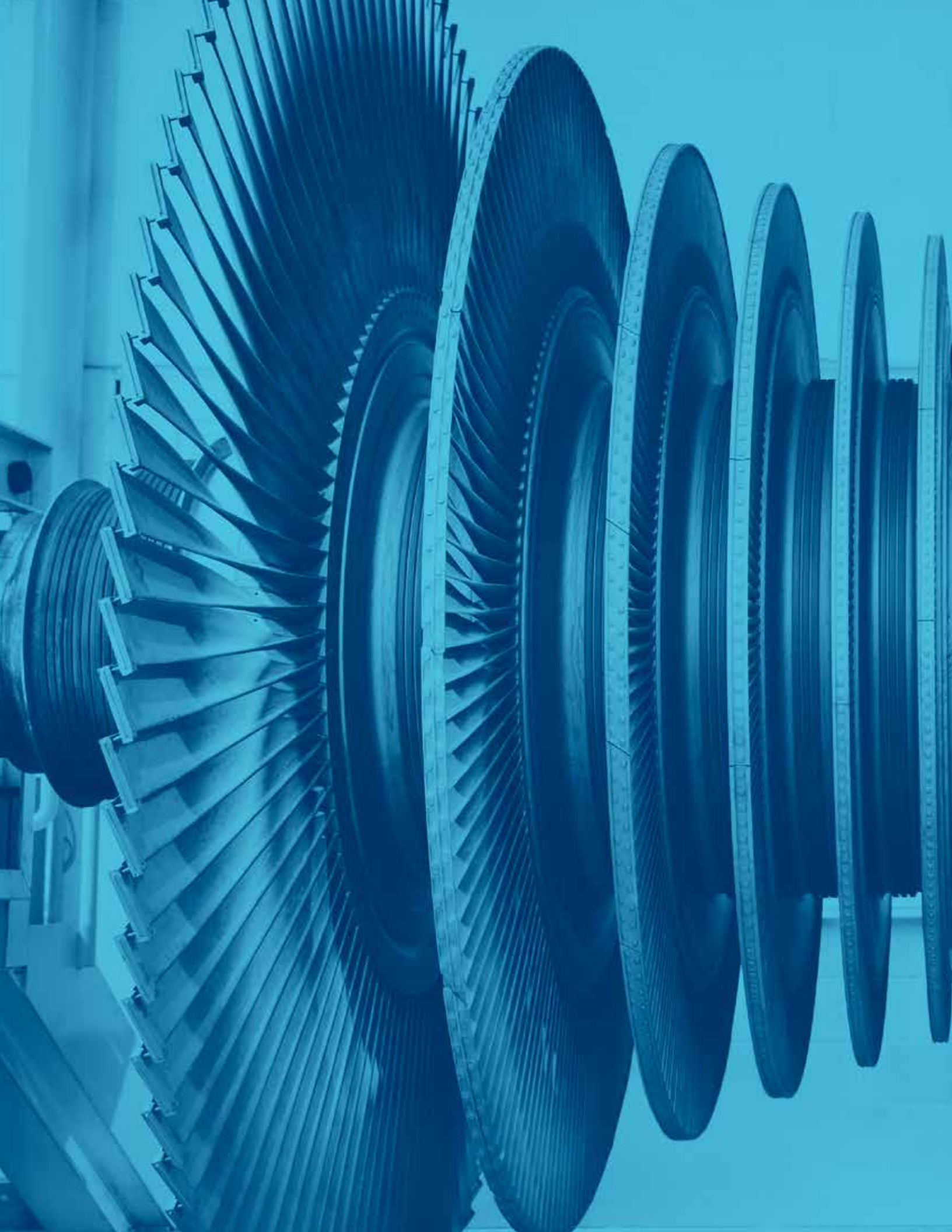




DEFEAT DESTRUCTIVE VARNISH TO OPTIMIZE TURBINE PERFORMANCE

INDUSTRIAL
LUBRICANTS
Run Better Longer

The VARTECH™ Solution



Turbines are at the heart of your operation. If they're attacked by varnish, your production could halt.

Industrial operators have long been aware of the tremendous damage that varnish can do to their operations. Many of them know that varnish can lead to a range of equipment problems, from poor performance to catastrophic failures. They typically consider varnish, and the difficulties that come with it, as inevitable to doing business – something that's beyond their control.

You do not have to accept this.

