FIVE TIPS FOR TURBINE OIL SYSTEM CARE AND MAINTENANCE

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SHELL LUBRICANTS
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AVOIDING UNPLANNED DOWNTIME

One of the biggest concerns among turbine users is unplanned downtime. Although oil quality is critical to successful turbine operation, proper system maintenance is equally important to avoid this disruptive and costly scenario. Poor system maintenance will lead to

- shorter lubricant life
- more oil wasted
- shorter turbine bearing life
- increased unplanned downtime
- lower profit per kilowatt of power generated.

Below are five steps you can take to get the most out of your turbines and keep them operating at their maximum efficiency.

1. KEEP IT CLEAN

Turbine oil cleanliness is key to ensuring the longest equipment and lubricant life. Particulates, the most damaging of contaminants in lubricating oil, can significantly

- reduce the life of bearings and gears
- affect servo valve operation
- promote system foaming.

Contamination can arise from several sources, both internally and externally, and may result in the formation of deposits and varnish. That is why you need to inspect your system frequently and ensure that your filtration system is in full working order.

2. OIL AND TOO MUCH WATER DO NOT MIX

Although maintaining low particulate levels is critical, water is also a destructive contaminant. If water cannot separate from the oil, free water or an oil-in-water emulsion is created and may interfere with the oil film needed to support the loads carried by the bearings. Water can promote rust and corrosion, speed up the rate of oil oxidation and promote other degradation processes such as hydrolysis. Water levels should be monitored using a good oil analysis programme. Water contamination limits should be checked against manufacturers' recommendations but, in general, water levels should be kept below 500 ppm for gas turbines and 1,000 ppm for steam turbines.

3. ANALYSE YOUR OIL

All turbine oils should be subjected to a proactive oil analysis monitoring. Many published turbine oil condition monitoring guidelines are available from ASTM, ISO and various equipment manufacturers and lubricant suppliers. A typical schedule for testing is shown below.

4. LEAKAGE ALERT

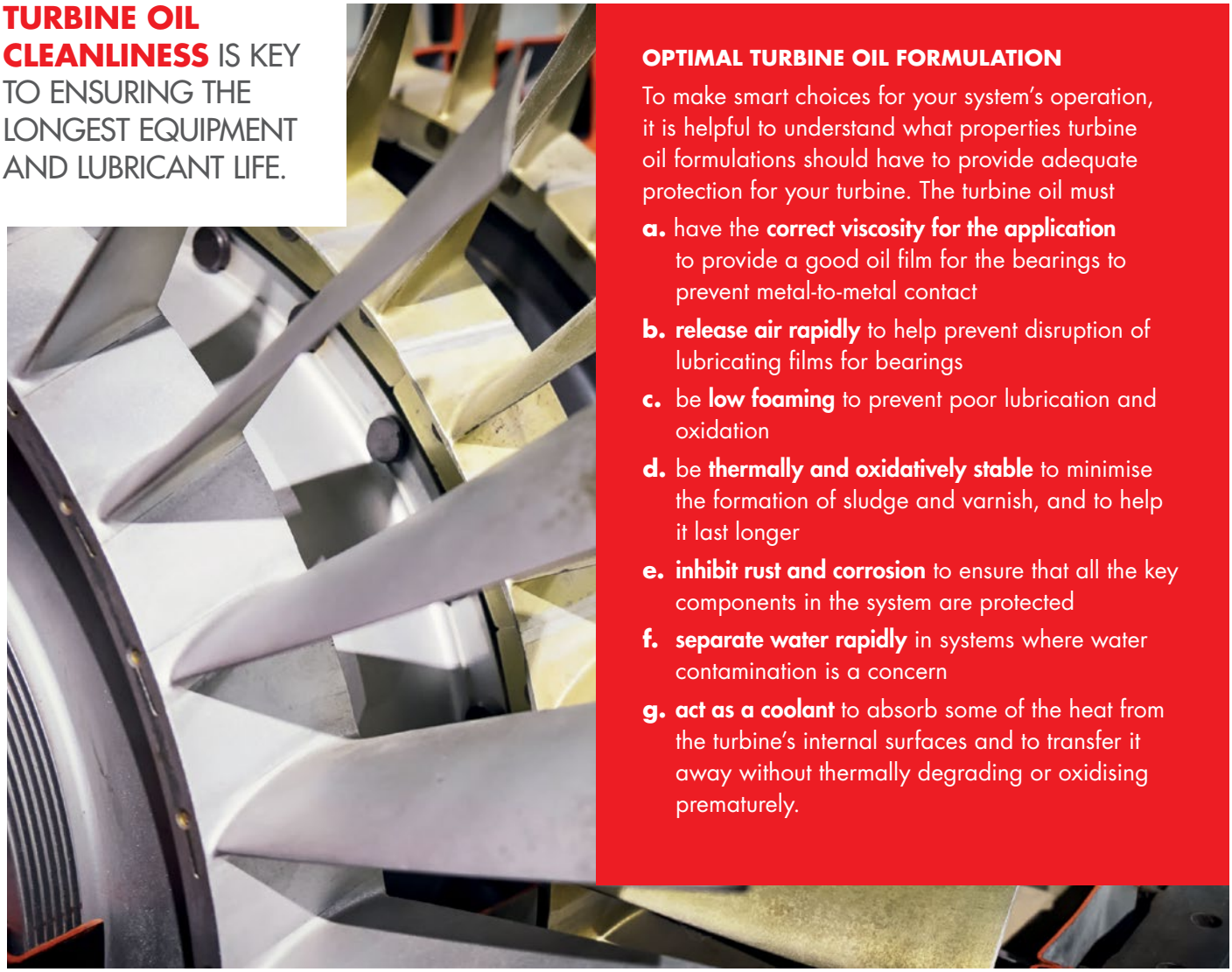
It is critical to trace any oil leaks to their source and to eliminate them as soon as possible. The following culprits are common sources:

- bearing seals
- oil-supply lines
- valve connections
- cooler tube joints.

5. MAINTAIN ACCURATE RECORDS

- **Temperature.** Keeping records of the following temperatures will alert you to sudden changes to enable quick investigation:
  - oil and water to and from the coolers
  - oil in reservoirs
  - oil return from main bearings
  - oil inlet to purification equipment.
- **Operations.** It is also important to keep operating records of
  - turbine operating hours
  - oil condition, laboratory results and service hours
  - time and amount of make-up oil added to system
  - time of filter changes and service hours
  - any repairs or replacements.

TURBINE OIL CLEANLINESS IS KEY TO ENSURING THE LONGEST EQUIPMENT AND LUBRICANT LIFE.



OPTIMAL TURBINE OIL FORMULATION

To make smart choices for your system's operation, it is helpful to understand what properties turbine oil formulations should have to provide adequate protection for your turbine. The turbine oil must

a. have the **correct viscosity for the application** to provide a good oil film for the bearings to prevent metal-to-metal contact

b. **release air rapidly** to help prevent disruption of lubricating films for bearings

c. be **low foaming** to prevent poor lubrication and oxidation

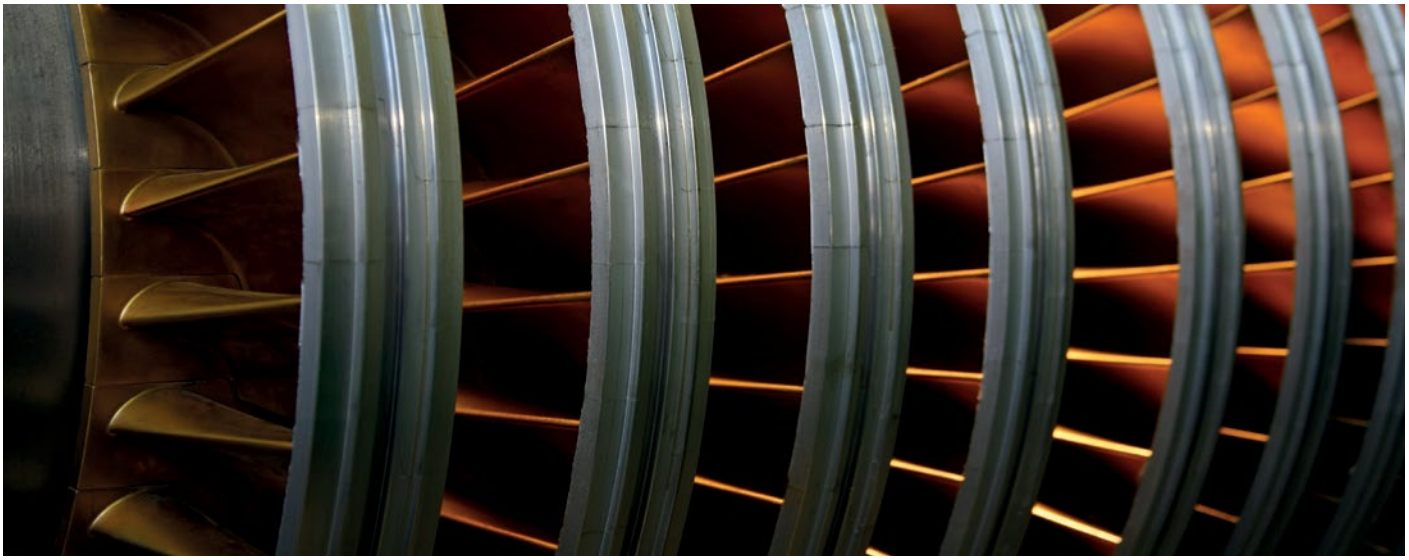
d. be **thermally and oxidatively stable** to minimise the formation of sludge and varnish, and to help it last longer

