

GST Advantage™ RO with VARTECH™ Technology



Performance when you
absolutely have to have it.



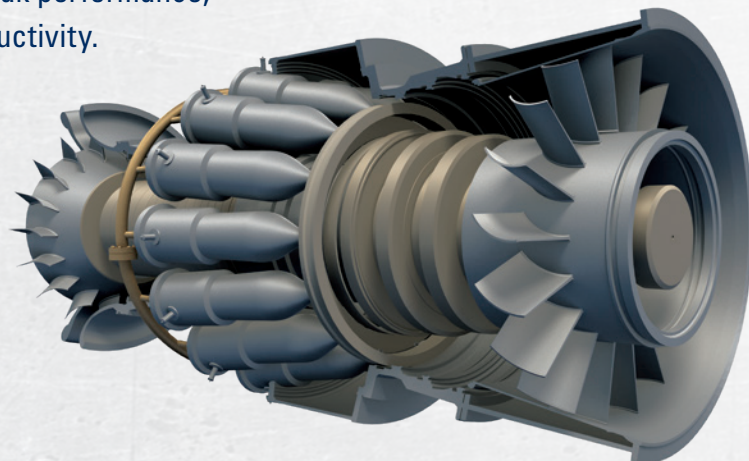
INDUSTRIAL
LUBRICANTS

Today's high-demand, high-severity operational environments call for an exceptional turbine oil: GST Advantage™ RO with VARTECH™ Technology.

For both steam and gas turbines, reliability is more critical than ever. Operating environments are getting hotter, harsher and more remote. Turbine metallurgy is at the edge of its temperature limits. Combined-cycle plants are raising the potential for water contamination. Startup times are shrinking. And through it all, uptime is an absolute must. Chevron GST Advantage RO with VARTECH Technology helps you meet these challenges head on, so your turbines run when they need to and your operation thrives.

GST Advantage RO delivers enduring performance on many fronts. It's formulated to help protect equipment from the varnish that causes valves to stick, bearings to fail, oil inlets and filters to clog, temperatures to spike, turbines to prematurely shut down. It also slows oil degradation through facilitation of water contamination removal to help prevent rust formation. GST Advantage RO can help you extend drain intervals, so you can synchronize oil changes with other scheduled maintenance and keep your turbines available and generating revenue.

GST Advantage RO with VARTECH Technology inhibits varnish formation to help maintain peak performance, reliability and productivity.



Fight your turbine system's worst enemy – varnish.

Among the many sinister elements attacking turbines, varnish can be the most destructive. To battle this menace, Chevron has formulated select GST® turbine oils with VARTECH™ Technology. The advanced lubrication chemistry used in VARTECH Technology inhibits the formation of varnish precursors, products of oil degradation that can deposit on internal surfaces and build up over time. You get exceptional oxidation stability, less degradation and long oil life – a breakthrough approach to varnish control.



GST Advantage™ RO with VARTECH™ Technology Provides the Answer

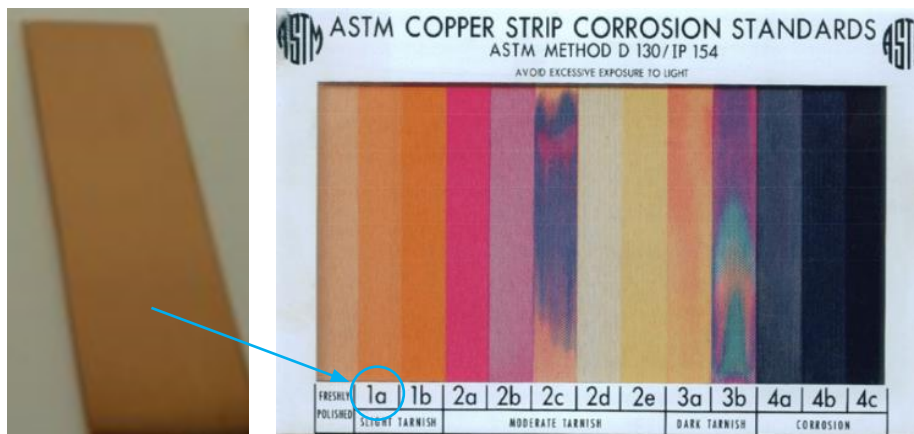
GST Advantage RO is uniquely formulated to meet some of the industry's highest performance requirements to minimize the effects of sludge and varnish on critical turbine components. GST Advantage RO turbine oil meets requirements for exceptional thermal and oxidative stability performance in several major manufacturers of turbines in non-g geared gas and steam turbines where extreme temperatures can be experienced. It is additionally suitable for severe service industrial applications that require a rust and oxidation inhibited (R&O) ISO 32 circulating oil with extended service capability.

GST Advantage RO with VARTECH™ Technology was Tested to the Limits

GST Advantage RO was examined in multiple tests to evaluate product performance. These tests were the Copper Corrosion Test ASTM D130, Membrane Patch Colorimetry (MPC) ASTM D7843, Thermal Stability Aging Test, Dry TOST ASTM D7873, and RPVOT ASTM D2272. These assessments confirmed that GST Advantage RO oil is thermally stable, has low sludge and varnish tendencies and has a long oil life. GST Advantage RO meets over a dozen OEM requirements, which help steam and gas turbines reach their maximum capabilities.

