



marine lubricants

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marine lubricants

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Chevron Marine Safety Data Sheets can be found at:
chevronmarineproducts.com/en_UK/products/sds.html



Your personalised lube chart can be found here:
<https://chevronproductsuklim.outsystemsenterprise.com/ChevronLubeChart/>



Keep your business running smoothly with around-the-clock OnePort™ access to your orders and account information



marine lubricants

marine lubricants handbook



marine lubricants

welcome to the chevron marine lubricants handbook

In this handbook you will find all of the information you need regarding the products and services Chevron Marine Lubricants provides, as well as the contact details of your global representatives, should you need support at any time. We deliver peace of mind — wherever you are in the world.

World-class products and services

By anticipating changes in regulations and technology that impact the shipping industry and continually developing innovative solutions for our customers, we aim to be the lubricants partner of choice for the global marine community.

Our industry-leading high performance lubricants are recognised for their reliability, efficiency and protective properties. All of our marine lubricants are fully approved by, or meet the requirements of, major marine equipment manufacturers (OEMs).

At Chevron Marine Lubricants, we always 'do the right thing' by our customers, developing and delivering rigorously tested, regulation-ready, approved products — without ever cutting corners.

supplier

Choice, reliability, integrity

Lead your business forward with Chevron Marine Lubricants solutions and expert support that will future-proof your organisation and keep you regulation-compliant. Whichever operational route you choose — we've got you covered.



future-proof



OEM approved



global support



optimize feed rates



corrosion protection



maintain engine cleanliness



FAST™ vessel optimization

Predictive measures and analysis play a vital role in the maintenance of equipment onboard your vessels, and deliver that all-important thing: peace of mind. The FAST service can help identify contamination or wear — before it results in costly downtime. DOT.FAST® and FAST customers benefit from expert recommendations delivered online, from our global ISO-certified laboratories.

DOT.FAST® drip oil analysis

Our drip oil analysis kit DOT.FAST is a complete service for onboard testing of used cylinder oil samples. DOT.FAST can help operators optimise cylinder oil feed rates, measure total iron wear and detect corrosion in the engine. DOT.FAST is recommended by major slow speed two-stroke engine OEMs MAN Energy Solutions and Wärtsilä to optimize the efficiency of your engine.

FAST services

FAST is a comprehensive fluid analysis service that provides analysis of all lubricated parts aboard your vessel. Technical teams at our global laboratories provide reliable interpretations of FAST test results and actionable recommendations based on the data. DOT.FAST and FAST customers receive regular laboratory analysis from experienced engineers.

Visit our website chevronmarineproducts.com for more information.





marine lubricants

marine products





marine lubricants

marine engine lubricants

**protect your engine with lubricants
formulated for today — and tomorrow**





take full control

our engine oils work hard so your engines don't have to

With one of the industry's largest distribution networks, Chevron has the infrastructure to deliver the marine products and services you need.

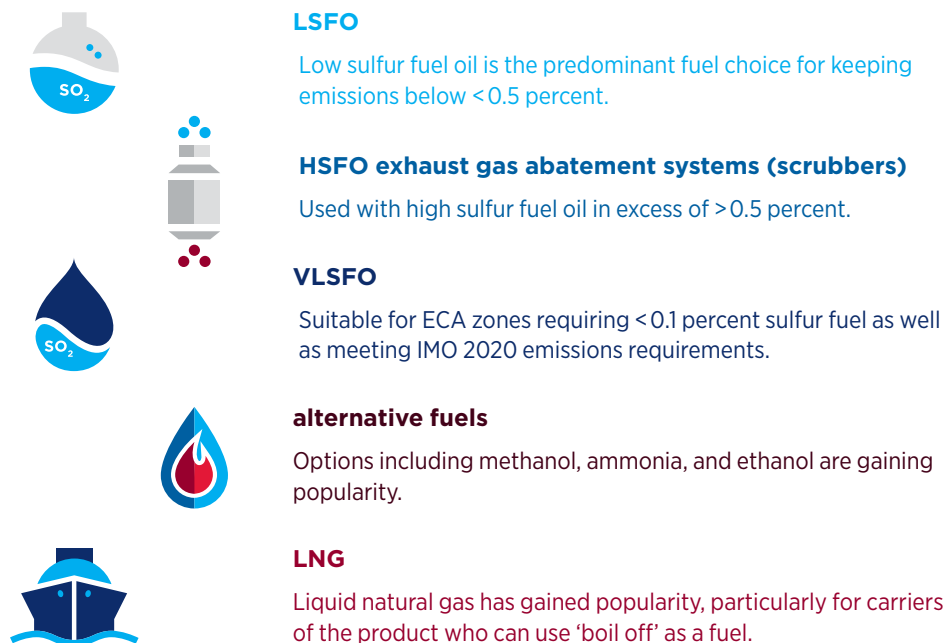
From our global operational reach to the depth of our experienced personnel, we stand for one thing above all else — reliability.



solutions for navigating your journey

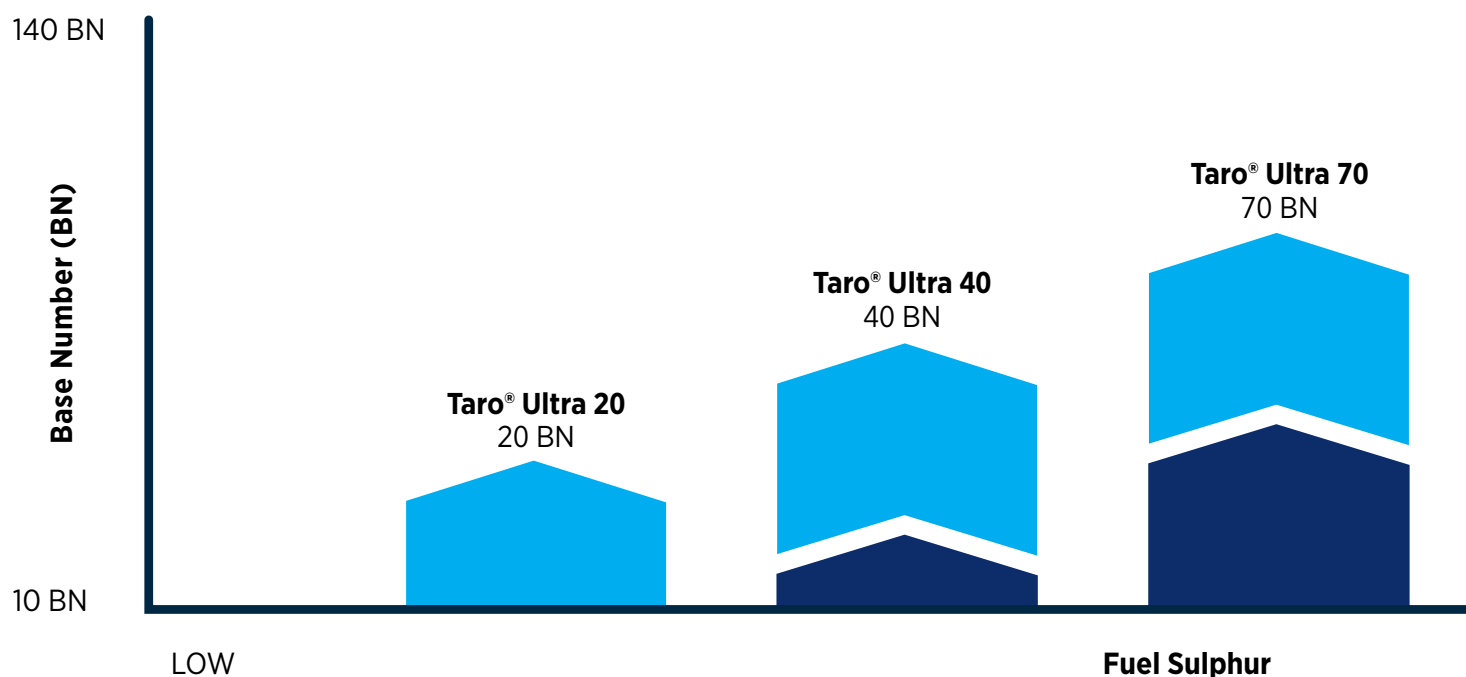
Chevron Marine's Taro® Ultra family is a regulation-ready range of new generation cylinder oils, providing the reassurance of a global lubrication solution for virtually every fuel eventuality, while protecting your engine and helping minimize the total cost of ownership.

routes to IMO 2020 compliance



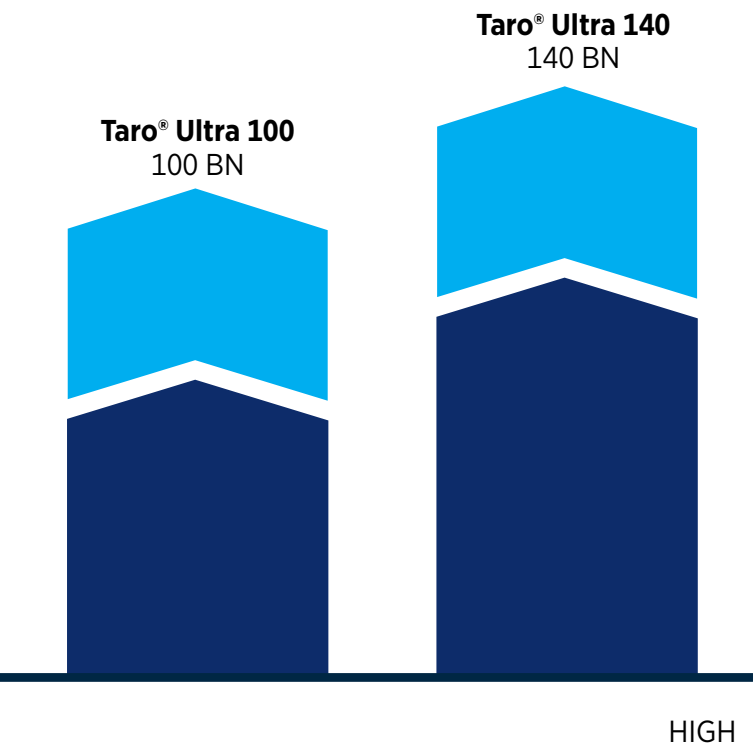
**we've got you covered ...
whichever operational route you choose**

cylinder oils for today — and tomorrow



Taro Cylinder Lubricants*

Taro Grade	Taro® Ultra 20	Taro® Ultra 40	Taro® Ultra 70
Description	High performance 20 BN SAE 50 cylinder oil for engines operating on ECA fuel, LNG, LPG and ethane ethanol.	High performance 40 BN SAE 50 cylinder oil for engines operating on LSFO and distillate fuel single grade for 0.50% sulphur. Additionally for the use of intermittent ECA fuel and permanent methanol.	High performance 70 BN SAE 50 cylinder oil for a wide range of fuels.
Base Number (BN)	20	40	70
ISO Viscosity Grade	50	50	50
Density 15°C kg/l	0.90	0.92	0.93
Viscosity at 100°C	19	19	19
Pour Point, °C	-12	-15	-15
OEM Approved			
MAN ES		✓	✓
WinGD (former Wärtsilä)	✓	✓	✓



Taro® Ultra 100	Taro® Ultra 140
High performance 100 BN SAE 50 cylinder oil, the optimal choice for most slow-speed vessels. Optimized to combat cold corrosion in two-stroke engines. Designed for high sulphur HFO & scrubber operations.	High performance 140 BN SAE 50 cylinder oil optimized to also combat cold corrosion and lower feed rates in two-stroke engines. Designed for cost performance optimization with scrubbers.
100	140
50	50
0.95	0.98
19	19
-15	-15
✓	✓
✓	

* Always use Taro products in line with OEM guidelines.

Cylinder lubricants for every need

Taro Ultra — formulated to cope with the demands and provide the flexibility needed post IMO 2020 implementation. Developed and field tested for over 65,000 hours in a range of 2-stroke engines and vessel applications using a variety of bunker fuels, including 0.50% sulfur blends, alternative and hybrid fuels as well as traditional bunker fuels to mirror almost all future operations. Performance analysis from the FAST™ vessel optimization program and strong working relationships with major marine OEMs provides the reassurance you expect from Chevron Marine Lubricants.



OEM approved



future-proof



optimize
feed rates



corrosion
protection



high temperature
performance



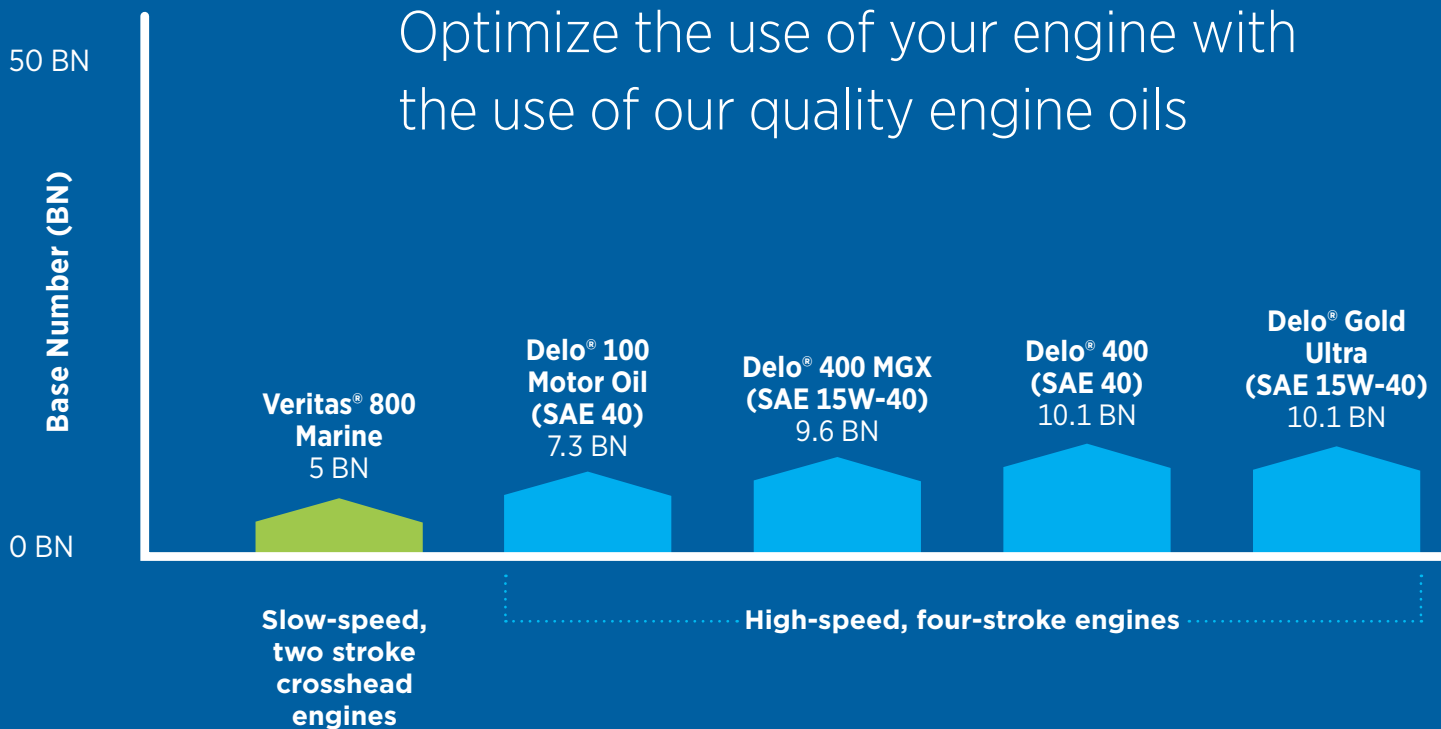
maintain engine
cleanliness



global support



diesel engine oils



DOT.FAST engine optimization

Predictive measures and analysis play a vital role in the maintenance of vessel equipment. DOT.FAST enables operators and engineers to quickly diagnose the condition of their engine, helping protect crucial equipment and manage lubricant feedrates for effective, reliable performance.



