydraulics	Filter compatibility	Filterability	Base oil and additive interactions

Shell: expert in turbine lubrication

Shell is itself one of the leading operators of rotating equipment. We recognize that maximizing output and minimizing downtime are vital within the power industry. So we innovate to develop market-leading products. We benchmark the output of equipment and machines and work in partnership with OEMs worldwide to deliver lubrication solutions combining our technological, product

and people expertise. Shell offers a comprehensive range of turbine oils designed to meet the challenges of today's power generation environment.

When combined with extensive service and advisory capabilities, Shell's approach to lubrication can play a major role in increasing equipment availability and reducing your maintenance costs.

Shell Turbo Oils CC

next generation turbine oils with improved deposit resistance

Varnish (or lacquer) formation in servo-valves has been shown to cause the valves to stick or seize. This leads to unit alarms, trips or fail-to-start conditions. Another costly concern is the formation of varnish on thrust or journal bearings, which can cause increased wear rates. Other problems include reduced cooling performance, increased bulk oil temperatures, prematurely plugged filters and strainers, and blocked small oil orifices.

The causes of varnishing are varied, and include:

- Extreme oxidative stresses from elevated operating temperatures
- The use of fewer polar Group-II and Group-III base stocks
- Spark discharge from mechanical filters
- Cyclic or peaking duty cycles
- Unsuitable turbine oil additive chemistries

Launched globally in 1997-98, this was the first Shell turbine oil range designed specifically for use in combined-cycle systems and has performed to great effect since its introduction. Shell Turbo Oils CC have been redeveloped to combat above mentioned problems and meet the severe demands imposed by modern, heavy-duty turbine applications. This new turbine lubrication technology offers a revolution in deposit resistance, setting a new standard for the industry.

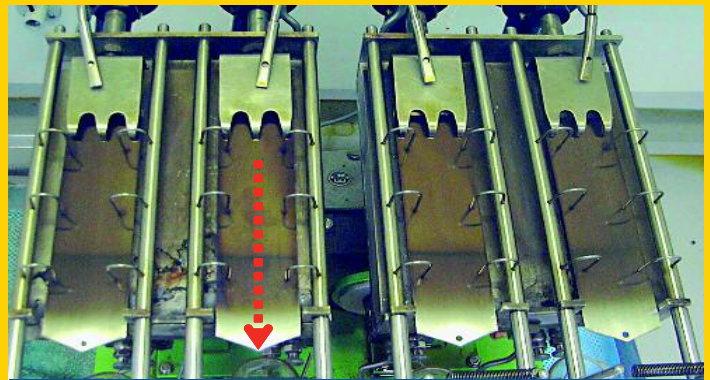
Next generation Shell Turbo Oils CC offer:

Extended oil life, less maintenance and less downtime through outstanding oxidation stability and RPVOT retention in combination with optimized RPVOT value.

Increased turbine reliability and availability through long-term sludge and deposit resistance - best performers in Shell's severe high temperature in-house deposit test.

Extra protection through rapid air release, high resistance to foaming, and excellent water-shedding properties.

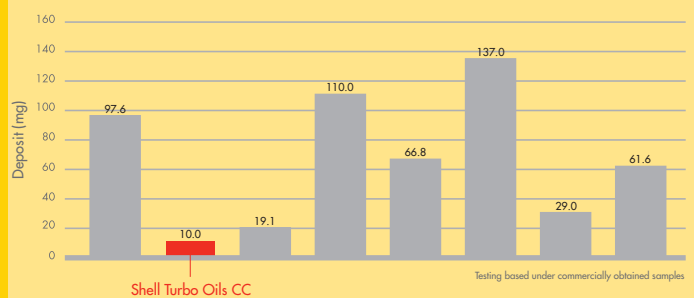
Good load carrying capacity making them suitable for use in turbines with highly loaded gears.



Test conditions: steel plate at >200°C (>392°F) - 24 hours

- Increased turbine reliability and availability through long term sludge and deposit resistance
- Best performer in Shell's severe high temperature in-house deposit test

Shell Turbo Oils CC shows the best deposit resistance at high temperatures



Tried, tested and proven...

For over 60 years, Shell has been investing in the development of industrial lubricants. With products working in a wide range of applications and environments in over 100 countries, Shell continues to innovate to meet the changing demands of the industry.

Here's what our customers say:

"I rate Shell Turbo Oils CC as a high quality oil that can cope with the extreme demands in power generation. With the experience we have with the product so far I can absolutely recommend the product to other power plants and for other applications."

Mr. Kurt Hammer, Plant Manager at Cottbus power plant, operating ABB (now called Alstom) steam turbines and an Alstom gas turbine.