Copper Corrosion Test ASTM D130

Many bearings are made using copper alloys which can be corroded by active sulfur or strong acids. The Copper Corrosion Test evaluates the corrosiveness of a lubricant in the presence of copper. It's a good indication of how the lubricant will behave in equipment.



Actual coupon sample of GST Advantage RO ASTM D130

Membrane Patch Colorimetry and Thermal Stability Aging Test

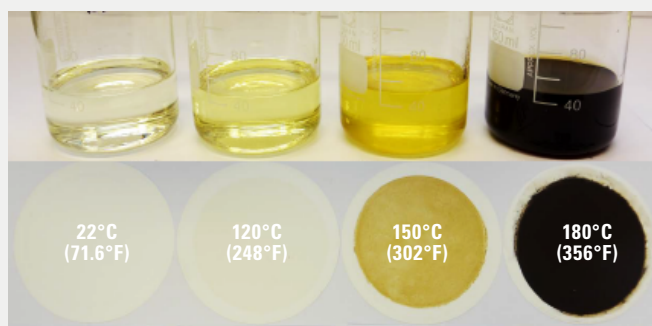
Major industrial compressor and turbine manufacturers require the Thermal Stability Aging Test as one component in determining lubricant performance requirements for use in their equipment. For most large turbine systems, high operating temperatures are the leading cause of premature turbine oil failure. The Thermal Stability Aging Test evaluates the thermal stability of the oil by using high temperatures to mimic hot spot conditions in a turbine system. It tests the varnish and sludge forming potential of a turbine oil by subjecting it to progressively elevated operating temperatures of 120°C (248°F), 150°C (302°F) and 180°C (356°F) in a short period of time.

The test was run in conjunction with the Membrane Patch Colorimetry (MPC), a tool often used to assess the potential for varnish in the turbine oil. The MPC

patches capture insoluble material and present a visual way to measure the condition of the oil based on the color of the contaminants. The darker patch indicates more varnish deposits and precursors.

Most conventional turbine oils demonstrate good performance when subjected to normal operating temperatures. But a conventional mineral oil will start to rapidly oxidize at temperatures above 82°C (180°F). Compared to the conventional turbine oil, GST Advantage RO was thermally stable and demonstrated the ability to minimize deposits at all three high operating temperatures throughout the test duration. The results clearly show only slight degrees of discoloration when subjected to elevated temperatures and indicate that GST Advantage RO provides excellent resistance to sludge and varnish formation.

Thermal Stability Aging Test (Testing Conducted at an Independent Laboratory)



Conventional Turbine Oil

Conventional turbine oil demonstrated thermal instability causing formation of insoluble material. The MPC patches show significant discoloration as the temperatures increased. This indicates the conventional turbine oil has a tendency to form sludge and varnish.



GST Advantage™ RO with VARTECH™ Technology

GST Advantage RO maintained a bright and clear color demonstrating high thermal stability at extreme temperatures causing minimal formation of insoluble material. The MPC patches show minimal discoloration as the temperatures increased. This indicates GST Advantage RO turbine oil has the ability to control sludge and varnish formation.

Major Turbine Manufacturer Specifications for Approval

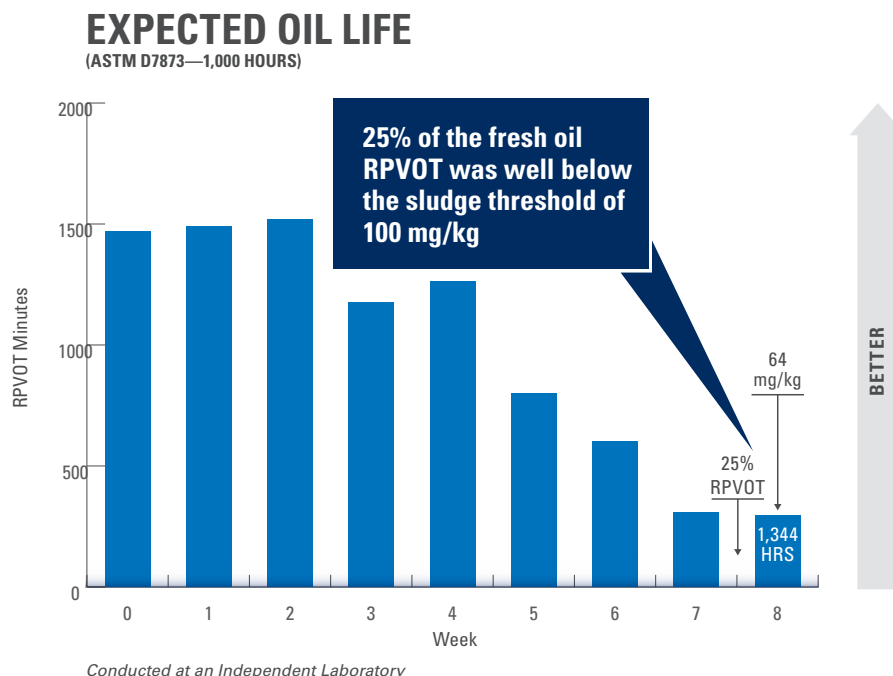
A major turbine OEM has developed some of the most stringent turbine oil specifications in the industry. At the core of the specification is an internally developed oxidation test which has demonstrated a strong correlation between a turbine oil's ability to meet the specification requirements to low varnish potential in the field. This test has been adapted as an industry standard within ASTM. It is called the ASTM D7873 Standard Test Method for Determination of Oxidation Stability and Insolubles Formation of Inhibited Turbine Oils at 120°C Without the Inclusion of Water (Dry TOST Method).