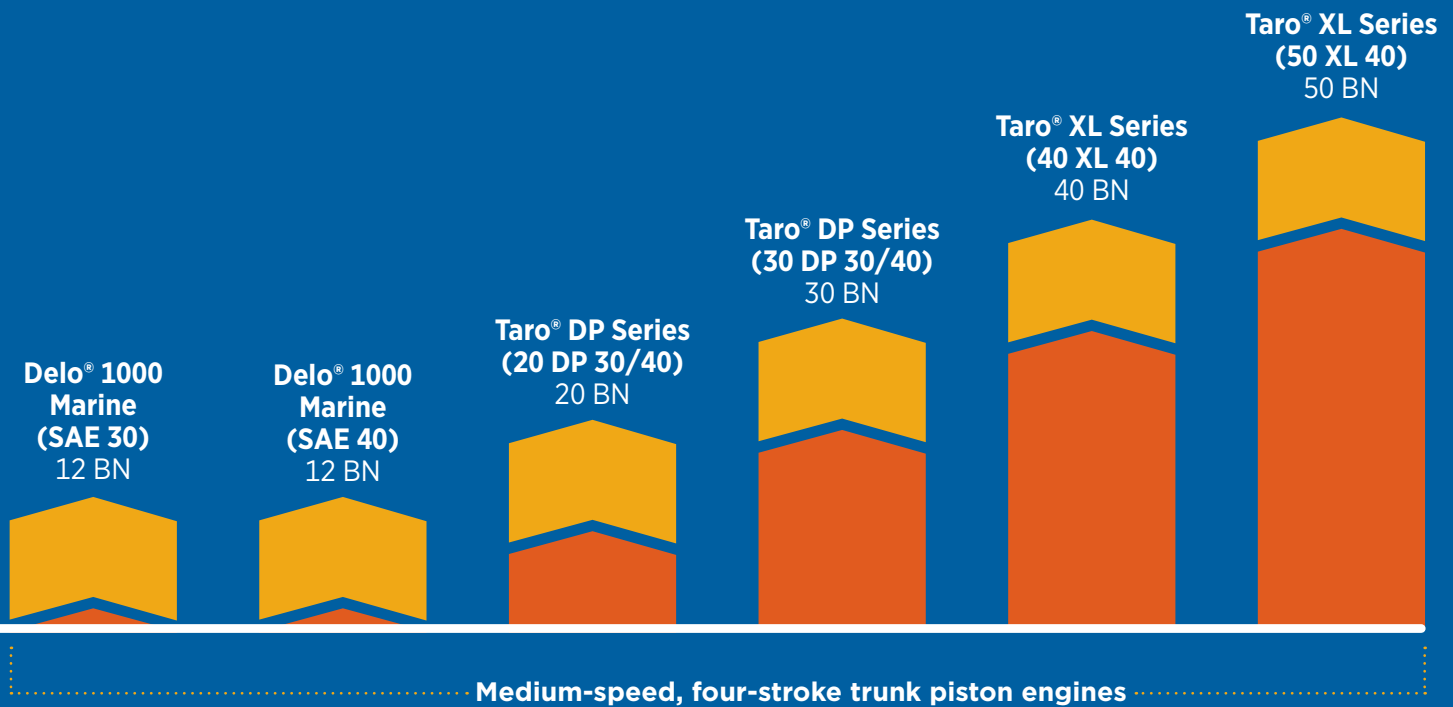
1
Take samples



2
Test on board



3
Send for lab analysis



the FAST™ range of services



DOT.FAST® Drip Oil Analyzer

Delivers onboard results with laboratory accuracy. Easy to use and innovative, the testing is supported by onshore analysis reviewed by experts.

FAST™

Provides comprehensive fluid analysis at our advanced global laboratories where the focus is on what you need most — reliability.

FAST™ OnBoard

A portable and user-friendly digital laboratory providing easy to interpret results, measuring viscosity, water and base number (BN).

XLI Portable Refractometer

A simple and easy to use onboard device to read the concentration of Chevron's XLI Cooling Water Treatment in fluid samples.



www.chevronmarineproducts.com



Our Family of Brands

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

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marine lubricants

delo[®] XLI corrosion inhibitor – concentrate cooling water treatment

help extend the life of your engine with
OAT corrosion inhibitor technology





The marine environment challenges your equipment.

Chevron marine products help you meet the challenge.

With one of the largest distribution networks in the industry, Chevron has the infrastructure to deliver the marine products and services you need. From our global operational reach to the depth of our experienced personnel, we stand for one thing above all else — **reliability**.





Delo® XLI cooling water treatment

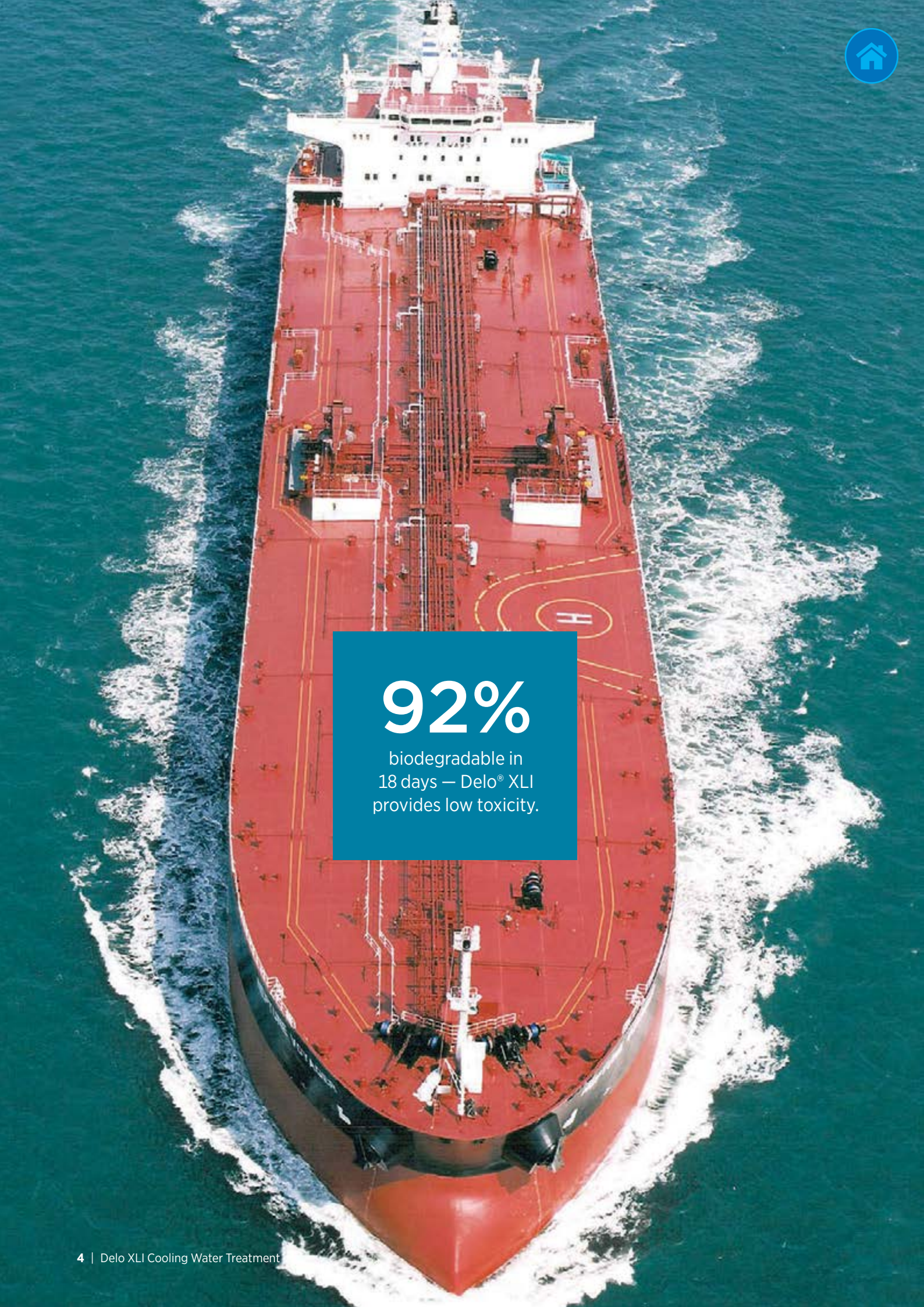
Field and laboratory tests prove that Chevron's Delo® XLI Corrosion Inhibitor – Concentrate (Delo XLI) cooling water treatment helps provide maximum protection and lasts longer than traditional technologies in your marine or power generation systems. It is recommended for cooling water treatment operating below 100°C. Delo XLI cooling water treatment combines performance with long service life to help keep your engines running for longer.

- Extended service life
- Improved heat transfer
- 92% biodegradable in 18 days
- Organic Acid Inhibitor Technology (OAT)
- Compatible with plastics and elastomers

32,000

number of hours
recommended maximum
service interval for
Delo® XLI cooling
water treatment.



An aerial photograph of a large red oil tanker ship sailing on a deep blue ocean. The ship is viewed from the bow, showing its long deck with various pipes, valves, and equipment. A white helipad is visible on the deck. The ship is leaving a white wake in the water.

92%

biodegradable in
18 days — Delo® XLI
provides low toxicity.



Delo® XLI cooling water treatment has an extended service life, with recommended maximum service intervals of 32,000 hours.

important advantages

Extended service saves time and money

The Organic Acid Inhibitor Technology (OAT) in our Delo® XLI cooling water treatment has a very low additive depletion rate, helping to ensure long-term corrosion protection under all operating conditions. There is no need for supplementary additive top-ups. Delo XLI cooling water treatment has an extended service life, with recommended maximum service intervals of 32,000 hours.

Caring for the environment

Delo XLI cooling water treatment is a water-based, low toxic, readily biodegradable, nitrite-free carboxylate inhibitor treatment.

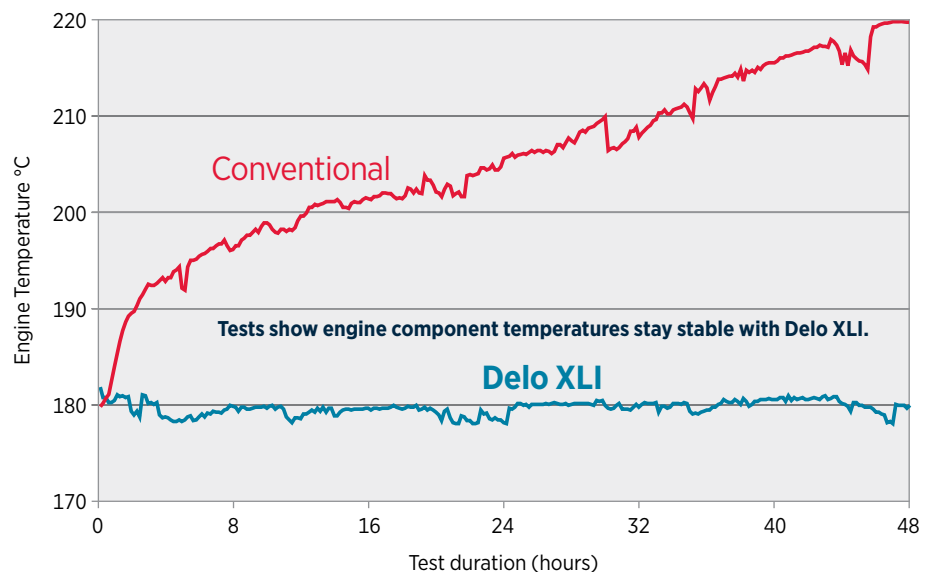
Minimized maintenance costs

Delo XLI cooling water treatment has better heat exchange than conventional coolants. Our technology inhibitor system is designed to protect against wet liner cavitation erosion and helps provide protection to aluminum and cast iron surfaces under heat transfer conditions.

outstanding at high temperatures

Tests show Delo XLI cooling water treatment remains stable at high temperatures and does not form a film that can hinder heat transfer. OAT helps to protect metal surfaces by physical absorption or by chemisorption only where needed, and does not impede heat transfer.

The graph below shows that with Delo XLI OAT, heat dissipation is stable over time, while with conventional cooling water treatment heat dissipation may decrease due to build-up of insulation layers (oxides and/or inhibitor salts), leading to increased component thermal stress.





corrosion protection mechanism

Corrosion is the combination of two processes, an oxidation-reduction of the metal surface and the electron flow from an anodic site to a cathodic site.

Conventional products help to limit corrosion by creating a protective layer over the complete metal surface, thus impeding heat transfer. Chevron's Delo® XLI cooling water treatment is designed to protect against corrosion by

electronically bonding with the anodic sites throughout the cooling system.

This polarization process helps protect the metal surface against oxidation-reduction. Because Delo XLI cooling water treatment bonds only with the anodic sites, additive depletion is minimal and heat transfer performance is not impeded, giving the product significant advantages.

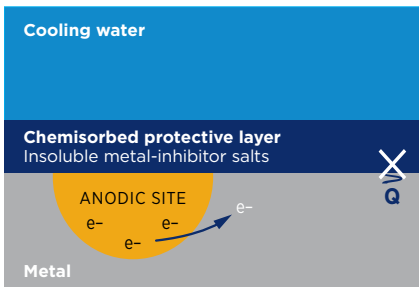
Industry approved*

The corrosion inhibitor technology (OAT) in Delo XLI has gained the approval of many major marine, heavy duty, automotive and stationary engine manufacturers, and is currently used in some of the world's most advanced engines.

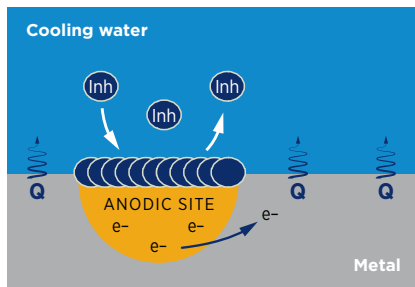
Manufacturers

- MAN Diesel & Turbo
- Winterthur Gas & Diesel (Wärtsilä Switzerland)
- Rolls-Royce
- Deutz
- MaK/CAT

* Operating with cooling water temperature below 100°C



Conventional protection mechanism

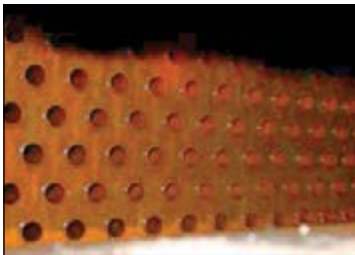


Chevron Delo XLI cooling water treatment

field test examples

Air cooler, Wärtsilä 12RTA84C-UG main engine — pipe bundle:

Before change-over



After 4,000 hours



After 13,000 hours



Pipe/pump housing connections:



3,000 hours service with conventional cooling water treatment

3,000 hours service with Delo XLI cooling water treatment

Field tests demonstrate Delo® XLI's corrosion and rust protection performance.

Deutz TBD 604BV16 after 43,000 hours (m/v *Le Ponant*).



12RTA96C engine after 21,000 hours (m/v *Cornelia Maersk*).



Cleaner inlet air coolers mean cooler inlet air and greater engine efficiency.



easy, cost-effective monitoring

Save time and money
by monitoring your
cooling water condition
with onboard testing
and FAST™ services.

Below, left to right: Chevron's Portable Refractometer designed to measure % Brix, pH and chloride test strips.

Refractometer testing

The hand-held refractometer spot test is a quick method for determining the concentration of Delo® XLI cooling water treatment in water. This method is easy to perform with Chevron's Portable Refractometer and does not require extensive sample handling or expensive equipment.

Chloride and pH monitoring is easy

Delo XLI's OAT corrosion inhibitor system is designed to protect aluminum and other system metals at lower pH levels than conventional coolants. Acid and base indicator strips are used to easily measure pH balance. High chloride levels can significantly increase the risk of corrosion, and are also evidence of seawater contamination in the system.

For onboard testing, commercially available test strips can be used for quickly and conveniently measuring rough chloride levels in cooling water. Chevron recommends testing the Delo XLI cooling water treatment's concentration, pH value and chloride levels once a week.

Comprehensive FAST™ reports

Chevron's FAST service provides in-depth onshore analysis of your cooling water samples at advanced global laboratories. We report on several parameters and elements in your cooling water samples, as part of our comprehensive equipment monitoring program.

Contact your sales office for more information.



7.5%

recommended
concentration of
Delo® XLI when the
cooling system is filled
with good quality water.

designed

to protect rubber
hoses, plastics,
elastomers, gaskets
and non-metal seal
materials.





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Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

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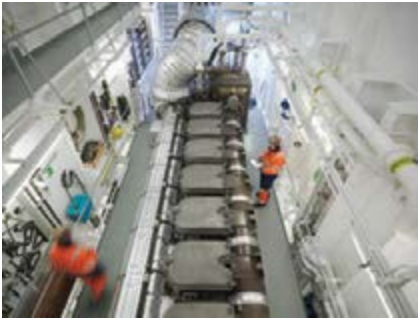
marine lubricants

clarity[®] environmentally acceptable lubricants

high performance meets
environmental responsibility



clarity[®] marine lubricants for today



The global trend is toward increasing regulations around water to surface applications.

the challenge

The global trend is toward increasing regulations around water to surface applications, with VGP compliance required in US waters and EU legislation pending. Added to that, responsible companies are investing in projects that promote stewardship and environmental sustainability. This means operators are looking for ways to achieve a 'green' operation without compromising on cost or quality.

the solution

Advances in marine technology mean that EAL products are outperforming or performing just as effectively as traditional lubricants. The Clarity[®] Synthetic EA range is developed with base oils that provide excellent oxidation and thermal stability, water separability and foam suppression while being fully biodegradable and future ready.

premium performance

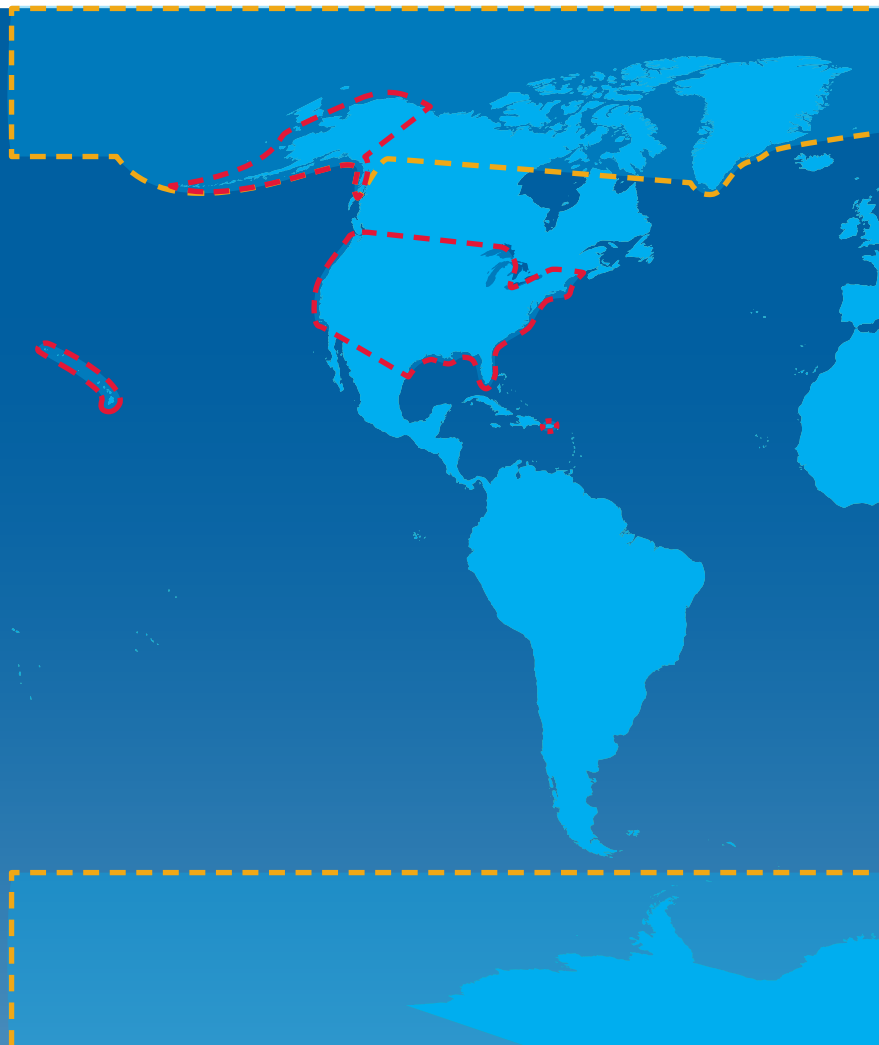
Clarity Synthetic EA lubricants range provides outstanding protection with the advantage of meeting or exceeding regulatory requirements. Exceptional performance based on Chevron's technical expertise powers the world forward and improves lives.