Shell Turbo Oils T

industry standard turbine oils

Shell Turbo Oils T have been used in turbines worldwide for the last 60 years. They have been continuously improved to anticipate industry needs, and offer high performance to meet today's challenges, such as:

- Increases in steam turbine operating capacity and efficiency
- Higher temperatures and steam pressures
- Decreasing unit sizes

Shell Turbo Oils T offer:

Extended service life, and hence lower costs through high resistance to oxidative degradation, especially in hot applications where oil life can be limited.

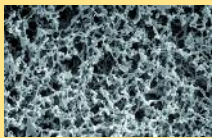
Lower risk of unplanned maintenance through excellent water-separation properties, giving protection from corrosion and other damaging effects of water circulating in the system.

Greater plant reliability thanks to outstanding resistance to foaming.

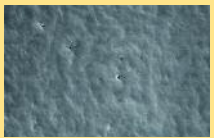
Reduced filter maintenance and extended service intervals as Shell Turbo Oils T are much more tolerant than many oils to the traces of contamination which can often lead to blocked filters.

Reliable operation and reduced safety risk from control valve deposits as the oxidation stability of Shell Turbo Oils T provides resistance to the formation of sludge and deposits.

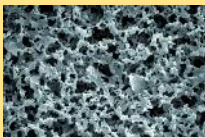
Measuring filterability with Shell in-house test method, wet and with calcium (TMS 511)



Blank filter membrane (0,8µm)

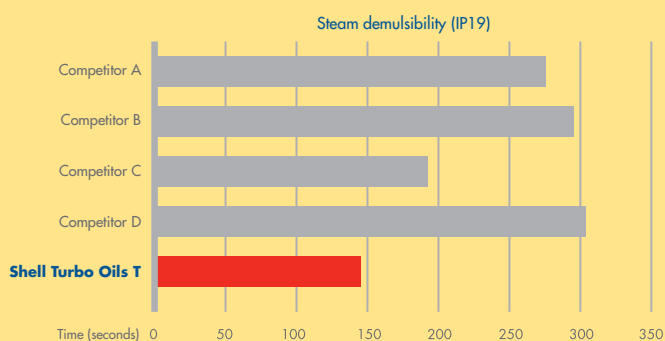


Oil with acidic components



Shell Turbo Oil T

Shell Turbo Oils T, best in class, quick water separation



Shell Turbo Fluids DR

fire-resistant fluid for electro-hydraulic governor control systems

Shell Turbo Fluid DR is a high-performance fire-resistant hydraulic fluid that minimizes risks associated with:

- Possible ruptures or leaks of high-pressure lines operating steam valves and governors
- Auto-ignition of hydraulic fluid due to contact with high temperature steam pipes or turbine casings

Shell Turbo Fluid DR is a synthetic phosphate ester-based product developed to minimize the propagation of flames associated with the burning of hydraulic fluid. It is designed for use in steam turbine electro-hydraulic governor control systems, including systems using fine-tolerance servo valves.

Shell Turbo Fluid DR offer:

Safety from spread of fire and possible harm to people and assets through its fire-resistant and self-extinguishing properties.

Extended fluid life through excellent oxidation stability and reduced waste disposal costs.

Fine control even at high pressures through excellent hydraulic fluid performance.

Prevention of electrochemical erosion of the hydraulic control system through high fluid resistivity.

Shell Turbo Fluid DR is approved by key Industry bodies, equipment manufacturers and Factory Mutual.

Shell Turbo Oils GT

top-performance synthetic hydrocarbon gas turbine oils

Shell Turbo Oils GT were first launched in 1994 and have amassed many thousands of successful running hours in several different gas turbines worldwide. The unique formulation, blended with Group III base oils, enables it to perform consistently well in modern-day conditions that include:

- Increased power outputs and efficiency
- Higher bearing temperatures resulting in greater thermal stress on oil
- Fewer oil changes

Shell Turbo Oils GT offer:

Optimized oil life through excellent oxidative stability, providing favourable service life, and hence lower costs, especially in hot bearing applications where oil life can be limited.

Increased turbine reliability and availability through excellent thermal stability, providing greater protection against thermal degradation.

Maintained turbine efficiency through the benefit of fluidity at lower start-up temperatures with lower frictional losses and superior cooling properties at high bearing operating temperatures.

Shell Turbo Oil GT:

The right oil makes all the difference. Gear box thrust bearing.