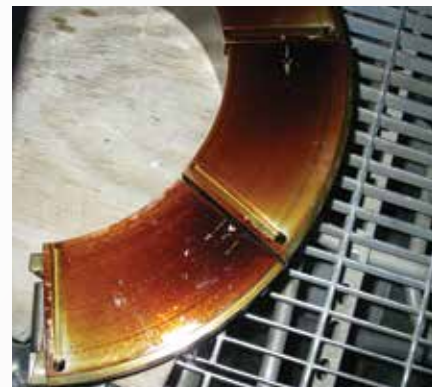
To defeat varnish, you first must understand it

The Culprit

Varnish is a coating that adheres to internal surfaces, wears out equipment components, restricts performance and can ultimately cause failures. It is composed primarily of organic residue mixed with metals, inorganic salts and other contaminants. Varnish can take different forms, from a sticky coating to a hard lacquer, and ranges in color from gray to brown to amber. Varnish is very destructive and hard to remove.

The Causes

Varnish is formed when high operating temperatures deplete protective additives, causing the lubricant to oxidize and break down. Water, chemicals, particles, gasses and other contaminants also act to degrade the oil. Elements of this degradation, known as varnish precursors, precipitate out of the oil and attach themselves to internal surfaces. The tacky nature of these deposits attracts more and more precursors, and varnish builds up layer by layer.



THRUST BEARING TILT PAD



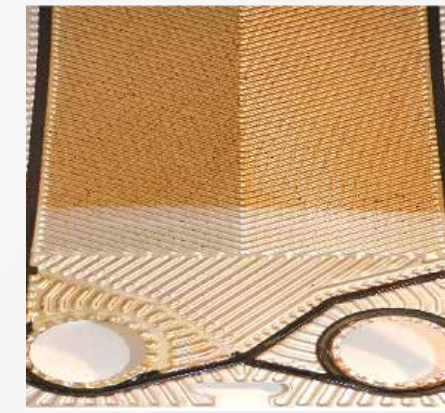
RESERVOIR HATCH COVER

The Cycle of Failure

As varnish worsens, a vicious cycle is often set in motion. The coating insulates metal surfaces which prevents efficient oil cooling which raises the temperature. This causes more more degradation and less effective lubrication. More precursors are created, more varnish layers are formed, and the problem spirals toward equipment failure.



RESERVOIR FLOOR



HEAT EXCHANGER
COOLING PLATE

The Consequences

Even the smallest amount of varnish can result in poor system performance and equipment failures. Valves stick, bearings overheat, components wear out, oil inlets and filters clog, and the internal mechanics of your turbine begin to malfunction. These issues tend to worsen over time as more varnish builds up, leading to shortened oil life, poor equipment performance and premature shutdowns.



**Varnish attacks turbines
from the inside, destroys
performance and threatens
operations**

It's time to fight back

The experts at Caltex Lubricants have developed a two-step, clean-and-control solution to help you protect equipment from varnish and ensure peak productivity in your operation:

The VARTECH™ Solution

STEP 1: CLEAN

VARTECH™ Industrial System Cleaner



Eradicate varnish that has infiltrated your turbine system

VARTECH™ Industrial System Cleaner (ISC) utilizes proprietary technology to do the most thorough and efficient cleaning job without creating operational constraints.

Its triple-action technology:



CUTS

It cuts through the hard varnish layers and removes them as micro-sized particles.



CAPTURES

It captures and stabilizes these varnish particles in a protective barrier so they can be removed from your system without redepositing in other parts of the equipment.



COMPATIBLE

It is compatible with the in-service oil for optimum operational flexibility while maintaining performance during the cleaning cycle that prepares the system for change out to fresh oil.

VARTECH™ ISC helps prepare your equipment for fresh oil. A Caltex lubrication specialist can work with you to recommend an optimized cleaning cycle time to effectively remove sludge and stubborn, baked-on varnish from your system. However, if unexpected delays are encountered, you can feel confident knowing that the cleaner can temporarily remain in your system without damaging internal components.