EALs are recommended for use around the North and South Poles and are a requirement for vessels entering US waters.

Clarity EALs biodegrade by

≥60%

in 28 days or less, minimizing impact on the environment





high performance with low toxicity



**Chevron delivers
future-ready EALs
that meet or exceed
legislative requirements.**

Chevron marine EA lubricants strike the perfect balance between excellent performance and low toxicity.

The carbon derived base fluid (HEPR) in Clarity® Synthetic EA Hydraulic Oil and Clarity Synthetic EA Gear Oil is a powerful lubricant, formulated to deliver the benefits of traditional petroleum products with minimum environmental impact. Tests show that HEPR separates from water at the same rate as traditional petroleum lubricants.

Clarity Synthetic EA Grease is a multipurpose thickened lubricating grease based on biodegradable esters. The combination of antioxidants, corrosion inhibitors, and EP/AW additives make this an ideal product for a variety of applications.



-48°C

pour point of ISO 100 Clarity
Synthetic EA Hydraulic Oil,
providing excellent fluidity
in Arctic conditions



the marine environment challenges your equipment — chevron marine products help you meet the challenge

With one of the largest distribution networks in the industry, Chevron has the infrastructure to deliver the marine products and services you need. From our global operational reach to the depth of our experienced personnel, we stand for one thing above all else — reliability.





reliable products that won't let you down



Clarity marine EA lubricants are ashless, premium oils that help keep your stern tube seals and deck hydraulic systems operating longer than ash type oils.

Clarity®

Clarity® Synthetic EA Grease

- On deck applications
- Lifeboat davit
- Ester based
- Corrosion inhibitor
- Excellent adhesion and water resistance

Clarity® Synthetic EA Hydraulic Oils

- Hydraulic equipment: vane, piston, gear pumps
- HEPR based
- Low temperature pumpability
- Non-sheening
- Excellent water separability
- Broad seal compatibility
- Excellent oxidative stability

Clarity® Synthetic EA Gear Oil

- Gear applications in marine environments
- HEPR based
- Excellent water separability
- Non-sheening
- Broad seal compatibility
- Excellent oxidative stability



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Chevron



marine lubricants product list

the complete range of high-performance
marine lubricants

solutions for your journey

We have regulation-ready, taro almost every compliant fuel requi whichever operational route you cho

Chevron products are subject to extensive field tests, and are designed available at major ports all around the globe. The following table gives a b details, please refer to individual product information at chevronmarineproc

Product List

	SAE or ISO VG	Density 15°C kg/l	Kinematic Viscosity mm ² /s (cSt) @		Viscosity Index	Flash Point °C
Slow-speed Engine Oils						
Taro® Ultra 20	50	0.90	—	19.0	>95	230
Taro® Ultra 40	50	0.92	—	19.0	>95	270
Taro® Ultra 70	50	0.93	—	19.0	>95	270
Taro® Ultra 100	50	0.95	—	19.0	>95	270
Taro® Ultra 140	50	0.98	—	19.0	>95	270
Veritas® 800 Marine 30	30	0.89	111.0	11.9	95	240
Medium-speed Engine Oils						
Taro® 20 DP 30 (X)*	30	0.90	94.0	11.0	102	240
Taro® 20 DP 40 (X)*	40	0.90	135.0	14.0	100	240
Taro® 30 DP 30 (X)*	30	0.91	94.0	11.0	104	240
Taro® 30 DP 40 (X)*	40	0.91	135.0	14.0	105	240
Taro® 40 XL 40 (X)*	40	0.90	135.0	14.0	105	240
Taro® 50 XL 40 (X)*	40	0.91	135.0	14.0	106	240
Delo® 1000 Marine 30	30	0.89	102.0	11.6	100	240
Delo® 1000 Marine 40	40	0.89	135.0	14.0	100	240
Delo® SHP SAE 30	30	0.89	104.0	11.8	100	240
Delo® SHP SAE 40	40	0.89	135.0	14.0	100	240
Delo® 710 LE SAE 20W-40	20W-40	0.88	—	15.5	—	—
High-speed Engine Oils						
Delo® 400 MGX SAE 15W-40	15W-40	0.88	—	14.6	—	228
Delo® Gold Ultra SAE 15W-40	15W-40	0.89	115.4	15.2	138	230
Delo® 400 XSP SAE 5W-40	5W-40	0.85	—	15.4	—	—
Delo® 400 SAE 40	40	0.89	—	14.7	—	—
Delo® 100 Motor Oil SAE 40	40	0.89	131.0	14.5	109	270

* Depending on the port designated, products may be delivered with or without the (X) identifier (e.g., Taro 40 XL 40X or Taro 40 XL 40). How

Custom-made solutions covering All requirements, delivering peace of mind Everywhere, wherever in the world you are.

to meet or exceed original engine manufacturer requirements. Supply is
 brief description and typical physical properties of each product. For more
 products.com, or contact your local Chevron representative or marketing office.

Pour Point °C	Base No. (BN)	Product Description
-12	20.0	High performance 20 BN cylinder oil formulated for large bore two-stroke engines operating on 0.1% sulphur fuels, including ECA zones and LNG operations.
-15	40.0	High performance 40 BN cylinder oil for large bore two-stroke engines operating on fuels with a sulphur content up to 1.5%, as well as intermittent ECA zone operations.
-15	70.0	High performance 70 BN cylinder oil for large bore two-stroke engines, compatible with a wide variety of fuels.
-15	100.0	High performance 100 BN cylinder oil suitable for use with a wide range of large bore two-stroke engines with a sulphur content of 1.5% and above, including scrubber equipped vessels.
-15	140.0	High performance 140 BN cylinder oil for large bore two-stroke engines operating on fuels with a sulphur content above 1.5%. Optimized for combating cold corrosion on scrubber equipped vessels.
-18	5.6	Large bore two-stroke slow speed engine system oil.
-12	20.0	Medium-speed engine oil. Fuel sulphur level up to 2%.
-12	20.0	Medium-speed engine oil. Fuel sulphur level up to 2%.
-12	30.0	Medium-speed engine oil. Fuel sulphur level up to 4%.
-12	30.0	Medium-speed engine oil. Fuel sulphur level up to 4%.
-12	40.0	Medium-speed engine oil. Fuel sulphur level up to 4.5%.
-12	50.0	Medium speed engine oil. Fuel sulfur level up to 4.5%. Suitable for operation on fuel of high sulfur content in combination with a low natural engine oil consumption.
-18	12.0	Medium-speed engine oil. Fuel sulphur level up to 1.5%.
-18	12.0	Medium-speed engine oil. Fuel sulphur level up to 1.5%.
-15	12.0	High performance SAE 30 diesel engine oil for medium- and high-speed trunk piston diesel engines operating under severe conditions.
-18	12.0	High performance SAE 40 diesel engine oil for medium- and high-speed trunk piston diesel engines operating under severe conditions.
-27	—	High performance zinc- and chlorine-free multi-grade diesel engine system oil.
-36	9.6	High-speed diesel engine oil with low saps. API CJ-4 performance.
-39	10.2	Standard mineral multi-grade four-stroke trunk piston engine oil on light fuels.
-46	10.0	Mixed-fleet engine oil for naturally aspirated and turbocharged four-stroke diesel and gasoline engines.
-24	10.1	Monograde of SAE 40 viscosity for four-stroke trunk piston engine on light fuels.
-24	7.3	Low ash, two-stroke diesel engine oil for Detroit Diesel engines.

However, the product typical test data both with or without the (X) identifier are miscible and fully compatible.

	SAE or ISO VG	Density 15°C kg/l	Kinematic Viscosity mm ² /s (cSt) @		Viscosity Index	Flash Point °C
			40°C	100°C		
Compressor Oils						
Capella® HFC 32	32	1.00	32.0	5.7	119	>240
Capella® HFC 55	55	1.01	53.0	8.4	132	>270
Capella® HFC 100	100	0.97	100.0	11.4	100	>260
Capella® Low Temp AB 68	68	0.87	68.0	6.5	—	190
Capella® WF 32	32	0.90	30.0	4.4	6	168
Capella® WF 68	68	0.91	64.0	6.5	13	179
Cetus® DE 100	100	0.96	96.0	10.1	—	252
Cetus® PAG	—	1.06	185.0	35.0	—	260
Cetus® PAO 46	46	0.84	46.0	8.1	150	232
Cetus® PAO 68	68	0.85	68.0	10.4	140	240
Compressor Oil EP VDL 100	100	0.89	100.0	11.3	97	248
Capella® A 68	68	0.84	68.7	10.6	143	260
Specialty Products						
1000 THF®	—	0.87	59.0	9.3	145	235
Delo® Gear EP-5 SAE 80W-90	—	0.88	135.0	14.3	101	150
Havoline® ATF III-H	—	0.86	34.1	7.0	171	—
Havoline® Outboard 2T	—	0.87	54.0	8.7	138	134
HDAX® 5200 Low Ash Gas Engine Oil SAE 40	40	0.88	—	13.5	—	—
Texatherm® 32	32	0.86	32.0	5.5	106	220
Texatherm® 46	46	0.86	46.0	6.9	105	235
Gear Oils						
Meropa® 68	68	0.88	68.0	8.8	100	200
Meropa® 100	100	0.88	100.0	11.4	100	200
Meropa® 150	150	0.89	150.0	14.9	100	215
Meropa® 220	220	0.89	220.0	19.2	100	215
Meropa® 320	320	0.90	320.0	24.3	100	215
Meropa® 460	460	0.90	460.0	30.0	100	215
Meropa® 680	680	0.90	680.0	36.5	95	240
Meropa® MG 100	100	0.89	100.0	11.3	99	234
Meropa® MG 150	150	0.90	150.0	14.8	98	254
Meropa® MG 220	220	0.90	220.0	19.0	97	268
Meropa® EliteSyn WS 150	150	1.05	150.0	25.0	227	284
Meropa® EliteSyn WS 220	220	1.06	220.0	42.0	241	284
Meropa® EliteSyn WS 460	460	1.07	460.0	83.0	262	284
Meropa® EliteSyn WS 680	680	1.07	680.0	122.0	272	284
Meropa® Synthetic EP 150	150	0.85	150.0	18.8	150	244
Meropa® Synthetic WM 320	320	0.85	320.0	35.4	156	240
Meropa® WG 460	460	—	439.0	30.0	97	284
Pinnacle® Marine Gear 220	220	0.89	220.0	22.7	115	250
Hydraulic Oils						
Rando® HDZ 15	15	0.88	15.0	3.9	155	144
Rando® HDZ 22	22	0.95	22.0	5.0	165	165
Rando® HDZ 32	32	0.87	32.0	6.3	151	200
Rando® HDZ 46	46	0.87	46.0	8.2	154	215
Rando® HDZ 68	68	0.88	68.0	11.0	150	222
Rando® HDZ 100	100	0.88	100.0	14.2	139	236
Clarity® Hydraulic Oil AW 100	100	—	95.0	13.8	145	260
Clarity® Synthetic Hydraulic Oil AW 32	32	—	32.5	7.0	183	220
Clarity® Synthetic Hydraulic Oil AW 46	46	—	46.5	9.3	183	225
Clarity® Synthetic Hydraulic Oil AW 68	68	—	68.5	11.8	162	240
Hydraulic Oil 5606®	15	0.87	15.0	5.5	300+	82
Turbine Oils						
GST® Premium 32	32	0.86	31.5	5.4	105	224
Regal R&O® 32	32	0.88	30.4	5.2	100	220
Regal R&O® 46	46	0.87	43.7	6.5	98	224
Regal R&O® 68	68	0.86	64.6	8.4	99	245
Regal R&O® 100	100	0.88	95.0	10.8	97	215
Regal R&O® 320	320	0.89	43.7	6.5	98	252
Regal SGT® 22	22	—	25.6	5.1	123	270



Pour Point °C	Base No. (BN)	Product Description
-57	—	Refrigeration compressor oil, for chlorine-free refrigerants such as R134a, R404a, and R507.
-51	—	Refrigeration compressor oil, for chlorine-free refrigerants such as R134a, R404a, and R507.
-30	—	Refrigeration compressor oil, for chlorine-free refrigerants such as R134a, R404a, and R507.
-42	—	Synthetic (alkylbenzene based) refrigeration compressor oil for ammonia and R22 or R502 at low evaporator temperatures.
-39	—	Refrigeration compressor oil, for ammonia, methylchloride, CO ₂ and certain types of (H)CFC refrigerant gases.
-33	—	Refrigeration compressor oil, for ammonia, methylchloride, CO ₂ and certain types of (H)CFC refrigerant gases.
-39	—	Synthetic (diester based) lubricating oil for reciprocating air compressors.
-30	—	Synthetic (PAG based) lubricating oil for chemical & hydrocarbon gas compressors (including LNG & LPG).
-46	—	Synthetic (PAO-based) lubricating oil for rotary air compressors.
-47	—	Synthetic (PAO-based) lubricating oil for rotary air compressors and turbochargers.
-12	—	Mild EP oil for reciprocating air compressors.
-57	—	Synthetic (PAO-based) lubricating oil for the lubrication of compressors used in refrigeration and air-conditioning systems with ammonia, carbon dioxide and halogenated refrigerants.
-42	—	High quality, multifunctional tractor hydraulic fluid.
-52	—	Automotive gear lubricant suitable for API GL-5 applications.
-50	—	Automatic transmission fluid.
-39	5.7	Two-stroke marine outboard oil, formulated with an ashless additive system.
-33	4.2	Low ash gas engine oil.
-15	—	Heat transfer fluid for temperatures up to 320°C (max. film temperature 340°C).
-15	—	Heat transfer fluid for temperatures up to 320°C (max. film temperature 340°C).
-15	—	Extreme pressure industrial gear lubricant.
-15	—	Extreme pressure industrial gear lubricant.
-15	—	Extreme pressure industrial gear lubricant.
-15	—	Extreme pressure industrial gear lubricant.
-15	—	Extreme pressure industrial gear lubricant.
-15	—	Extreme pressure industrial gear lubricant.
-10	—	Extreme pressure industrial gear lubricant.
-24	—	Premium high-performance gear oil.
-25	—	Premium high-performance gear oil.
-26	—	Premium high-performance gear oil.
-42	—	Premium performance synthetic industrial gear oil (PAG based).
-42	—	Premium performance synthetic industrial gear oil (PAG based).
-36	—	Premium performance synthetic industrial gear oil (PAG based).
-33	—	Premium performance synthetic industrial gear oil (PAG based).
-48	—	Synthetic high VI gear oil of ISO VG 150.
-48	—	Synthetic high VI gear oil of ISO VG 320.
-9	—	High viscosity industrial gear and steam cylinder oil with low carbon residue.
-45	—	Synthetic high VI gear oil of ISO VG 220.
-60	—	High VI hydraulic oil.
-48	—	High VI hydraulic oil.
-48	—	High VI hydraulic oil.
-47	—	High VI hydraulic oil.
-42	—	High VI hydraulic oil.
-36	—	High VI hydraulic oil.
-40	—	Zinc-free and ashless hydraulic fluid (environmentally sensitive areas).
-45	—	Synthetic, zinc-free, ashless hydraulic oil with an environmentally acceptable formulation.
-42	—	Synthetic, zinc-free, ashless hydraulic oil with an environmentally acceptable formulation.
-42	—	Synthetic, zinc-free, ashless hydraulic oil with an environmentally acceptable formulation.
-63	—	High performance general purpose red-dyed hydraulic oil.
-14	—	Premium turbine oil for special Mitsubishi application under MS04-MA-CL002.
-15	—	Marine turbine oil, including gas turbines.
-15	—	Marine turbine oil, including gas turbines.
-15	—	Marine turbine oil, including gas turbines.
-15	—	ISO VG 100 turbine oil for steam and hydroelectric turbines.
-15	—	ISO VG 320 turbine oil for steam and hydroelectric turbines.
-57	—	Designed for use in modified aviation type gas turbines in non-aviation stationary applications such as industrial power generation and marine service.