After 16,500 running hours on a mineral turbine oil

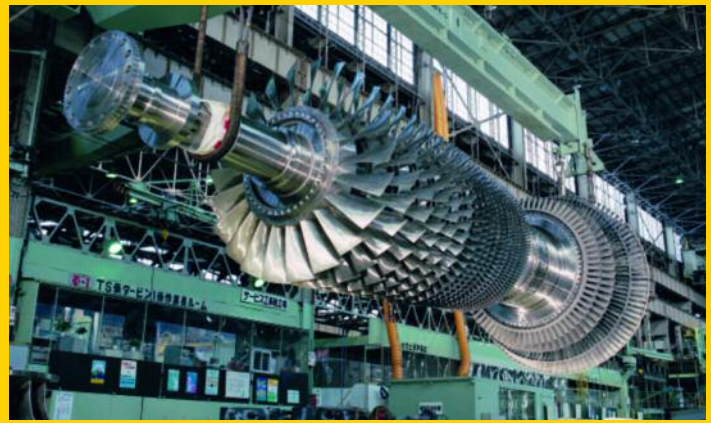


After 30,000 running hours on Shell Turbo Oil GT 32

Tried, tested and proven...

"Next year we will have reached the technical life time of our FIAT gas turbine. For every new gas turbine we will install, we are absolutely convinced of Shell's turbine oils, and I will strongly recommend Shell Turbo Oils GT for our next Gas Turbine."

Mr. Frans de Milliano, Technologist Rotating Equipment of Yara Sluiskil B.V., The Netherlands.



Shell Turbo Oils J

industry-standard turbine oils designed to meet MHI's requirements

Shell Turbo Oil J has been specially formulated to satisfy the demanding requirements of the MHI (Mitsubishi Heavy Industry) manufactured non-g geared steam and gas turbines.

Shell Turbo Oil J offer:

Extended oil life through reduced deposit-forming tendencies relative to other oils in the newly emerging industry dry TOST test. This reduces oil service costs, especially in hot applications where oil life can be limited.

Less filter maintenance as Shell Turbo Oil J is much more tolerant than many oils to the traces of contamination which can often lead to blocked filters. This means extended service intervals, reduced maintenance costs and greater confidence in oil performance.

Improved plant reliability as Shell Turbo Oil J has outstanding resistance to foaming and offers rapid air release. This gives you good defence against pump cavitation, oil pressure drops and lubricant starvation.

Lower risk of unplanned maintenance through excellent water separation properties, giving protection from corrosion and other damaging effects of water circulation in the system.

Reduced oil analysis costs through ability to control sludge formation, even in severe gas turbine applications. This allows the use of conventional turbine oil condition monitoring practices and makes the use of extra test to monitor the concentration of sludge precursors superfluous.

Shell Turbo Oil J 32 shows low sludging tendency, within MHI specified safety zone.

Shell Turbo Oil J exceeds the major steam turbine manufacturers' lubricant specifications and is approved by MHI according to their specifications: Turbine Oil Type 2 (additive) MS04-MA-CL001 (R-1) and MS04-MA-CL002 (R-1).

SHELL TURBINE OIL PORTFOLIO

	Hydro Turbines	Steam Turbines	Gas Turbines	Combined-cycle Turbines
Fire-resistant fluid for electro-hydraulic governor control systems		Shell Turbo Fluid DR		
Top performance synthetic hydrocarbon turbine oils with proven deposit resistance, bearings run cooler, stronger oil film			Shell Turbo Oils GT	
Next generation premium quality industrial gas, steam & combined cycle turbine oils with improved deposit resistance and extra FZG for geared turbines		Shell Turbo Oils CC		
Industry standard turbine oils designed to meet MHI's requirements		Shell Turbo Oil J		
Industry standard turbine oils for steam, hydro and non-geared gas turbine applications	Shell Turbo Oils T			

Full Factory Plant Maintenance product range

Shell also manufactures a full range of factory plant maintenance products designed to give you improved protection, longer service life and reduced wear.

Hydraulic oils	Shell Tellus	A complete range of hydraulic oils for stationary and mobile applications
Compressor oils	Shell Corena	High-quality compressor oils
Bearing & circulating oils	Shell Morlina	Premium-quality bearing & circulating oils available in a wide range of viscosities for a large number of industrial applications
Industrial greases	Shell Albida and Alvania	High-performance industrial greases
Electrical Oils	Shell Diala	High-quality transformer oils

Local product portfolio might vary slightly. Please consult your Shell representative for more information.
Photography cover and Shell Turbo Oil J: courtesy of MHI. Other photography: courtesy of Siemens AG.

For more information, contact:

Shell
TURBO
Turbine Oils



Shell Lubricants

www.shell.com