The Dry TOST test is viewed by most subject matter experts in the industry to be one of the best indicators of sludge and varnish forming tendencies of a turbine oil.

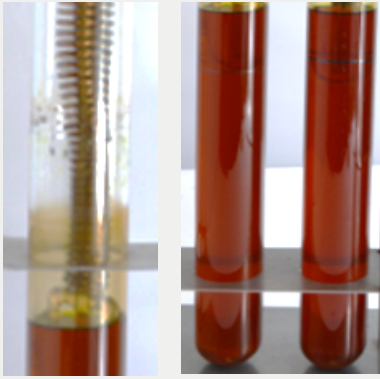
The key properties used to measure the performance of the turbine oil are remaining oxidation life based on RPVOT and the amount of sludge per kg of oil.

Dry TOST test for GST Advantage™ RO with VARTECH™ Technology showed the turbine oil's ability to extend to 1,344 hours before reaching the end of the test: 25% of the fresh oil RPVOT was well below the sludge threshold of 100 mg/kg.

The test requires reaching 500 hours while staying below 100 mg/kg and >25% RPVOT. The graph below shows that GST Advantage RO performance far exceeds the 500-hour limit reaching >1,000 hours before the RPVOT drops below 25 percent and the sludge values are below the limit, even at reduced oxidation life.



DRY TOST (ASTM D7873) 500 HOURS @ 120°C (248°F)



Conventional Turbine Oil



GST Advantage™ RO with VARTECH™ Technology

GST Advantage™ RO with VARTECH™ Technology turbine oil has a clearer and lighter appearance relative to the conventional oil after 500 hours of aging at a high temperature. The color indicates the turbine oil has the ability to withstand the effects of oxidation and sludge formation.

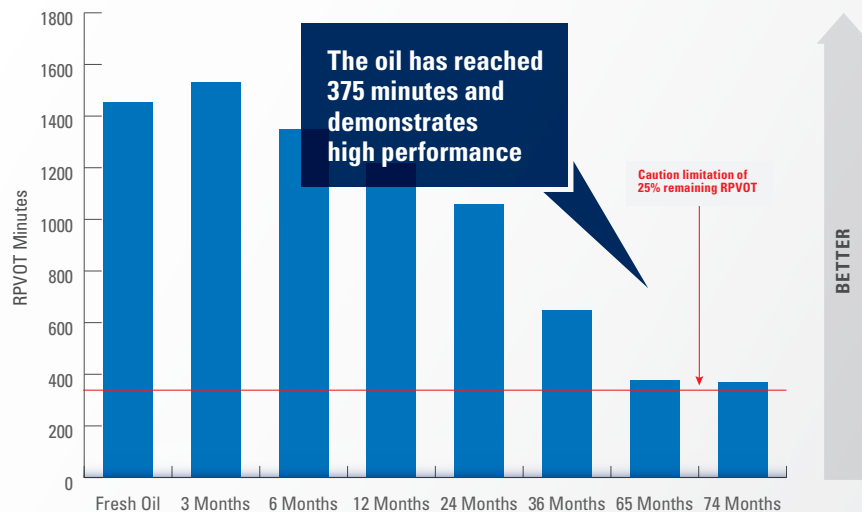
Conducted at Chevron Richmond Technical Center

RPVOT (ASTM D2272) Test

The RPVOT test is used for turbine oils to estimate the expected oil life, especially those that are prone to water contamination, by subjecting the oil to high temperatures and introducing oxygen, water and metal catalysts for evidence of acid formation. The ASTM D2272 tracks the acid number increase of the oil as it ages and the test is complete when it

either reaches 2.0 mg of KOH or 10,000 hours. GST Advantage RO met the 10,000-hour limit and the test was stopped. Testing could have continued; however, then the precision of the test is not accurate and the time extends beyond the defined standard test limit. When the test limit is exceeded, it is considered a modified ASTM test.

RPVOT (ASTM D2272) TEST RESULTS IN THE FIELD GST ADVANTAGE™ RO WITH VARTECH™ TECHNOLOGY



Field test conducted at Chevron Sycamore Cogeneration Facility in Bakersfield, California

Learn more at
chevronlubricants.com



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