Clean without compromise



BEFORE CLEANING



AFTER CLEANING WITH VARTECH™ ISC

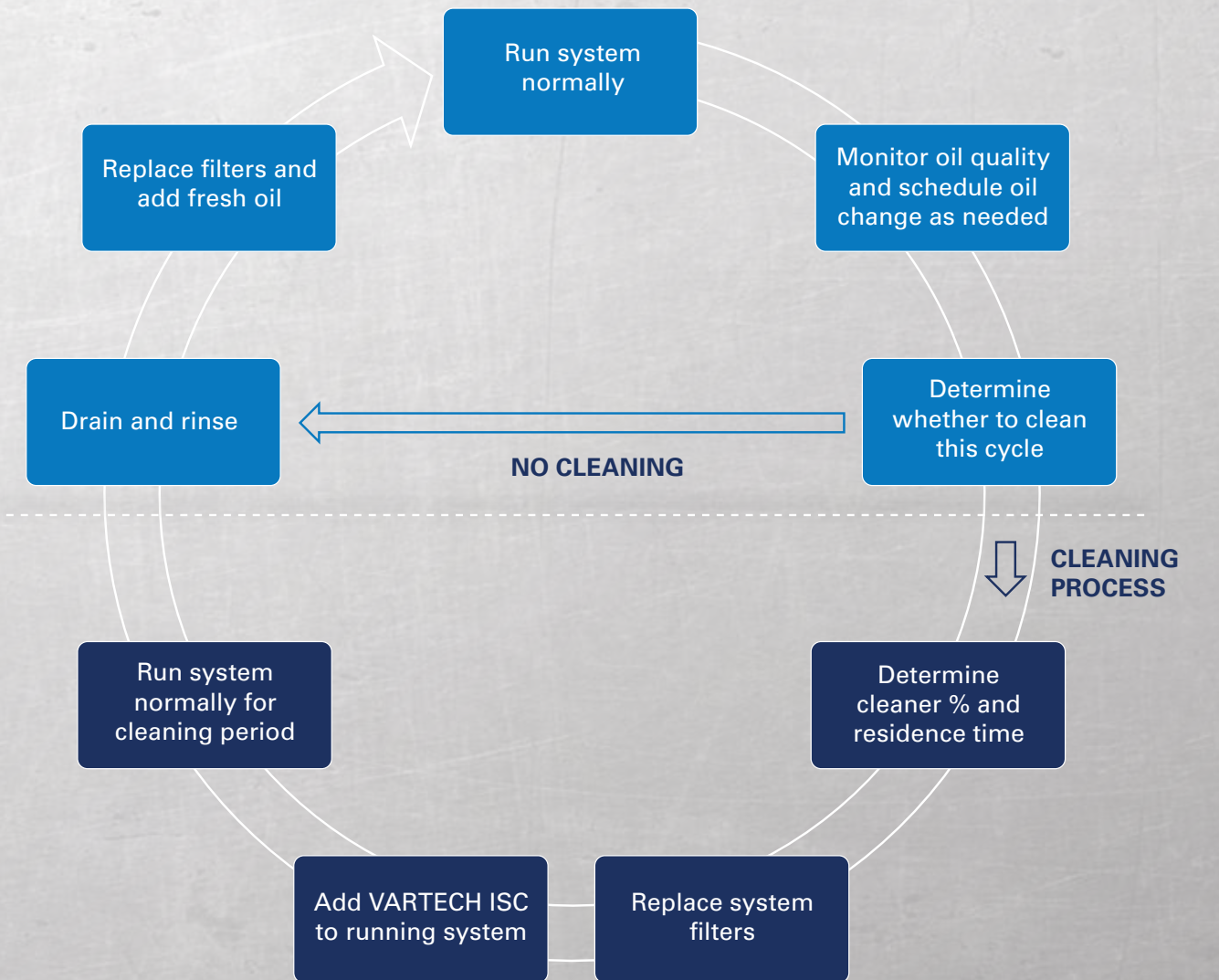


AFTER CLEANING WITH COMPETITIVE CLEANERS



VARTECH™ ISC	COMPETITIVE CLEANERS
<ul style="list-style-type: none"> • Turbines remain online and productive • Varnish micro-particles are gradually removed to avoid overwhelming filters • Compatible with internal equipment components, including seals • Demonstrated compatibility with most turbine and compressor oils • Minimally impacts performance of new oil • Compatibility with the in-service oil can allow longer residence time (if needed) for better removal of stubborn, baked-on varnish • Can temporarily remain in the system, causing no operational constraints • Efficient cleaning process saves time and money 	<ul style="list-style-type: none"> • Shutdown sometimes required • Large pieces of varnish can break loose and settle in other areas of the system • Harsh chemicals can damage seals and cause leaks • Has the potential to lower lubricant flash point causing higher fire and explosion risk • May accelerate oil degradation, shorten oil life and cause system corrosion • Short cleaning cycle doesn't effectively clean • Repeated filter plugging and shorter filter life • Shorter equipment life and higher maintenance costs

Maximize operational efficiency



The VARTECH™ Industrial System Cleaner (ISC) cleaning process is simple, streamlined and economic. Conventional system cleaners are more complex and require additional steps, external filtration and multiple rinses and compatibility tests.