	Thickener	Color	Penetration worked at 25°C	Average Drop Point °C	Min/ Oper Temp
Greases					
Coupling Grease®	Lithium	Dark Brown	330	190	-10 t
Delo® Starplex EP 2	Lithium Complex	Dark Red	280	230+	-35 t
Molytex® EP 2	Lithium	Dark Grey	280	210	-25 t
Multifak® EP 0	Lithium	Light Brown	370	180	-30 t
Multifak® EP 1	Lithium	Amber to Brown	325	195	-30 t
Multifak® EP 2	Lithium	Brown	280	195	-30 t
Multifak® EP 3	Lithium	Amber to Brown	235	205	-30 t
Novatex® EP 2	Calcium Anhydrous	Light Yellow	280	>140	-30 t
Rust Proof Compound L®	—	Dark Brown	280	—	55 (t
Clarity® Synthetic EA Grease	Anhydrous Calcium	Yellow	280	>140	-40 t
SRI Grease®	Polyurea	Dark Green	280	243	-20 t
Starplex® EP 3	Lithium Complex	Brown	220-250	>250	-20 t
Texclad®	Calcium	Black	280	88	-10 t
Ulti-Plex® Synthetic EP	Lithium Complex	Light Tan	315	280	-30 t

	ISO VG	Kinematic Viscosity mm ² /s (cSt) @		Viscosity Index	Flash Point °C
		40°C	100°C		
Environmentally Acceptable Lubricants[†]					
Clarity® Synthetic EA Gear Oil 100	100	100	18.0	199	185
Clarity® Synthetic EA Hydraulic Oil 100	100	100	18.8	210	193

[†] The specifications for Clarity® Synthetic EA Grease can be found in the Greases section of this product list.

	Base	Density at 20°C kg/l	Concentration (In water) %	Freeze Protection °C	C
Cooling Water Treatments					
Delo® XLC Antifreeze/Coolant – Concentrate	Ethylene-Glycol based Carboxylic Acid	1.11	50	-37	
Delo® XLI Corrosion Inhibitor – Concentrate	Water-based Carboxylic Acid	1.06	5-10	Nil	

‡ Chevron's proprietary inhibitor technology operates by attacking free radical sites on the metal surface and sealing them before corrosion begins.

The data contained in the tables above are typical values shown for information only and may vary from location to location. Cons

Additional Services

FAST™ Service

Contracted customers have access to FAST™, a comprehensive equipment condition monitoring program which reports the condition of oil in service and plots the trends of important properties of the oil.

Lubrication Charts

Each contracted vessel has a detailed lubrication chart, listing all onboard equipment, lubricants, and the suggested application based on manufacturers' recommendations. Our system enables authorized users to access details on the Internet.

OnePort™

Authorized users can use this Internet-based ordering system to check prices at different ports, place orders and track deliveries through the various stages of supply.

Max Operating Temp °C	NGLI-Class	Description/Application
to 120	1	A tacky lithium grease specifically designed for lubrication of industrial flexible couplings.
to 140	2	Multi-purpose EP grease for general applications.
to 120	2	Multi-purpose EP grease containing MoS ₂ as a solid lubricant for high load applications.
to 120	0	Multi-purpose EP grease for general applications.
to 120	1	Multi-purpose EP grease for general applications.
to 120	2	Multi-purpose EP grease for general applications.
to 120	3	Multi-purpose EP grease for general applications.
to 110	2	Water resistant extreme pressure calcium-12-hydroxystearate grease.
max)	L	Soft film rust preventive for relatively long-term protection of iron and steel components.
to 100	2	This multi-purpose biodegradable EP grease offers excellent adhesion and water resistance.
to 140	2	Specially formulated grease containing a highly refined paraffinic base oil, synthetic polyurea ashless organic thickener and high-performance rust and oxidation inhibitors.
to 150	3	High performance multipurpose grease, formulated for long-term service in roller-and ball-bearing applications, operating at high temperatures and under high loads.
to 60	2	Calcium grease with graphite and MoS ₂ for open gears, wire ropes & general grease points of deck equipment.
to 230	1.5	Synthetic multi-purpose and high-performance grease for high and low temperature applications.

Temp °C	Pour Point °C	Description/Application
	-39	Environmentally Acceptable, VGP compliant gear oil.
	-48	Environmentally Acceptable, VGP compliant hydraulic and stern tube oil.

Toxic Classification	Seal Compatibility	Content on Nitrite; Amine Phosphate Borate, Silicate	Color	Description/Application
Harmful	No adverse effect on rubber hoses & gasket materials.	Nil	Orange	Long-life protection against freezing, boiling, corrosion [†] .
Low		Nil	Green	Long-life corrosion protection [†] .

also providing a very efficient heat transfer.

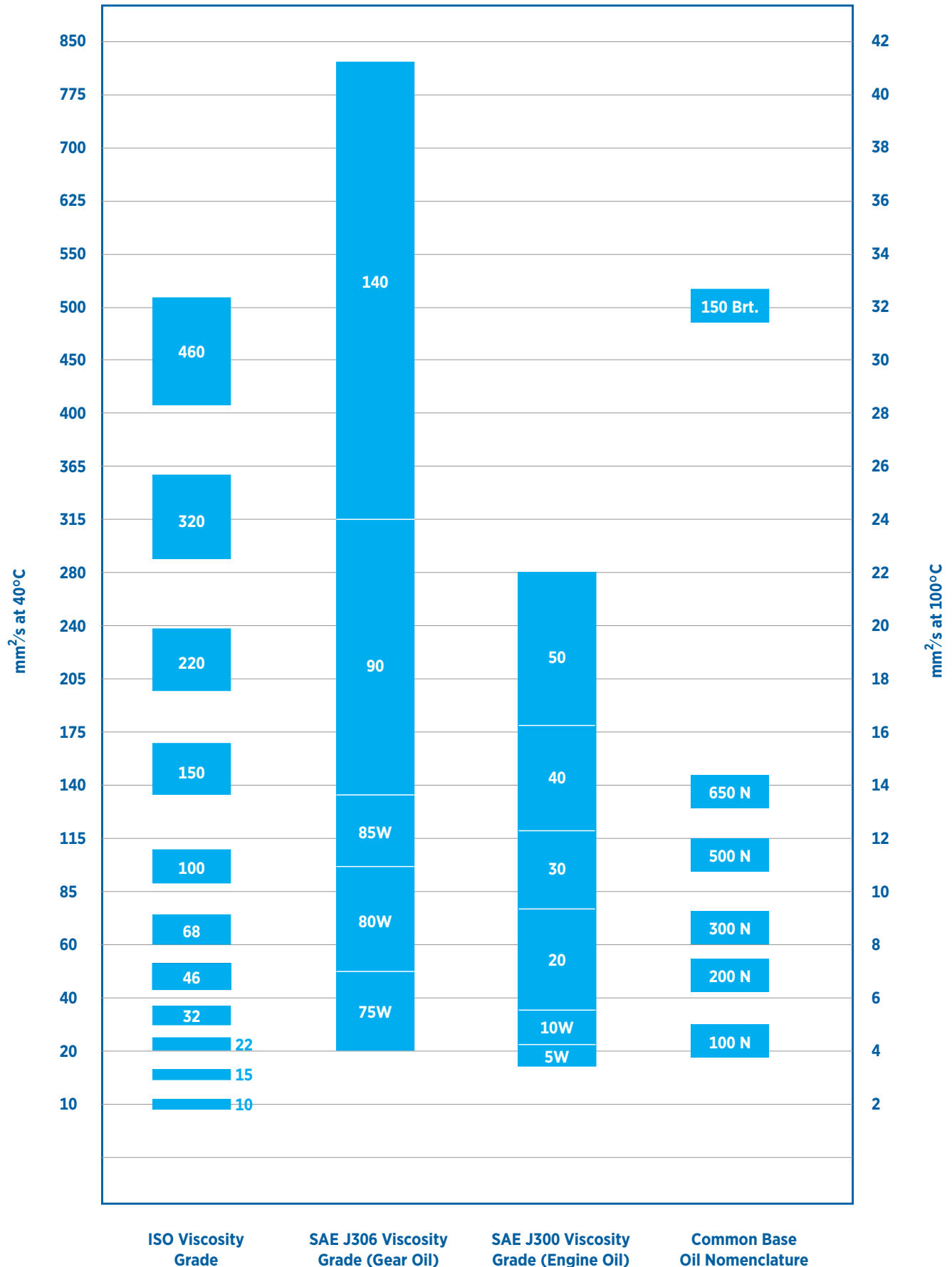
Consult your original equipment manufacturer for recommendations about selecting the appropriate product for your equipment.

DOT.FAST® Service Contracted customers have access to DOT.FAST®, a complete service including the Drip Oil Analyzer for onboard testing of used cylinder drain oil samples (drip oil) and regular laboratory analysis with expert advice from experienced engineers. Drip Oil Analysis is recommended by the major slow-speed engine builders to better understand piston running conditions in the engine.

Vessel Optimization To protect the equipment that drives your business, Chevron has developed a vessel optimization support program — supported by our industry-experienced technical field staff and lubricants analysis experts — providing advice to reduce your total cost of operation, maximizing uptime and improving reliability. Contact your account manager to find out how Chevron Marine Lubricants can optimize your operation.



Comparative Viscosity Classifications





Our Family of Brands

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

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marine lubricants

technical services





FAST[™] lubricant analysis services

**maintain and protect crucial equipment onboard
and increase the efficiency of your vessel**





protecting your assets in a changing world

The marine industry has experienced great change over recent years and with even more change on the horizon with global sulphur limit legislation, it's more important than ever to protect and ensure optimal operation of your vessels equipment.

In recent years the global marine industry has seen tremendous changes triggered by:

- demand for more efficient engines
- increased environmental awareness and legislation
- global upward pressures on fuel and lubricant prices
- changes in residual fuel oil quality



the range of FAST™ lubricant analysis services:

1. FAST Service..... page 3
2. FAST OnBoard page 7
3. DOT.FAST® Service page 8
4. Sweeptest page 14
5. XLC/XLI Refractometers page 15

1



scan to watch a
YouTube video about
our FAST™ Service

FAST™ Service



Tools and technical
support to optimize the
efficiency of your engine.

Predictive measures and analysis play a vital role in the maintenance of equipment on board your vessels, and Chevron's FAST™ service can help you identify contamination and wear — **before** it results in costly downtime.

What is FAST?

FAST is a comprehensive fluid analysis service performed in our ISO 17025 certified labs. FAST helps protect your vessels, with online access to a readily accessible database of fluid analysis reports and expert commentary.





FAST™ features and benefits

The advantages of using FAST™ for managing and monitoring the condition of all lubricated equipment on board are numerous:

- ✓ Accurate results on diverse test packages and flexibility for specialized testing procedures
- ✓ Reliable interpretations of test results and actionable recommendations based on the data
- ✓ Reports which have been optimized for readability
- ✓ Expert advice on reports via helpdesk: CMLfast@chevron.com
- ✓ Samples are tested at our dedicated ISO certified laboratories in Belgium and China
- ✓ Cost-effective standard and specialty tests
- ✓ Online access to complete historical records (downloadable through Excel® 5.0 or higher)





what you can expect from implementing this program

FAST™ enables you to track the performance of equipment that your business depends on to get your cargo to points around the globe on time and without incident.

By analyzing operating fluid on a regular basis, you can optimize equipment life and oil replacement

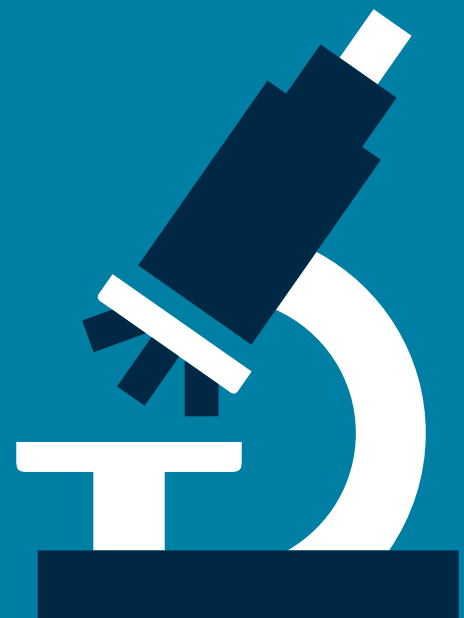
intervals — and identify issues before they result in damage — through follow up on the trends of the different parameters.

This knowledge helps in the precise scheduling of maintenance work that can help reduce downtime and minimize the risk of equipment failure.

complete fluid analysis for improved marine reliability

The FAST program provides comprehensive analyses for all vessel equipment that requires lubricating oil, greases or coolants. Our stern tube advanced testing, for example, complies with the requirements of the major shipping classification societies.

A FAST report with satisfactory results on the analysis of the stern tube lubricant is a valuable tool when considering the extension of the period between dry-dockings for classification surveys.



ISO 17025 certified laboratories

Chevron's laboratories are some of the best equipped in the marine industry. With facilities in China and Belgium we deliver reliable, expert support wherever you are in the world.

Our global marine team is on call to accurately diagnose the condition of your equipment — FAST!



the FAST™ process

Submitting samples for FAST™ analysis is as easy as 1-2-3.



Prepare sample and complete the information on Label 3.



Add Label 2 to the bottle, keeping Part 1 for your records.



Send the sample bottle along with Label 3 in the sample bag provided.

Customers calling at China mainland ports can send samples to our FAST Chinese laboratory. All other samples should be mailed to our laboratory in Belgium. Most sample analysis will be completed within 24-48 hours of receipt, and your reports are conveniently delivered by email. Address labels can also be downloaded from the Chevron Marine Lubricants website.

standard test packages

FAST simplifies the process of testing with a list of standard tests for frequent, typical applications. Samples are analyzed according to a particular test schedule, depending on the type of lubricant and the application. Examples of typical analysis are indicated to the right.

Engine Oils

- Appearance
- Water
- Viscosity@40°C
- Base Number
- Soot Load, %wt
- Flash point
- Additive elements
- Wear elements
- (Nature of water*)

* on stern tube and thruster systems

Non-Engine Oils

- Appearance
- Water
- Viscosity@40°C
- Wear elements
- Additive elements
- Total Acid Number
- (Nature of water)

For more information on standard test packages, visit www.chevronmarineproducts.com

FAST™ Service

Condition Monitoring Report

Vessel **GLOBAL TRANSPORTER**
 System **MAIN ENGINE BEFORE FINE FILTER**
 IMO Number **99999999**
 Customer **GLOBAL TRANSPORT CORP**
 Log in **XXXXXXX**

No action required

Current Product		VERITAS 800 MARINE 30		Latest Sample	Report Date: 06/02/2017
Lab Number	20455324	21202856	21208713	20365850	21079476
Request No	20455324	21202856	21208713	20365850	21079476
Product	VERITAS 800 MARINE 30 UNKNOWN	VERITAS 800 MARINE 30	VERITAS 800 MARINE 30	VERITAS 800 MARINE 30	VERITAS 800 MARINE 30
Port	JACKSONVILLE, FLA. LAKE CHARLES, LA.	SAVANNAH, GA.	LAKE CHARLES, LA.	TAMPA, FLORIDA	25/01/2017
Date Sampled	19/12/2015	16/03/2016	19/10/2016	25/01/2017	26/01/2017
Date Landed	20/12/2015	20/06/2016	20/10/2016	03/02/2017	11/05/2017
Date Received	12/01/2016	31/03/2016	25/10/2016	17/11/2016	17/11/2016
Product Service Hrs	109494	112171	114517	115829	115829
Total Equipment Hrs	110747	112171	113758	115770	117182
Consumption Hrs	0	30	65	70	70
Condition	Normal	Normal	Normal	Normal	Normal
APPEARANCE	Black	Black	Brown	Brown	Black
WATER CONT. %	Negligible	Negligible	Negligible	Negligible	Negligible
WIL. VISCOSITY @40°C	117.37	117.92	116.31	116.31	116.31
BETA FLASH °C	>190	>190	>190	>190	>190
SOOT LOAD %	0.25	0.23	0.21	0.27	0.25
BASE NUMBER (CIBAC) mg/kg	7.2	7.6	7.6	7.1	7.7
Element Analysis 1:					
CALCIUM ppm	3187	3214	3188	3084	3122
ZINC ppm	267	256	268	263	262
PHOSPHORUS ppm	230	221	213	226	227
BORON ppm	1	2	2	1	1
IRON ppm	8	8	7	8	6
COPPER ppm	13	14	11	11	11
LEAD ppm	3	1	2	0	1
CHROMIUM ppm	0	0	0	0	0
VANADIUM ppm	10	9	8	8	6
ALUMINUM ppm	0	0	0	0	0
SILICON ppm	3	3	4	4	4
TIN ppm	0	0	1	2	0
NICKEL ppm	4	4	3	3	2

Latest Comments (NORMAL) PRODUCT IS CONSIDERED SUITABLE FOR FURTHER SERVICE.

Please note that Chevron provides this FAST Report, and the comments and information contained herein for guidance only. Nothing provided represents an endorsement of any product or type of engine. Chevron assumes that the samples are representative. Chevron has relied upon the information provided to make the recommendation set forth in this Report. Responsibility for taking action, based on information contained in this FAST Report, lies solely with the customer or end user.

Page 1 of 2

the FAST report

As soon as the lab has completed testing your samples, our in-house experts review the data and provide comprehensive comments and recommendations. Each report includes a traffic light icon, indicating whether the condition of the sample is normal or if further action needs to be taken. The reports also contain historical data for follow up on the trends of the different parameters, providing operators with a full overview of the condition of their equipment.



2

FAST™ OnBoard

The FAST OnBoard test kit from Chevron Marine Lubricants offers ship engineers a compact, portable and easy-to-use array of tests to quickly and accurately assess the performance of oils used aboard their vessels.