e. **inhibit rust and corrosion** to ensure that all the key components in the system are protected

f. **separate water rapidly** in systems where water contamination is a concern

g. **act as a coolant** to absorb some of the heat from the turbine's internal surfaces and to transfer it away without thermally degrading or oxidising prematurely.

TEST	FREQUENCY		SUGGESTED LIMITS
	Steam turbine	Gas turbine	
Appearance (visual)	Quarterly/bi-annually	Quarterly	Hazy
Colour (ASTM D1500)	Quarterly/bi-annually	Quarterly	Unusual/rapid darkening
Viscosity at 40°C	Quarterly/bi-annually	Quarterly	±5% of fresh oil value
Total acid number (TAN), mg KOH/g	Quarterly/bi-annually	Quarterly	Caution = 0.1–0.2 mg KOH/g above new oil value; warning = 0.3–0.4 above new oil value
Water content (KF), ppm	Quarterly/bi-annually	Quarterly	<0.1% steam turbine; <0.05% gas turbine
Elemental analysis (ICP)	Quarterly/bi-annually	Quarterly	Check contamination
Particle count (ISO 4406)	Quarterly/bi-annually	Quarterly	Manufacturers' limits 18/16/13
RPVOT, min	Annual	Quarterly	<25% fresh oil (review TAN)
Voltammetry/FTIR (antioxidant trending)	Annual	Quarterly	<25% of fresh oil
Demulsibility (ASTM D14010), ml-ml-ml (min)	Annual	Not required	>40-37 (40 min)
Rust test (ASTM D665A)	Annual	Not required	Light fail
MPC (ASTM D7833)	Not required	Quarterly	<40 (MPC) (not part of ASTM standard)
Foaming (ASTM D892), ml-ml	Annual	Annual	450/10 max.
Air release (ASTM D3427)	Annual	Annual	2× fresh oil air release value



The use of Shell Turbo products in combination with a high-quality lubricant analysis programme such as Shell LubeAnalyst can help to extend the life of turbine components and the life of the oil. By extending component and oil life, a turbine system is more productive, which lowers the total cost of ownership. The most common lubricants used in turbines today are based on robust additive systems tailored to high-quality mineral base oils.

Mineral base oils are available as API Group I, II or III. Shell's gas-to-liquids (GTL) base oil, a high-performance API Group III base oil, provides some of the following advantages:

- **enhanced oxidation protection** to help the turbine oil last longer and resist the formation of oxidation by-products, which, ultimately, lead to the formation of varnish
- **rapid air release** to enable the turbine oil to operate more efficiently by minimising the likelihood of the oil film breaking, which is critical in the lubrication of bearings
- **a high viscosity index**, which helps to maintain the optimum viscosity and film thickness required for turbine bearings across a wide range of temperatures.

Turbine oil additive systems are designed to

- minimise foam
- provide rust and corrosion protection
- help separate water very quickly so it can be removed
- contain a robust antioxidant system to extend oil life.

Shell Turbo T turbine oil has been designed with good oxidation control in mind to provide reliable levels of performance and protection. It meets the requirements for industrial steam and light-duty gas turbine oils that do not require enhanced anti-wear performance for gearboxes. Shell Turbo T has established a strong track record and offers high resistance to foaming, rapid air release and good water shedding and corrosion protection.

Extension to the range for those turbine systems looking for something extra are Shell Turbo S4 X and Shell Turbo S4 GX oils, which use Shell GTL Group III base oils in combination with a specially developed additive system. Testing in the laboratory and in the field has shown that these products have

- **high resistance to oxidation and thermal breakdown** to minimise the formation of sludge and varnish on critical turbine surfaces
- **rapid air release** and **low foaming properties** to help to improve the overall efficiency of turbine operation.

The use of Shell Turbo products in combination with a suitable oil monitoring programme such as Shell LubeAnalyst can help to extend the life of critical turbine components and of the turbine oil. This can result in lower costs and less unplanned downtime and help to lower the total cost of ownership for your operation.

Find out more by visiting
www.shell.com/lubricants