Turbine operation temperatures kept below alarm levels

SPAR FLOATING PLATFORM, TAHITI FIELD, GULF OF MEXICO

Cleaning with VARTECH™ Industrial System Cleaner helped save \$80K+ in annual maintenance costs.*

STEEL PLATES FROM OIL COOLER



BEFORE CLEANING: Varnish film



AFTER CLEANING: Varnish film cleaned using VARTECH™ ISC

The Equipment

Two Solar Titan 130 gas turbines are configured in generator sets that deliver 15,000 kW of electricity to the platform. Power loss would halt production.

The Problem

Varnish in the oil coolers was causing the unit to run hot, triggering high-temperature alarms. The operator tried a conventional cleaner, which created operational challenges during the cleaning process and only temporarily lowered the temperatures. The operation had to resort to costly mitigation measures, sending the coolers onshore every 4 months to clean the varnish, costing the operation \$80,000+ per year.*

The Solution

VARTECH™ Industrial System Cleaner (ISC) was added to the in-service oil, and temperatures quickly dropped below alarm levels. There were no filter clogging problems, and the operator no longer had to live with the varnish problem.

*Actual savings can vary.





Turbine operation maintained at full design capacity

SAN JOAQUIN VALLEY BUSINESS UNIT, CALIFORNIA

Cleaning with VARTECH™ Industrial System Cleaner helped achieve \$350K in annual revenue gain.*

The Equipment

Solar Taurus 60 gas turbine is used in a steam/ electricity co-generation configuration. The steam facilitates oil recovery and the electricity is sold to a power utility.

The Problem

Varnish in the turbine oil coolers was causing the unit to run too hot to operate at full design capacity, and the operation was losing \$350,000 annually from lost electricity sales.

The Solution

VARTECH™ Industrial System Cleaner (ISC) was added to the in-service oil, cleaning the varnish from the oil coolers. Operating temperatures quickly dropped and the turbine returned to full design capacity, recapturing the lost \$350,000.*

SJV WAS ABLE TO OPERATE THE GAS TURBINE AT FULL CAPACITY WITH NO TEMPERATURE ALARMS

	BEFORE VARTECH™ ISC	AFTER VARTECH ISC	IMPACT
Header temp.	159	154	-5°F / -20°C
Bearing temp.	206	194	-12°F / -24°C
Unit output (MW)	3.3	5.5	+2.2

*Results may vary depending on equipment type, operating conditions and utility costs.

Lubricants Formulated with VARTECH™ Technology

Prevent the formation of new varnish

After existing varnish has been cleaned from your system, it is important to refill your equipment with a lubricant that helps prevent the formation of new varnish. Caltex has developed advanced lubrication chemistry which inhibits the precursors that can form in your oil stream, deposit on internal surfaces and eventually become varnish.

Caltex lubrication experts are formulating a range of lubricants with VARTECH Technology to protect operations across a number of industries. Our first products will be GST® turbine oils formulated with VARTECH Technology.

They are developed to control the formation of varnish and help:

- Improve oxidation stability
- Reduce oil degradation
- Extend oil life.



The VARTECH Solution for varnish control leads to full-on protection for your equipment, so you can achieve peak performance, reliability and productivity.



Detect varnish, then defeat it

The best way to prevent varnish from attacking your equipment is to detect it early and take decisive action. Fluid monitoring and oil analysis are excellent methods for tracking the health of your lubricating system, but while they can detect varnish precursors in your oil stream, they can't detect varnish that has already formed. Look for changes in oil color, spiking temperatures or visible varnish deposits during routine maintenance.

You can also run a number of tests to monitor the health of your lubricating system. Ruler-voltammetry testing can measure oxidation trends in your oil. Membrane patch colorimetry (MPC), RPVOT and particle count testing can help you measure oil degradation and determine lubricant condemning limits.

Run Better Longer

Caltex Lubricants has developed advanced expertise, premium lubricants and targeted programs for a broad array of industries, to help our customers' equipment and operations Run Better Longer. Find out more at chevronlubricants.com

Contact the experts at Caltex industrial lubricants to help you tackle precisely the right lubrication program to protect equipment performance.

Learn more at
chevronlubricants.com



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