Benefits of FAST OnBoard

- Portable, lightweight, robust kit
- Fast and easy to use
- Suitable for lubricants, hydraulic, gear, compressor and fuel oils
- Immediate test results, no 'lab lag'
- Continuity in sampling and testing regime
- Key oil parameters monitored
- Non-hazardous reagents
- Supplied with full instruction manual
- Allows the user to monitor trends
- Greater optimization when used alongside DOT.FAST®

FAST OnBoard features by application

Application	Water	Base Number	Insolubles	Viscosity	Salt Water
New diesel engine oil	✓	✓	✓	✓	✓
Used diesel engine oil	✓	✓	✓	✓	✓
Cylinder/Scrapedown oil	✓	✓			
Hydraulic oil	✓			✓	✓
Gear oil	✓			✓	✓
Greases	✓				
Compressor oil	✓		✓	✓	
Turbine oil	✓		✓	✓	
Heavy fuel oil (HFO)	✓			✓	✓
Marine gas oil (MGO)	✓				✓
Diesel fuel	✓		✓		✓

Accurately trend the performance of the oils used aboard your vessels.



Multi-parameter test features

Water — The supplied water test cell, with its easy-to-read digital display, provides instructions and results at various concentrations from 200–10,000 ppm, 0–10%.

Base Number — Utilizing the same reaction cell used for water, the FAST OnBoard Kit reports the used BN value for oils up to 150 BN.

Insolubles — Chromatography papers easily display soot/ carbon accumulation in the lubricating oil. High insoluble content in engine oils can be caused by poor combustion, poor filtration/separation, or keeping the oil in service for too long. High soot content can lead to increased viscosity and filter blocking.

Viscosity Comparator — Recognized as one of the most important oil characteristics, the Viscostick provides a direct comparison of a used oil viscosity against a sample of the new oil, helping to identify fuel dilution, oxidation, emulsification issues.

Salt Water Determination — A simple colour change pad easily indicates Sodium Chloride contamination from seawater.

Why should you use FAST OnBoard?

- Identifies earliest onset of change in the condition of your asset
- Allows engineers to take immediate action based on results
- Enables identification and use of correct grades and types of oil
- Encourages a monitoring culture on-board vessels
- Regular testing of critical operating equipment saves costs



3



scan to watch a
YouTube video about
our DOT.FAST® Service

DOT.FAST® service



“Continuous monitoring of drain oil samples is a good way to optimize the cylinder oil feed rate and consumption and to safeguard the engine against excessive wear. The fastest way to evaluate the corrosive behavior of an engine and optimize the feed rate is to do a stress test, a so-called sweep test. It can also be used in the ACC familiarization period to find the suitable lube oil feed rate for your particular engine, operating pattern and lube oil used.”

MAN Energy Solutions SE

“Measuring the total iron content of piston underside drain oil with Chevron’s DOT.FAST® Service provides very valuable feedback of the piston running conditions in each cylinder, and allows operators to optimize cylinder oil feed rates for a specific set of operating conditions.”

Wärtsilä Switzerland



why should your fleet use drip oil analysis?

With IMO 2020 bringing the greatest change to the marine industry in many years, it's critical to ensure optimized engine operation as you navigate change. Whatever your 2020 compliance option, DOT.FAST will help you reduce wear and corrosion, ensure the correct feed-rate and increase engine efficiency.

For this reason, it is now more important than ever to better understand and balance conditions in your engine.

Drip oil analysis can give you the answers and is recommended by the major slow speed 2-stroke engine OEMs (MAN Energy Solutions SE & Winterthur Gas & Diesel Ltd.). Analysis of unburned cylinder lubricant which has passed the piston and rings to the main engine stuffing box is an effective way to monitor engine wear using DOT.FAST.



The DOT.FAST Onboard Test Kit consists of the Drip Oil Analyzer, pipette, DispoRack™, and DOT.FAST Onboard Software.

“It is MAN’s experience that, in addition to regular scavenge port inspections, drip oil analysis can be a very useful tool to monitor combustion and cylinder conditions.

“Drip oil analysis can detect changes in cylinder liner wear and help to optimize the cylinder oil feed rate.

“Chevron’s DOT.FAST® Service makes it possible to monitor, both onboard and onshore, the total amount of adhesive, abrasive and corrosive wear.”

MAN Energy Solutions SE



the DOT.FAST[®] service provides your fleet with accurate and comprehensive onboard and onshore analysis of drip oil, and takes the *total iron wear* into account

Everything you need to get started is supplied with your first order, where we then make sure that with every DOT.FAST onboard analyzer at least one DispoRack is included.



Chevron's Drip Oil Analyzer and MicroMan[®] Pipette



DispoRack[™] with 12 ITUs (Iron Testing Units)

onboard analysis

The benefits you may receive from onboard analysis include:

- Reliable OnBoard wear measurement with laboratory accuracy
- Immediate feedback on cylinder running conditions
- Optimized cylinder lubrication at different engine operating modes
- Early indication of elevated engine wear of any type
- Minimized build-up of abrasive deposits and engine fouling
- Reduced risk of scuffing
- Minimized cylinder oil consumption by optimizing cylinder oil feed rate
- Combined with on board testing of the Base Number, it is possible to determine if the wear is of corrosive nature.
- Easy compliance with engine builders' recommendations
- Better engine protection while fuels of varying quality and catfine content are in use
- Increased time between overhauls
- Predictive maintenance and less downtime, i.e., Condition Based Monitoring (CBM)
- Monitoring of running-in of new units
- A valuable complement to regular engine inspections

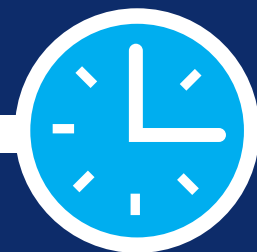
onshore analysis

The additional benefits of onshore analysis may include:

- Testing of drip oil samples via highest industry standards in two quality certified laboratories
- Comprehensive reporting with to-the-point commenting considering the full picture
- Monitoring effectiveness of fuel purification through measurement of CAT Fines
- Identifying excessive system oil leakage (for example, through stuffing box glands)
- Monitoring of piston ring groove wear
- Indication of blow-by

250 running hours

Recommended sampling frequency for **Onboard** Drip Oil Analysis (or each time the vessel switches to a new batch of HFO).



1,000 running hours

Recommended sampling frequency for **Onshore** Drip Oil Analysis.



DOT.FAST SERVICE Drip oil analysis report

Vessel

IMO number

Customer name

System

Engine type

MAIN ENGINE

MAN-B&W 7560MC-C @ 105 RPM

Current drip oil sample batch

Sample batch data

Date sampled 03 September 2018
Date received in lab 08 September 2018
Date reported 09 September 2018

Cylinder lubrication

Cylinder	Product	Feed rate (g/kWh)
1	TARO ULTRA 70	0.70
2	TARO ULTRA 70	0.70
3	TARO ULTRA 70	0.70
4	TARO ULTRA 70	0.70
5	TARO ULTRA 70	0.70
6	TARO ULTRA 70	0.70
7	TARO ULTRA 70	0.70
8		
9		
10		
11		
12		
13		
14		

Engine operation data

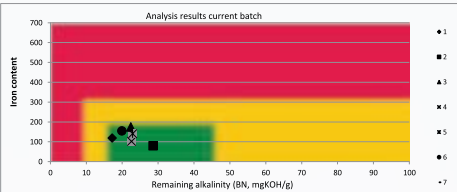
Total engine running hours 57329 h
Max. power (MCR) 15800 kW
Actual average engine load 72 %MCR
Overall cylinder oil feed rate 0.70 g/kWh

Fuel data

Sulfur content 2.48 %wt
Aluminum content 4 ppm
Silicon content 7 ppm
Kinematic Viscosity @ 50°C 361.3 mm/s²

Oil feed rate factor

(overall) 0.28 g/(kWh*5%wt)



Current sample batch Comments

The levels of the wear metals are within normal limits except for unit 3 has high copper wear. Copper could originate from running-in ALU-coating of the piston ring pack, copper sliding rings on the piston skirt, stuffing box material or the scavenge air cooling system. The remaining alkalinity ("residual BN") are within normal limits. No action is required.

Chevron recommends to operate the engine in line with the recommendations of the engine manufacturer. Adjustments to cylinder oil feed rate should be monitored closely to ensure safe engine operation and keep the wear rates at the desired level. Chevron provides this report and the comments and information herein for guidance only. Nothing provided represents an endorsement of any product or type of engine. Chevron assumes that the samples are representative. Chevron has relied upon the information provided to make the recommendation set forth in this report. The responsibility for taking action based on information contained in this report lies solely with the customer or end user.



field experience

The DOT.FAST® Service was evaluated in cooperation with operators and equipment builders in the marine and power generation industries.

In field tests onboard Wallenius Marine's M/V *Undine* and Suisse Atlantique's M/V *Général Guisan*, lubrication engineers and crew members found the DOT.FAST Drip Oil Analyzer to be both effective and easy to operate.

Chevron's laboratories provide complete analysis of your samples with review and comments by technical experts.



Balancing cylinder lubrication



the sulphur/base balance

High sulphur fuel oil burns to produce oxides of sulphur (SO_x) during combustion. In the presence of water, these SO_x form sulphuric acid which causes corrosion in the engine; different levels of sulphur in the fuel oil contribute to varying levels of acidity.

One task for the cylinder oil is to protect the engine from acidic corrosion. This is achieved by the alkalinity of the cylinder oil, defined by its base number (BN) and its feed rate. Too much alkalinity however, will result in the formation of excessive abrasive deposits on the piston crown top lands, ultimately leading to increased liner wear and scuffing.

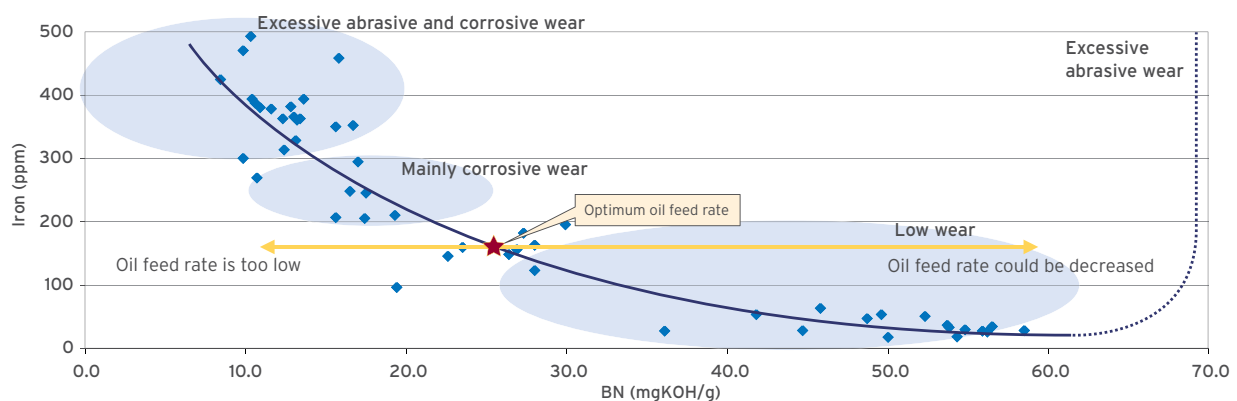
It is important to maintain the correct sulphur/base balance. This balance can be achieved by changing to a cylinder oil with an appropriate BN, by adjusting the cylinder oil feed rate or a combination of the two. Chevron Marine Lubricants offers cylinder oils with a very wide BN range, going from 20 BN to 140 BN (Taro® Ultra 20, Taro Ultra 40, Taro Ultra 70, Taro Ultra 100, and Taro Ultra 140).

The **total iron content** measured by DOT.FAST® indicates the total wear taking place in the engine, including corrosive wear, enabling you to make any necessary adjustments.



Fe

DOT.FAST OnBoard Drip Oil Analysis provides accurate measurement of **total iron wear** including **corrosive wear**.



This graph is based on real time data and will vary from engine to engine.

Iron Content as Function of BN



onboard analysis

The DOT.FAST® Drip Oil Analyzer is unique and innovative in the industry and delivers onboard test results with laboratory accuracy. The DOT.FAST Drip Oil Analyzer comes with everything you need to prepare and test samples, including a custom-designed DispoRack and software to record, process and interpret results.

Using the Drip Oil Analyzer once every two weeks ensures effective management of your engine's lubrication. It can also be beneficial to do onboard drip oil analysis after changing to a new batch of fuel oil or to monitor the running-in process of new overhauled units.

onshore analysis

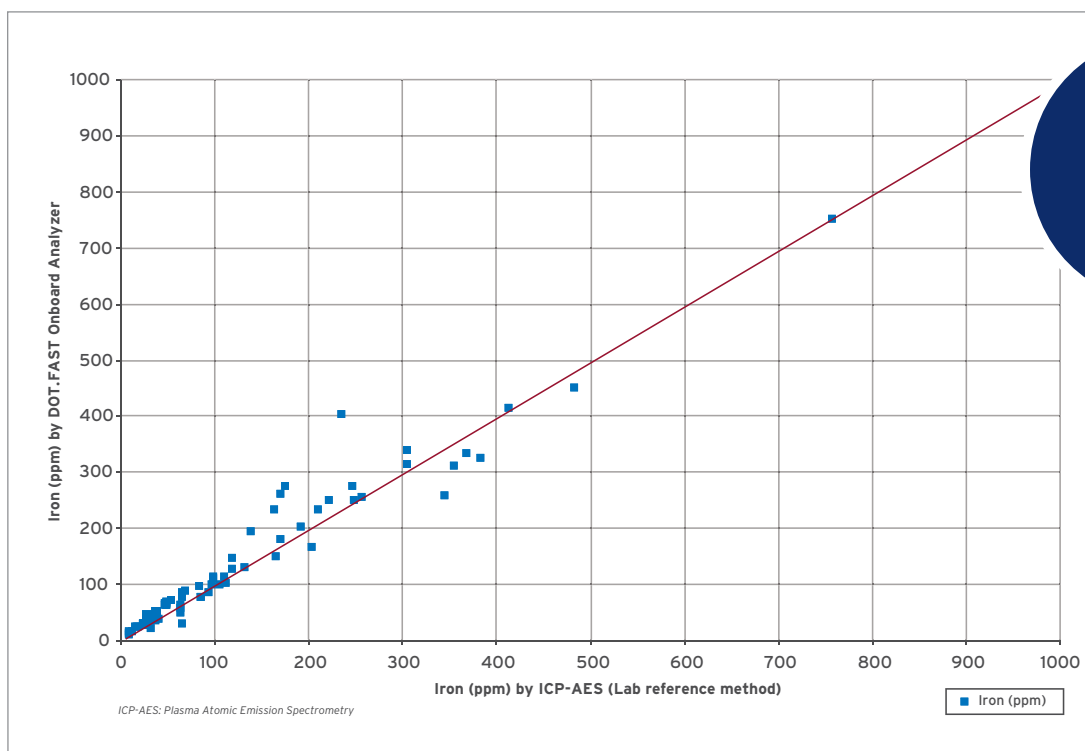
Samples sent to Chevron's laboratory are fully analyzed (base number, iron and all other elements). The results are tabulated and reviewed by technical experts.

Recommendations are reported back to the ship. Historical data is maintained and can be accessed via a password-protected Internet site.

Subscribers to the DOT.FAST Service may send a full set of samples for analysis once every two months.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

Correlation Between Onboard and Onshore Analysis



Extensive testing has shown that the DOT.FAST Drip Oil Analyzer provides unbiased results compared with ICP-AES used in a laboratory setting.



4



A feed rate sweep test is helpful in shortening the oil feed rate factor ($\text{g/kWh} \times \text{S\%wt}$) familiarization period.

sweep test sample analysis

Performing a sweep test is the shortest way to determine the optimal oil feed rate factor, bringing **valuable cost saving** efficiencies to your operation, and is recommended by major OEMs such as MAN Energy Solutions AS.

Analysis of sweep test oil samples is conducted on-shore at our ISO certified laboratories, and customers receive feedback in a fully reviewed FAST™ report within 24–48 hours of receipt of the final sample. These reports indicate what the optimum oil feed rate factor ($\text{g/kWh} \times \text{S\%wt}$) is

with the given cylinder oil in use. FAST sample kits contain everything you need to conduct the tests, including standard sized sample bottles, labels and pre-addressed envelopes for our laboratories.

sweep test sample delivery

To be included with each batch of samples:

Completed DOT.FAST® engine data sheet

Download a copy from the DOT.FAST CD-ROM or from the CML website:

chevronmarineproducts.com/en_UK/lubricants-services/dotfast-drip-oil-analysis-service.html

Batches received without this sheet will not be analyzed.

One main engine system oil used sample

Required in order to calculate the amount of system oil dilution in the drip oil samples.

Fully completed FAST sample labels for each bottle

These tests will be handled separately in the laboratory.

Testing guidelines:

- 1 For the cylinder oil to be evaluated, collect drip oil samples at different cylinder oil feed rates.** A typical approach is to start at 1.4 g/kWh and lower in steps of 0.2 g/kWh to the OEM minimum recommended. For every step, collect the samples after 24 running hours from every cylinder at the same time (complete batch of samples)
- 2 Use FAST labels** and indicate the corresponding cylinder number on the label. Fully complete a FAST label for any system oil sump tank sample included.
- 3 Always include a completed DOT.FAST engine data sheet with every batch of samples.**
- 4 Send completed sweep tests to our global FAST laboratories.** Please do not send FAST samples to the personal attention of any of our staff as this will delay processing (use addresses located on back).



5



Regular testing of the condition of your cooling water is easy with Delo® XLI and XLC cooling water treatment.

XLI/XLC refractometers

Field and laboratory tests prove that Chevron's Delo cooling water treatments provide maximum protection and last longer than traditional technologies in your marine or power generation systems.

Delo® XLI and XLC cooling water treatments combine excellent performance with long service life to help keep your engines running for longer. In fact, if Delo cooling water treatments are replenished regularly to compensate for leakage, the cooling water can be considered as fill for life. It is vital to test

the cooling water at Chevron's recommended test frequency, so, ensure to check the Delo inhibitor/glyco concentration every week, check the chloride levels once a week and do a full FAST™ analysis of all systems on a half-yearly basis.

easy, cost-effective monitoring

Save time and money by monitoring your cooling water condition with onboard testing and FAST™ services.



Refractometer testing

This method is easy to perform with Chevron's portable refractometers for Delo XLI or XLC cooling water treatment respectively, and does not require extensive sample handling or expensive equipment.

Comprehensive FAST™ reports

Chevron's FAST service provides in-depth onshore analysis of your cooling water samples at advanced global laboratories. We report on several parameters and elements in your cooling water samples, as part of our comprehensive equipment monitoring program.

Chloride and pH monitoring is easy

Delo XLI's Organic Acid Inhibitor Technology (OAT) corrosion inhibitor system is designed to protect cast iron, copper and other system metals at lower pH levels than conventional coolants. Acid and base indicator strips are used to easily measure pH balance. High chloride levels can significantly increase the risk of corrosion, and are also evidence of seawater contamination in the system.

For onboard testing, test strips can be used for quickly and conveniently measuring rough chloride levels in cooling water. Chevron recommends testing the Delo inhibitor cooling water treatment's concentration, pH value and chloride levels once a week.

Below, left to right: Chevron's Portable XLI Refractometer designed to measure % Brix, pH and chloride test strips.





all samples from any of the lubricant analysis services mentioned in this brochure are to be sent to the following addresses:

Inform the courier company that the receiver is 'Warehouse Assistant'.

Chevron Marine Lubricants — FAST Program

Chevron Technology Ghent
Technologiepark — Zwijnaarde 88
B-9052 Ghent/Zwijnaarde
Belgium
Tel: +32 9 2937141

Samples landed in mainland China can be sent to our laboratory in Shanghai:

Chevron Marine Lubricants — FAST Program

SGS-CSTC Standards Technical Services Co., Ltd
No.88 Pugong Road, Fengxian District
Shanghai Chemical Industrial Park,
Shanghai, 201507, China
上海市奉贤区化学工业区普工路88号 (201507)
Tel: +86 021 6027 6372

Search our YouTube channel for Chevron Marine Lubricants training videos on how to conduct safe, reliable tests and visit our website chevronmarineproducts.com for more FAST resources.

www.chevronmarineproducts.com



Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

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marine lubricants

DOT.FAST[®] service

quick start guide — sampling and analysis

Step 1 | Sample the drip oil



- Sample at the scavenge air drain sampling valve during stable engine running conditions.
- Flush well before sampling.
- Collect a sample of 50–100 ml in a clean plastic container.
- Transfer that sample in a FAST sample bottle for both onshore and onboard testing and identify the bottle well.



Recommended sampling frequency:

Onshore Drip Oil Analysis:
Every 2 months (~1000 running hours)

Onboard Drip Oil Analysis:
Every 2 weeks (~250 running hours)

Test frequency can be changed depending on situation, needs and experience (e.g., after using new fuels batches, after an overhaul, after a corrective action and oil feed rate adjustment, etc.).

Step 2 | Collect the data and complete the Engine Data Sheet

Note: Drip Oil samples intended for onshore analysis should always be accompanied with a complete Engine Data Sheet. The Engine Data Sheet can be found in the DOT.FAST kit, and additional copies are easily downloaded from the Chevron website at www.chevronmarineproducts.com/en_UK/lubricants-services/dot-fast.html

Chevron DOT.FAST [®] service engine data sheet		Port samples landed:		Date sampled:	Date landed:
Engine brand & type:	Number of cylinders:	Number of drip oil samples:	Lubricator type: ☐ Pulse Fuel ☐ Pulse Jet ☐ Other:		
Actual engine running hours (hr):	Actual engine speed (rpm):	Actual engine load (%MCR):	Phosor Chlorine Ring / Anti-Bore Polishing Ring installed: ☐ Yes ☐ No		
Maximum power (100%MCR) (kW):	Actual engine power (kW):	Scavenge space pressure (bar):	Scavenge space temperature (°C):	Intake air humidity (%):	Scavenge air water drain (BT246):
Total amount of scavenge drain (l/24 hr):		Total cylinder oil consumption (l/24 hr):		Cylinder oil in use (brand & type):	
Actual cylinder oil feed rate (g/hr):		Cylinder oil in use (brand & type):		Cylinder oil in use (brand & type):	
Actual fuel in use:		Fuel / Liquid fuel data:		For dual fuel operation only:	
☐ Heavy Fuel Oil ☐ Distillate Fuel Oil ☐ MGO / MDO ☐ MGO / MDO ☐ Dual Fuel engine operation ☐ Other:	Viscosity @ 40°C / 100°C (cSt) Sulfur (S) (%) Aluminum (Al) (ppm + mg/kg) Silicon (Si) (ppm + mg/kg) Vanadium (V) (ppm + mg/kg) Other:	☐ Heavy Fuel Oil (HFO) ☐ Distillate Fuel Oil (MDO) Main / gas fuel: ☐ LNG ☐ Other: Fuel mix ratio: % pilot fuel % main / gas fuel			
Remarks:					



Step 3 | Analyze the drip oil samples using the DOT.FAST® Onboard Test Kit

3.1 Always use recommended personal protection equipment.



3.2 Set up the test equipment and samples in a clean environment.



3.3 Identify the ITUs with corresponding cylinder number. Include one extra blank ITU if zeroing the Drip Oil Analyzer.



3.4 Take the oil sample correctly with the pipette and dispense in the ITU.



3.5 Close the ITU, crush ALL four ampoules and shake well. If zeroing, use the same process for the blank ITU (e.g., crush all four ampoules and shake well).





- 3.6** Tap the ITU content to the bottom and rest the ITU in a sloping position.

Rest time:	BROWN:	~1 hr
	BLACK:	~3 hrs
	CLEAR:	~1 hr



- 3.7** Prepare the Drip Oil Analyzer and zero if necessary. See the DOT.FAST® Instruction Manual, Section 3.4, Steps 11 and 17–21 for details on how to zero the Drip Oil Analyzer.

Important: do not press the ZERO button with an actual sample in place. Ensure that the cuvette is filled with clear liquid from the blank ITU (see Manual, Section 3.4, Step 20).



- 3.8** Place a cuvette in the DispoRack™ and attach a filter to the ITU.



- 3.9** Turn the ITU upside down above the cuvette and wait, allowing the liquid to separate into two layers. Then push the clear bottom layer into the cuvette until it reaches the mark.





- 3.10** Immediately place the cuvette in the Drip Oil Analyzer, read and record the result using the DOT.FAST® Worksheet.



- 3.11** Repeat for each ITU.

Note: Keep your equipment clean and free from dust. In case of spills, wipe the wet surfaces clean immediately.

Step 4 | Enter the data

Enter all test results and the recorded data from the Engine Data Sheet into the DOT.FAST Onboard Software.

Step 5 | Dispose of the waste

Dispose of used ITUs and their content according to the waste management plan required by MARPOL regulations. Empty the oil-reagent mixture from each cuvette and ITU in a suitable container that can be drained to the sludge tank. Treat and dispose the remaining plastic container as mixed waste.

For further detailed information, please refer to the DOT.FAST Instruction Manual.

For any technical inquiries about the DOT.FAST Service, please contact your local Chevron sales representative or our Technical Services Help Desk (DOT.FAST@chevron.com).

Visit www.chevronmarineproducts.com for more information and resources about the DOT.FAST Service.





DOT.FAST[®] service

engine data sheet

Attention: This data sheet is required for each batch of drip oil samples.

Batches of drip oil samples with missing/incomplete datasheets will NOT be analyzed.

- Take samples from each cylinder at the same time (complete batch of samples).
- Always use FAST labels and indicate the corresponding cylinder number on the label.
- Use a fully completed FAST label for any system oil sump tank sample included.
- Ship all samples with this completed engine data sheet to our onshore laboratory.
- This datasheet can be downloaded from <https://www.chevronmarineproducts.com/>



Vessel / facility name*:	Lloyds/IMO number*:	Port samples landed:	Date sampled*:	Date landed:
--------------------------	---------------------	----------------------	----------------	--------------

Engine brand & type*:	Number of cylinders*:	Number of drip oil samples*:	Lubricator type:	
Actual engine running hours (h)*:	Actual engine speed (rpm)*:	Actual engine load (%MCR)*:	☐ Pulse Feed ☐ Pulse Jet	☐ Alpha ACC ☐ Other:
Maximum power (100%MCR) (kW)*:	Actual engine power (kW)*:	Piston Cleaning Rings / Anti-Bore Polishing Rings installed*: ☐ Yes ☐ No		
Scavenge space pressure (bar):	Scavenge space temperature (°C):	Inlet air humidity (%):	Scavenge air water drain (MT/24h):	

Total amount of scavenge drain (l / 24 h):	Total cylinder oil consumption (l / 24 h)*:	Cylinder oil in use (brand & type)*:												
Actual cylinder oil feed rate* (g/kWh)														
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	

Actual fuel in use*:	Pilot / Liquid fuel data*:	For dual fuel operation only*:	
☐ Heavy Fuel Oil (HFO/RMA/RMB/RMD/RME/RMG/RMK) ☐ Distillate Fuel Oil (MGO / MDO/DMX/DMA/DMB/DMZ) ☐ Hybrid Fuel Oil ☐ Dual Fuel engine operation ☐ Other:	Viscosity @ 40°C / 50°C (cSt) Sulphur (S) (%wt) Aluminum (Al) (ppm = mg/kg) Silicon (Si) (ppm = mg/kg) Vanadium (V) (ppm = mg/kg)	Pilot / liquid fuel: ☐ Heavy Fuel Oil (HFO) ☐ Distillate fuel (MGO / MDO) Main / gas fuel: ☐ LNG ☐ Other:	Fuel mix ratio: % pilot fuel % main / gas fuel

* Mandatory



Remarks:



marine lubricants

DOT.FAST[®] service worksheet

DATE _____ BY _____

Cylinder Unit	Iron (ppm)	BN (mg KOH/g)	Cylinder Oil Feed Rate*
			☐ g/kWh Measured @ ☐ g/bhph ☐ Actual load ☐ 100% MCR
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

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*It is very important to keep record of oil feed rate differences between units, as this influences measured results.



marine lubricants

DOT.FAST[®] service

quick start guide — onboard software

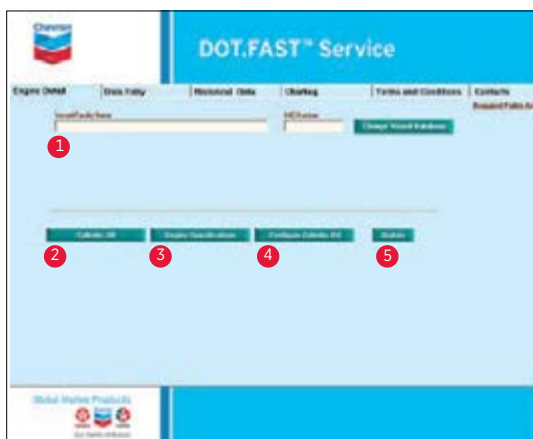
If the DOT.FAST[®] Onboard Software is **not** installed on your PC, follow Steps 1 and 2. Otherwise proceed directly to Step 3.

Step 1 | Install the DOT.FAST Onboard Software

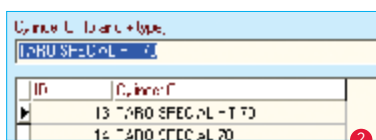


- 1.1 Insert the DOT.FAST CD into your CD drive. Select **INSTALL ONBOARD SOFTWARE** to launch the Setup Wizard.
- 1.2 Read and accept the License Agreement.
- 1.3 Select the directory where you want to install the program.
- 1.4 Click **INSTALL** and then **FINISH** to complete the installation.

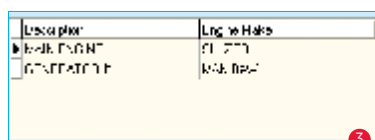
Step 2 | Enter Information about your vessel/facility



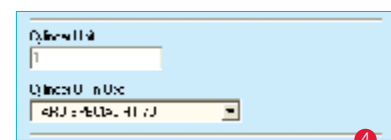
- 2.1 Enter the vessel/facility name and IMO number in the **Engine Detail** tab.
- 2.2 Click the **CYLINDER OIL** button. Enter and manage the cylinder oils used onboard your vessel.
- 2.3 Click the **ENGINE SPECIFICATIONS** button. Enter and manage required system details.
- 2.4 Click the **CONFIGURE CYLINDER OIL** button. Enter and manage cylinder oils used by each individual unit.
- 2.5 When finished, click the **UPDATE** button.



Sample from the Cylinder Oil screen.



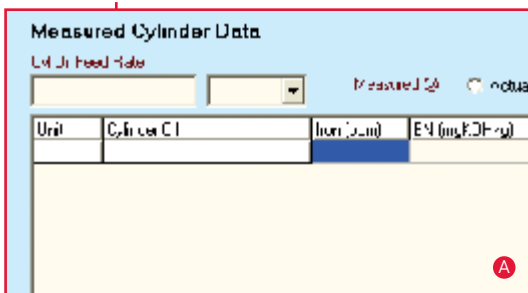
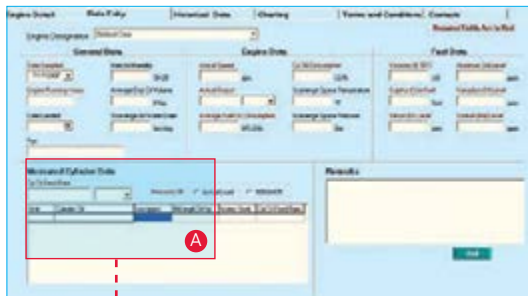
Sample from the Engine Specifications screen.



Sample from the Configure Cylinder Oil screen.

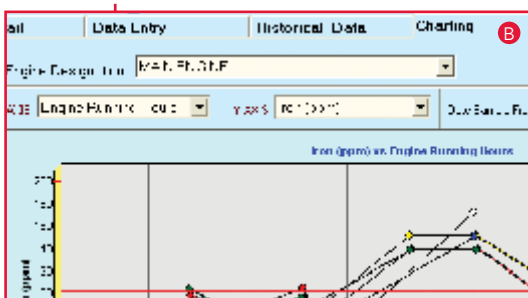
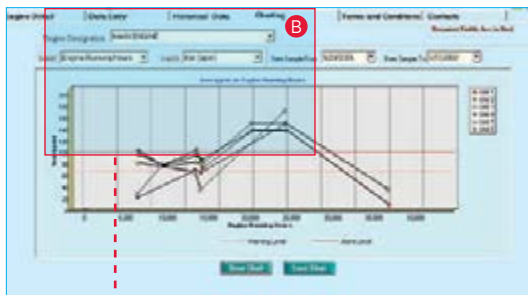


Step 3 | Enter measured results and operational data from the DOT.FAST® Worksheet and Engine Data Sheet



- 3.1 Open the **Data Entry** tab and choose a system from the **Engine Designation** drop-down menu.
- 3.2 Fill in required operational data fields.
- 3.3 In the Measured Cylinder Data section, first enter the default oil feed rate setting for the system and choose the unit of measurement. Then enter the measured data for iron, BN, and if necessary, different oil feed rate settings for individual units.
- 3.4 Provide additional information in the Remarks field (e.g., unit overhaul, running-in, etc.).
- 3.5 Click the **ADD** button to save the data.

Step 4 | View trending charts to easily interpret the data



- 4.1 Open the **Charting** tab and choose a system from the Engine Designation drop-down menu.
- 4.2 Select trending parameters for the **X-axis** and **Y-axis** from the drop-down menus.
- 4.3 Choose a date range from the **Date Sample From** and **To** drop-down menus.
- 4.4 Draw the chart by clicking the **DRAW CHART** button.
- 4.5 To save or print the chart, click the **SAVE CHART** button.

Note: The default alarm and warning limits for iron and BN can be changed. See the DOT.FAST Instruction Manual for more information.



Step 5 | Update or complete unfinished data sets, print an Engine Data Sheet or export the database content to Microsoft® Excel®

Historical Data tab. Search Engine dropdown menu. Update button.

To update

- 5.1 Open the **Historical Data** tab.
- 5.2 Click on the **Engine Designation** drop-down menu to open the Search Engine.
- 5.3 Select the data set to be updated from the Search Engine.
- 5.4 Make any necessary changes. Click the **UPDATE** button to save the changes.

If needed, click on the **RESET** button to revert back to the initial settings or the **DELETE** button to remove the data set completely.

Engine Data Entry form. General Data and Engine Data sections.

To print an Engine Data Sheet

- 5.2.1 Select a data set from the Historical Data Search Engine.
- 5.2.2 Click the **ENGINE DATA SHEET** button.
- 5.2.3 Click the **PRINTER** icon.

DOT.FAST service engine data sheet form. Includes sections for Vessel/Facility name, Engine brand & type, Actual engine running hours, Maximum power, Scavenge space pressure, Total amount of scavenge drain, Actual cylinder oil feed rate, and Fuel data.

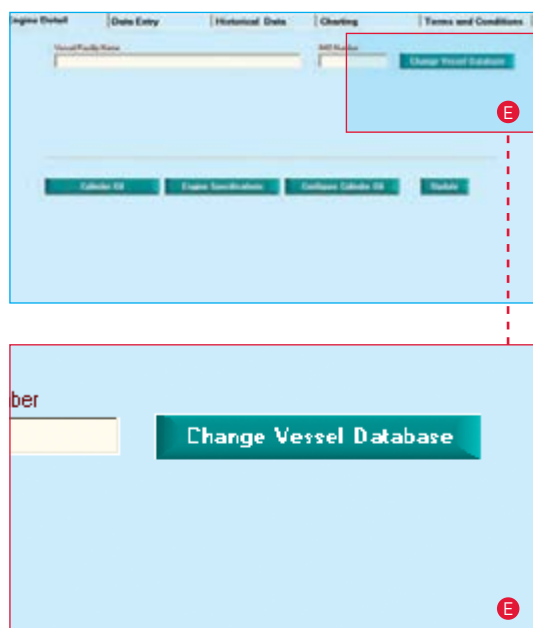
Engine Data Sheet form. Update, Delete, and Reset buttons.

To export to Microsoft Excel

- 5.3.1 Select a data set from the Historical Data Search Engine.
- 5.3.2 Click on the **EXPORT TO EXCEL** button in the **Historical Data** tab.
- 5.3.3 Enter a file name.
- 5.3.4 Select a save location, then click **SAVE**.



Step 6 | How to share or change to another vessel/facility database



Data files can be shared and opened by other users using the DOT.FAST® Onboard Software.

To share

- 6.1** Open the **DATA folder** of the DOT.FAST Onboard Software.
- 6.2** Make a copy of the data file (*.abs) you want to share.
- 6.3** Send it to another user.

To read other data files

- 6.2.1** Copy the data file into the DATA folder of your DOT.FAST Onboard Software.
- 6.2.2** In the **Engine Detail tab**, click on the **CHANGE VESSEL DATABASE** button, then click on the data file you would like to open.
- 6.2.3** Now all of the historical data and charts in that database are available and can be fully accessed by the software.

For further detailed information, please refer to the DOT.FAST Instruction Manual.

For any technical inquiries about the DOT.FAST Service, please contact your local Chevron sales representative or our Technical Services Help Desk (DOT.FAST@chevron.com).

Visit www.chevronmarineproducts.com for more information and resources about the DOT.FAST Service.





marine lubricants

sweptest sample deliveries

a DOT.FAST® service

Performing a sweptest can help improve feed rates and bring **valuable cost saving** efficiencies to your operation.

Analysis of sweptest oil samples is conducted on-shore at our ISO certified laboratories, customers receive feedback in a fully reviewed FAST™ report within 24–48 hours of receipt of the final sample. These reports indicate what the optimum ACC factor is with the given cylinder oil in use.

FAST sample kits contain everything you need to conduct the tests, including standard sized sample bottles, labels and pre-addressed envelopes for our global laboratories.

To be included with each batch of samples:

Completed DOT.FAST® engine data sheet

Download a copy from the DOT.FAST CD-ROM or from the CML website:

chevronmarineproducts.com/en_UK/lubricants-services/dotfast-drip-oil-analysis-service.html

Batches received without this sheet will not be analyzed.

One main engine system used oil sample

Required in order to calculate the amount of system oil dilution in the drip oil samples.

Fully completed FAST sample labels for each bottle

These tests will be handled separately in the laboratory.

Testing guidelines:

- 1 Take samples from every cylinder** at the same time (complete batch of samples).
- 2 Use FAST labels** and indicate the corresponding cylinder number on the label. Fully complete a FAST label for any system oil sump tank sample included.
- 3 Always Include a completed DOT.FAST engine data sheet with every batch of samples.**
- 4 Send completed sweepstakes to our global FAST laboratories.** Please do not sent FAST samples to the personal attention of any of our staff as this will delay processing.

Inform the courier company that the receiver is 'Warehouse Assistant'.

Chevron Marine Lubricants — FAST Program

Chevron Technology Ghent
Technologiepark — Zwijnaarde 88
B-9052 Ghent/Zwijnaarde
Belgium
Tel: +32 9 2937141

Samples landed in mainland China can be sent to our laboratory in Shanghai:

Chevron Marine Lubricants — FAST Program

SGS-CSTC Standards Technical Services Co., Ltd
No.88 Pugong Road, Fengxian District
Shanghai Chemical Industrial Park,
Shanghai, 201507, China
上海市奉贤区化学工业区普工路88号 (201507)
Tel: +86 021 6027 6372

Note that our laboratory does not run fuel samples.

Providing the key parameters of the fuel are indicated on the DOT.FAST Service engine data sheet — sulfur content, and preferably also aluminum and silicon content — this is sufficient information to obtain accurate results.

Search our [YouTube](#) channel for Chevron Marine Lubricants training videos on how to conduct safe, reliable tests and visit our website chevronmarineproducts.com for more FAST resources.

Contact the DOT.FAST helpdesk with any questions at CMLtechservice@chevron.com.



brix refractometer instructions guide for monitoring XLI concentration

Description

By following the guidelines highlighted here, you will extend the life of the refractometer and obtain the best measuring results, thereby enabling effective corrective actions to improve your operations. This user guide can also be used for refractometer models with minor differences (i.e., models with range of 0–5% Brix or with a self-correcting lens).

The hand-held refractometer spot test is a quick method for determining the concentration of XLI in water. This method is easy to perform and does not require extensive sample handling or expensive equipment.

Figure 1: Equipment

Refractometer: Brix 0–10% Item No. 2710

- 1 — Daylight Plate (also known as Prism Cover)
- 2 — Prism
- 3 — Zero Adjustment Screw
- 4 — Mirror Tube
- 5 — Eyepiece



Figure 2: Scale adjustment

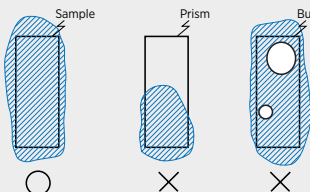
1. Open daylight plate and put a few drops of distilled water on the prism surface.



2. Close the daylight plate gently.



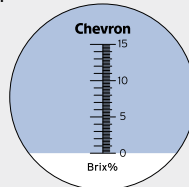
3. Water spreads all over the prism surface.



4. Look into eyepiece and turn it so that the scale is in sharp focus.



5. The boundary line must appear near the zero point.



6. Set boundary line at the zero point by turning Zero adjustment screw with a screwdriver.



7. After scale is adjusted, wipe water off the prism and daylight plate.



Figure 3: Sample measurement

1. Put a few drops of the sample on the prism.



2. Read the value of scale at the boundary line. Do not turn the Zero adjustment screw.



3. Wipe the sample off the prism and daylight plate with soft tissue paper, and clean them with water.



Procedure

The refractive index of the solution (in % Brix) is measured by a hand-held refractometer. The reading is plotted on a calibration curve, from which the concentration of XLI is determined. Note that % Brix is NOT equal to % XLI — this is why the calibration curves must be used. Measure all solutions between 15–30°C.

1. Select the appropriate refractometer (Brix 0–10% Item No. 2710).
2. Ensure the prism surface and the plastic cover are clean. If not, clean them with distilled water and wipe dry with paper tissue. Do not immerse the refractometer in water.
3. Check the zero setting of the refractometer with water as described in Figure 2. Perform this operation prior to every set of measurements.
4. Check that the water sample temperature is between 15–30°C.
5. Hold the refractometer in a horizontal position.
6. With a clean pipette, place a few drops of the sample between the prism and daylight plate until the prism is completely covered with liquid. The liquid should not have bubbles.
7. Point the instrument toward a light source and look into the eyepiece. Keep the refractometer horizontal. Turn the eyepiece so that the scale is in sharp focus.
8. The Brix % reading is the dividing line where the boundary between light and dark (the edge of the shadow) crosses the scale.
9. If the edge of the shadow is not sharp, turn the eyepiece to bring the edge of the shadow into sharp focus. It is also possible that the edge of shadow is not sharp because the measuring surfaces were not sufficiently clean or dry, or an insufficient sample of coolant was used. Rinse the prism with distilled water, wipe dry and repeat the test.
10. The concentration of coolant can be derived from the conversion table shown in Figure 4 (below).

Calculations

In the absence of calibration curves, empirical calculation formulas can be used:

$$\% \text{ XLI} = (\% \text{ Brix} - 0.0031) / 0.3695$$

(An estimation can be obtained using this formula: % XLI = % Brix × 2.7)

Precautions

1. The refractometer is a precision optical instrument. Handle it with care; avoid sudden impacts.
2. The prism is made of soft glass material. Take care not to scratch its surface.
3. After use, clean prism surface and daylight plate with a soft cloth soaked in water, and wipe off moisture with a dry cloth.
4. Best readings are obtained with a sample temperature between 15–30°C.

Figure 4: Conversion table of % Brix into % XLI

Brix % at 20°C refractometer	Vol % XLI	Brix % at 20°C refractometer	Vol % XLI	Brix % at 20°C refractometer	Vol % XLI	Brix % at 20°C refractometer	Vol % XLI
0.0	0.00	2.3	6.22	4.6	12.44	6.9	18.67
0.1	0.26	2.4	6.49	4.7	12.71	7.0	18.94
0.2	0.53	2.5	6.76	4.8	12.98	7.1	19.21
0.3	0.80	2.6	7.03	4.9	13.25	7.2	19.48
0.4	1.07	2.7	7.30	5.0	13.52	7.3	19.75
0.5	1.34	2.8	7.57	5.1	13.79	7.4	20.02
0.6	1.62	2.9	7.84	5.2	14.06	7.5	20.29
0.7	1.89	3.0	8.11	5.3	14.34	7.6	20.56
0.8	2.16	3.1	8.38	5.4	14.61	7.7	20.83
0.9	2.43	3.2	8.65	5.5	14.88	7.8	21.10
1.0	2.70	3.3	8.92	5.6	15.15	7.9	21.37
1.1	2.97	3.4	9.19	5.7	15.42	8.0	21.64
1.2	3.24	3.5	9.46	5.8	15.69	8.1	21.91
1.3	3.51	3.6	9.73	5.9	15.96	8.2	22.18
1.4	3.78	3.7	10.01	6.0	16.23	8.3	22.45
1.5	4.05	3.8	10.28	6.1	16.50	8.4	22.73
1.6	4.32	3.9	10.55	6.2	16.77	8.5	23.00
1.7	4.59	4.0	10.82	6.3	17.04	8.6	23.27
1.8	4.86	4.1	11.09	6.4	17.31	8.7	23.54
1.9	5.13	4.2	11.36	6.5	17.58	8.8	23.81
2.0	5.40	4.3	11.63	6.6	17.85	8.9	24.08
2.1	5.67	4.4	11.90	6.7	18.12	9.0	24.35
2.2	5.95	4.5	12.17	6.8	18.39		





marine lubricants

product data sheets





Taro® Ultra 20



Description

Taro® Ultra 20 is a 20 Base Number (BN) cylinder lubricant designed for lubricating the latest generation two-stroke marine engines operating at high mechanical and thermal loads under all operating conditions on low sulphur fuels (<0.1% sulphur), including those in continuous operation within Emissions Control Area (ECA) zones and LNG operation. Taro Ultra 20 is blended with highly refined base oils and carefully selected additives to provide excellent ring and liner wear protection and piston cleanliness in slow-speed crosshead diesel engines.

Typical Characteristics

SAE Viscosity Grade	50
MPID	219033
Base number, mg KOH/g (ASTM D2896)	20
Density at 15°C, kg/l (ASTM D4052)	0.90
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-12
Kinematic Viscosity at 100°C, mm²/s (ASTM D445)	19.0

Recommended Applications

Taro Ultra 20 is recommended for lubricating the cylinders of large low-speed marine diesel engines continuously using low sulphur fuel (<0.1% sulphur), under all loads and operating conditions, including those in continuous operation within Emissions Control Area (ECA) zones. Running on low sulphur fuel (<0.1% sulphur) requires the reduction of base introduced into the cylinder.

Taro Ultra 20 is approved by WinGD (formerly Wärtsilä) for use in the latest generation engine designs, including WinGD dual fuel engines operating with gas fuels. Taro Ultra 20 should be used in accordance with OEM guidelines and recommendations.

Performance Benefits

1. Engine Protection

Protects against excessive cylinder liner and piston ring wear, thus allowing prolonged service intervals.

2. Engine Cleanliness

Prevents ring sticking and minimizes deposit formation on the pistons and throughout the combustion chamber exhaust areas.

3. Storage Stability

Stable at ambient temperatures and during long-term storage.

4. Compatibility

Miscible and compatible with diesel cylinder lubricants generally known to the international marine trade.



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Taro[®] Ultra 40



Description

Taro[®] Ultra is new range of cylinder lubricants specifically designed to cope with the demands and required flexibility for IMO 2020. Taro Ultra cylinder lubricants have been fully field tested using a wide variety of fuels expected to be available post IMO 2020 implementation and are approved by major OEMs.

Taro Ultra 40 is a 40 Base Number (BN) cylinder lubricant designed for lubricating the latest generation two-stroke marine engines running on low sulphur fuels under all loads and operating conditions. Taro Ultra 40 is blended with highly refined base oils and carefully selected additives to provide excellent ring and liner wear protection and piston cleanliness in slow-speed crosshead diesel engines.

Typical Characteristics

SAE Viscosity Grade	50
MPID	219034
Base number, mg KOH/g (ASTM D2896)	40
Density at 15°C, kg/l (ASTM D4052)	0.92
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-15
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	19.0

Recommended Applications

Taro Ultra 40 is recommended for lubricating the cylinders of large low-speed marine diesel engines continuously using low sulphur fuel, under all loads and operating conditions. Running on low sulphur fuel requires the reduction of base introduced into the cylinder. This can be achieved by optimizing the oil feedrate or selecting a diesel cylinder lubricant with a lower base number. Taro Ultra 40 should be used in accordance with OEM guidelines and recommendations.

Taro Ultra 40 Is Approved For:

- ☒ **MAN Energy Solutions**
- ☒ **WinGD (formerly Wärtsilä)**

Performance Benefits

1. Engine Protection

Protects against excessive cylinder liner and piston ring wear, thus allowing prolonged service intervals.

2. Engine Cleanliness

Prevents ring sticking and minimizes deposit formation on the pistons and throughout the combustion chamber exhaust areas.

3. Storage Stability

Stable at ambient temperatures and during long-term storage.

4. Compatibility

Miscible and compatible with diesel cylinder lubricants generally known to the international marine trade.



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Taro[®] Ultra 70



Description

Taro[®] Ultra is new range of cylinder lubricants specifically designed to cope with the demands and required flexibility for IMO 2020. Taro Ultra cylinder lubricants have been fully field tested using a wide variety of fuels expected to be available post IMO 2020 implementation and are approved by major OEMs.

Taro Ultra 70 is a 70 Base Number (BN) cylinder lubricant designed for lubricating two-stroke marine engines running on low sulphur fuels but corrosive operating conditions or older mild corrosive engines equipped with exhaust abatement technologies using heavy fuel oil. Taro Ultra 70 is blended with highly refined base oils and carefully selected additives to provide excellent ring and liner wear protection and piston cleanliness in slow-speed crosshead diesel engines.

Typical Characteristics

SAE Viscosity Grade	50
MPID	219035
Base number, mg KOH/g (ASTM D2896)	70
Density at 15°C, kg/l (ASTM D4052)	0.93
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-15
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	19.0

Recommended Applications

Taro Ultra 70 is recommended for lubricating the cylinders of large low-speed marine diesel engines running on low sulphur fuels but corrosive operating conditions or older mild corrosive engines equipped with exhaust abatement technologies using heavy fuel oil. Taro Ultra 70 should be used in accordance with OEM guidelines and recommendations.

Taro Ultra 70 Is Approved For:

- ☒ MAN Energy Solutions
- ☒ WinGD (formerly Wärtsilä)

Performance Benefits

1. Engine Protection

Effective acid neutralization ensures protection against excessive cylinder liner and piston ring wear resulting from the use of high sulphur heavy fuel oils, thus extending cylinder liner and piston ring life.

2. Engine Cleanliness

Prevents ring sticking and minimizes deposit formation on the pistons and throughout the combustion chamber exhaust areas.

3. Storage Stability

Stable at ambient temperatures & during long-term storage.

4. Compatibility

Miscible and compatible with diesel cylinder lubricants generally known to the international marine trade.

5. Operating cost

If oil feedrate is above minimum recommended by OEM, there is potential to move to a higher base number formulation to provide the same level of alkalinity and corrosion protection but at lower feedrates, therefore reducing operating cost.



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Taro[®] Ultra 100



Description

Taro[®] Ultra is new range of cylinder lubricants specifically designed to cope with the demands and required flexibility for IMO 2020. Taro Ultra cylinder lubricants have been fully field tested using a wide variety of fuels expected to be available post IMO 2020 implementation and are approved by major OEMs.

Taro Ultra 100 is a 100 Base Number (BN) cylinder lubricant specially formulated to combat the effects of cold corrosion in two-stroke marine engines equipped with exhaust abatement technologies running on heavy fuel oil, under all loads and operating conditions. Taro Ultra 100 is blended with highly refined base oils and carefully selected additives to provide excellent ring and liner wear protection and piston cleanliness in slow-speed crosshead diesel engines.

Typical Characteristics

SAE Viscosity Grade	50
MPID	219036
Base number, mg KOH/g (ASTM D2896)	100
Density at 15°C, kg/l (ASTM D4052)	0.95
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-15
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	19.0

Recommended Applications

Taro Ultra 100 is recommended for lubricating the cylinders of the latest generation large low-speed marine diesel engines equipped with exhaust abatement technologies operating with heavy fuel oil, under all loads and corrosive operating conditions. Taro Ultra 100 should be used in accordance with OEM guidelines and recommendations. Taro Ultra 100 can also be used in combination with Taro Ultra 25 in MAN Energy Solutions diesel engines equipped with Automated Cylinder Oil Mixing (ACOM).

Taro Ultra 100 Is Approved For:

- ☒ MAN Energy Solutions
- ☒ WinGD (formerly Wärtsilä)



marine lubricants

Performance Benefits**1. Engine Protection**

Effective acid neutralization ensures protection against excessive cylinder liner and piston ring wear resulting from the use of high sulphur heavy fuel oils, thus extending cylinder liner and piston ring life.

2. Engine Cleanliness

Prevents ring sticking and minimizes deposit formation on the pistons and throughout the combustion chamber exhaust areas.

3. Storage Stability

Stable at ambient temperatures and during long-term storage.

4. Compatibility

Miscible and compatible with diesel cylinder lubricants generally known to the international marine trade.

5. Operating cost

If oil feedrate is above minimum recommended by OEM, there is potential to move to a higher base number formulation to provide the same level of alkalinity and corrosion protection but at lower feedrates, therefore reducing operating cost.



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Taro[®] Ultra 140



Description

Taro[®] Ultra is new range of cylinder lubricants specifically designed to cope with the demands and required flexibility for IMO 2020. Taro Ultra cylinder lubricants have been fully field tested using a wide variety of fuels expected to be available post IMO 2020 implementation and are approved by major.

Taro Ultra 140 is a 140 Base Number (BN) cylinder oil specially formulated for use in high corrosion environments. As an ultra-high base number cylinder lubricant, this product is created for the latest type of highly efficient two-stroke engines which have an increased tendency to develop cold corrosion inside the cylinder than the older, less efficient installations. Taro Ultra 140 provides the same level of alkalinity and corrosion protection as Taro Ultra 100 at lower feedrates, therefore helping to reduce operating costs. Taro Ultra 140 is blended with highly refined base oils and carefully selected additives to provide excellent ring and liner wear protection and piston cleanliness in slow-speed crosshead diesel engines.

Typical Characteristics

SAE Viscosity Grade	50
MPID	219037
Base number, mg KOH/g (ASTM D2896)	140
Density at 15°C, kg/l (ASTM D4052)	0.98
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-15
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	19.0

Recommended Applications

Taro Ultra 140 is recommended for lubricating the cylinders of the latest generation large low-speed marine diesel engines equipped with exhaust abatement technologies operating with heavy fuel oil, under all loads and very corrosive operating conditions. The base number of Taro Ultra 140 makes this product ideal for use in engine types and under operating conditions which are sensitive to cold corrosion in the cylinder. Taro Ultra 140 should be used in accordance with OEM guidelines and recommendations.

Taro Ultra 140 Is Approved For:

☒ **MAN Energy Solutions**



marine lubricants

Performance Benefits**1. Engine Protection**

Effective acid neutralization ensures protection against excessive cylinder liner and piston ring wear resulting from the use of high sulphur heavy fuel oils, thus extending cylinder liner and piston ring life.

2. Engine Cleanliness

Prevents ring sticking and minimizes deposit formation on the pistons and throughout the combustion chamber exhaust areas.

3. Storage Stability

Stable at ambient temperatures and during long-term storage.

4. Compatibility

Miscible and compatible with diesel cylinder lubricants generally known to the international marine trade.

5. Operating cost

Ultra-high base number formulation provides the same level of alkalinity and corrosion protection at lower feedrates, reducing operating cost.



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Veritas® 800 Marine 30



Description

Veritas® 800 Marine 30 is a crankcase lubricant for two-stroke marine engines. Veritas 800 Marine is blended with highly refined base oils and carefully selected additives to provide very good anti-corrosion and anti-foam properties. The combination of detergency and the exceptional oxidation stability provides clean piston interiors and crankcase. Veritas 800 Marine 30 is formulated with the appropriate level of alkalinity to neutralize acidic combustion products that can enter the crankcase.

Typical Characteristics

SAE Viscosity Grade	30
MPID	219100
Base number, mg KOH/g (ASTM D2896)	5.6
Density at 15°C, kg/l (ASTM D4052)	0.89
Flash point, COC, °C (ASTM D92)	180 min
Pour point, °C (ASTM D97)	-18
Kinematic Viscosity at 40°C, mm²/s (ASTM D445)	111.0
Kinematic Viscosity at 100°C, mm²/s (ASTM D445)	11.9
Viscosity Index	95
FZG test (A/8.3/90), failure load stage (CEC-L-07-95)	11

Recommended Applications

Veritas 800 Marine 30 is recommended for the crankcase lubrication of large low-speed marine diesel engines operating with all fuel types and under all loads and operating conditions. Veritas 800 Marine 30 should be used in accordance with OEM guidelines and recommendations.

Veritas 800 Marine 30 Is Approved For:

- ✓ MAN Energy Solutions
- ✓ WinGD (formerly Wärtsilä)
- ✓ Japan Engine Corporation (Mitsubishi)

Performance Benefits

1. Engine Protection

Helps to protect bearings and white metals in the engine lubrication systems against corrosive wear from acidic combustion by-products.

2. Engine Cleanliness

Helps to ensure clean crankcases, piston interiors and lubricating oil lines.

3. Smooth Operation

Can prevent the formation of foam and ensures smooth operation of pumps with a continuous oil feed to all engine parts.

4. Easy Purification

Effective water and contaminants handling.



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Delo[®] 710 LE SAE 20W-40

Regional equivalent: Delo 6170 CFO SAE 40



Description

Delo[®] 710 LE SAE 20W-40 is an industry leading, ultra-high-performance diesel engine oil for use in EMD and GE engines in railroad, marine and power generation applications. It is formulated specifically for engines using Low Sulphur and Ultra Low Sulphur Fuels and new low emission engines.

Delo 710 LE SAE 20W-40 uses premium quality base oils that are very pure, with extremely low levels of sulphur, nitrogen and aromatics to enhance oxidation resistance. It employs newly developed dispersants, detergents and oxidation inhibitors to promote outstanding oil life and minimal ash content.

Typical Characteristics

MPID	219370
Kinematic viscosity at 100°C, mm ² /s	15.50
Flash Point	230

Recommended Applications

Delo 710 LE SAE 20W-40 is recommended for diesel engines using Low Sulphur and Ultra Low Sulphur Fuels; with or without exhaust after treatment; where Zn-free oils are required in applications such as Railroad, Marine, Offshore Drilling and Production, Stationary Power Generation. Sporadic use in combination with high sulphur fuel is only allowed when a strong used oil analysis program is possible. Close monitoring of the base number is essential.

Delo 710 LE SAE 20W-40 is Approved For:

- ☒ **Electro-Motive Diesel** LMOA Generation 5
- ☒ **General Electric** LMOA Generation 4 Long Life, LMOA Generation 6

Performance Benefits

1. Good Oxidation Stability

Good oxidation stability, soot dispersancy and base retention for long oil life with newly designed low consumption power assemblies

2. Promotes Oil Consumption Reduction

SAE 20W-40 helps provide a 15–25% oil consumption reduction versus single grade engine oils.

3. Offers Protection Against Wearing

Designed to offer high performance wear protection in railroad, marine and power generation applications, helping reduce costs.

4. Promotes Engine Cleanliness

Advanced keep-clean formulation promotes optimum engine cleanliness with reduced maintenance downtime.

5. Reduces Deposits

Helps reduce exhaust system and turbocharger deposits, contributing to increased uptime and system efficiency.

6. Zinc Free

Zinc free, non-chlorinated.



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Delo[®] 1000 Marine



Description

Delo[®] 1000 Marine lubricants are high-performance diesel engine oils for medium-speed trunk piston diesel engines. Delo 1000 Marine lubricants are blended with highly refined base oils and carefully selected additives. They have very good viscosity control when used in severe high-temperature service, and their great BN retention characteristics prevent corrosive wear over long periods of operation. The unique detergent and dispersant additive system provides piston cleanliness and soot handling. This results in extreme reduction of both “hot” (piston lands and grooves, piston undercrown, purifier preheaters) and “cold” (crankcase, cambox, rocker area, fuel pumps, purifier bowl) deposits. Delo 1000 Marine lubricants provide a high degree of water tolerance and have good water separation.

Typical Characteristics

SAE Viscosity Grade	30	40
MPID	219201	219200
Base number, mg KOH/g (ASTM D2896)	12	12
Density at 15°C, kg/l (ASTM D4052)	0.89	0.89
Flash point, COC, °C (ASTM D92)	180 min	180 min
Pour point, °C (ASTM D97)	-18	-18
Kinematic Viscosity at 40°C, mm ² /s (ASTM D445)	102.0	135.0
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	11.6	14.2
Viscosity Index	100	100
FZG test (A/8.3/90), failure load stage (CEC-L-07-95)	12	12

Recommended Applications

Delo 1000 Marine lubricants are recommended for medium-speed trunk piston diesel engines burning distillate and low sulfur fuels. The good load carrying capacity of Delo 1000 Marine lubricants also makes these suitable for use in engine reduction gears and other applications where EP properties are required. Delo 1000 Marine should be used in accordance with OEM guidelines and recommendations.

Delo 1000 Marine Lubricants Are Approved For:

- ☒ MAN Energy Solutions
- ☒ Wärtsilä and MaK (Caterpillar)
- ☒ Rolls Royce Bergen

- ☒ Daihatsu
- ☒ Hyundai Himsen
- ☒ Yanmar



marine lubricants

Performance Benefits**1. Engine Protection**

Controls cylinder liner wear effectively and helps to protect bearings from corrosion. High performance, anti-wear additives provide protection against wear for cams, camshaft and bearings. Delo® 1000 Marine lubricants also promote a high degree of water tolerance and anti-foam protection.

2. Engine Cleanliness

Helps to ensure clean crankcases, piston interiors and lubricating oil lines.

3. Easy Purification

Effective water and contaminants handling.

4. Smooth Operation

Helps to provide minimum maintenance and downtime, long engine life and economical operating costs.



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Delo[®] SHP



Description

Delo[®] SHP lubricants are high-performance diesel engine oils for medium- and high-speed trunk piston diesel engines with or without oil purifiers. Delo SHP lubricants are blended with highly refined base oils and carefully selected additives. Delo SHP lubricants have very good viscosity control when used in severe high-temperature service, and their BN retention characteristics help to prevent corrosive wear over long periods of operation. The unique detergent and dispersant additive system promote piston cleanliness, liner lacquer control and first-rate soot handling. This results in extreme reduction of both “hot” (piston lands and grooves, piston undercrown, purifier preheaters) and “cold” (crankcase, cambox, rocker area, fuel pumps, purifier bowl) deposits. Delo SHP lubricants help to provide a high degree of water tolerance and have good water separation.

Typical Characteristics

SAE Viscosity Grade	30	40
MPID	219203	219206
Base number, mg KOH/g (ASTM D2896)	12	12
Density at 15°C, kg/l (ASTM D4052)	0.89	0.89
Flash point, COC, °C (ASTM D92)	180 min	180 min
Pour point, °C (ASTM D97)	-15	-18
Kinematic Viscosity at 40°C, mm ² /s (ASTM D445)	104.0	135.0
Kinematic Viscosity at 100°C, mm ² /s (ASTM D445)	11.8	14.0
Viscosity Index	100	100
FZG test (A/8.3/90), failure load stage (CEC-L-07-95)	12	12

Recommended Applications

Delo SHP lubricants are recommended for medium- and high-speed trunk piston diesel engines burning distillate and low sulfur fuels. Delo SHP can be used in diesel engines with or without oil purifiers and particularly suited for engines sensitive to liner lacquering. The good load carrying capacity of Delo SHP lubricants also makes these suitable for use in engine reduction gears and other applications where EP properties are required. Delo SHP should be used in accordance with OEM guidelines and recommendations.

Delo SHP Lubricants Are Approved For:

- | | |
|---|--|
| ☒ MAN Energy Solutions | ☒ Daihatsu |
| ☒ Wärtsilä Marine – Deutz SBVM628 | ☒ Hyundai Himsen |
| ☒ MaK (Caterpillar) | ☒ Yanmar |
| ☒ Rolls Royce Bergen | |

Delo SHP Lubricants Are Suitable For Use In:

- ☒ MTU Type 2



marine lubricants

Performance Benefits**1. Engine Protection**

Controls cylinder liner wear effectively and helps to protect bearings from corrosion. High performance, anti-wear additives help to provide protection against wear for cams, camshaft and bearings. Delo® SHP lubricants also provide a high degree of water tolerance and anti-foam protection. It can also help protect against liner lacquer formulation.

2. Engine Cleanliness

Helps to ensure clean crankcases, piston interiors and lubricating oil lines.

3. Easy Purification

Effective water and contaminants handling.

4. Smooth Operation

Helps to provide minimum maintenance and downtime, long engine life and economical operating costs in applications with or without oil purifiers.



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Taro[®] DP and XL Series



Description

Taro[®] DP and XL series lubricants are high-performance diesel engine oils for medium-speed trunk piston diesel engines. Taro DP and XL series are blended with highly refined base oils and carefully selected additives. Taro DP and XL series lubricants have very good viscosity control when used in severe high-temperature service, and the BN retention characteristics helps to promote corrosive wear over long periods of operation. The unique detergent and dispersant additive system promotes piston cleanliness as well as control of fuel contaminants. This results in extreme reduction of both “hot” (piston lands and grooves, piston undercrown, purifier preheaters) and “cold” (crankcase, cambox, rocker area, fuel pumps, purifier bowl) deposits. Taro DP and XL series lubricants provide a high degree of water tolerance and have good water separation.

Typical Characteristics

	Taro 20 DP 30 / 40 (X)*	Taro 30 DP 30 / 40 (X)*	Taro 40 XL 40 (X)*	Taro 50 XL 40 (X)*
SAE Viscosity Grade	30 / 40	30 / 40	40	40
MPID	219230 / 219240	219231 / 219241	219243	219244
Base number, mg KOH/g (ASTM D2896)	20	30	40	50
Density at 15°C, kg/l (ASTM D4052)	0.90	0.91	0.90	0.91
Flash point, COC, °C (ASTM D92)	180 min	180 min	180 min	180 min
Pour point, °C (ASTM D97)	-12	-12	-12	-12
Kinematic Viscosity at 40°C, mm ² /s (ASTM D445)	94.0 / 135.0	94.0 / 135.0	135.0	135.0
FZG test (A/8.3/90), failure load stage (CEC-L-07-95)	12	12	12	12

* Depending on the port designated, products may be delivered with or without the (X) identifier — e.g., Taro 20 DP 30X or Taro 20 DP 30 — however, the product typical test data both with or without the (X) identifier are miscible and fully compatible.

Recommended Applications

Taro DP and XL series lubricants are recommended for medium-speed trunk piston diesel engines burning residual or marine diesel fuels. Taro DP and XL series should be used in accordance with OEM guidelines and recommendations. The good load carrying capacity of Taro DP and XL series lubricants also makes these suitable for use in engine reduction gears and other applications where EP properties are required.

Taro DP and XL Series Lubricants Are Approved For:

- | | |
|--|--|
| ☒ MAN Energy Solutions | ☒ Daihatsu |
| ☒ Wärtsilä and MaK (Caterpillar) | ☒ Hyundai Himsen |
| ☒ Rolls Royce Bergen | ☒ Yanmar |



marine lubricants

Performance Benefits**1. Engine Protection**

Controls cylinder liner wear effectively and helps to protect bearings from corrosion. High performance, anti-wear additives can provide protection against wear for cams, camshaft and bearings. Taro® DP and XL series lubricants also promotes a high degree of water tolerance and anti-foam protection.

2. Engine Cleanliness

Helps to ensure clean crankcases, piston interiors and lubricating oil lines.

3. Easy Purification

Effective water and contaminants handling.

4. Smooth Operation

Helps to provide minimum maintenance and downtime, long engine life and economical operating costs.



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Delo[®] 100 Motor Oil SAE 40

Regional equivalent: Ursa Extra Duty SAE 40



Description

Delo[®] 100 Motor Oil SAE 40 is a heavy duty monograde engine oil specifically formulated for heavy duty two-stroke diesel engines (Detroit Diesel) operating in both on- and off-highway service. These low ash engines have special lubricating needs which no ordinary diesel crankcase engine oil could satisfy.

Delo 100 Motor Oil SAE 40 is formulated with proven solvent refined base stocks and a carefully balanced system of detergents, inhibitors and anti-wear additives.

Typical Characteristics

MPID	219932
Characteristic	SAE 40
Density at 15°C, kg/l	0.90
Kinematic viscosity at 40°C, mm ² /s	131.0
Kinematic viscosity at 100°C, mm ² /s	14.5
Viscosity Index	109
Pour point, °C	-24
Flash point COC, °C	270
Total Base Number, mg KOH/g	7.3
Sulphated Ash, %wt	0.8

Recommended Applications

Delo 100 Motor Oil SAE 40 is recommended for use in older two- and four-stroke diesel engines in farm machinery, construction equipment, marine, and other off-highway applications where the SAE 40 grade is specified by the OEM. Delo 100 Motor Oil SAE 40 utilizes reliable technology to help provide robust performance in older engines burning ultra-low sulphur diesel fuels. Delo 100 Motor Oil SAE 40 may also be used in industrial applications such as: gear drives, pump chains, or where a detergent type engine oil is required.

Delo 100 Motor Oil SAE 40 Meets The Requirements Of:

- ✓ **Detroit Diesel** Two-stroke Series 71, 92 and 149
- ✓ **API** CF-2, CF

Performance Benefits

1. High Temperature Deposit Control

Helps to protect against high temperature oxidation and oil thickening in older engines.

2. Special Extreme Pressure Anti-Wear Properties

Good control of deposits and wear optimize the engine overhaul intervals.

3. Protection Against Rust, Corrosion, Varnish & Sludge

Helps keep oil screens, filters, and rings clean and free for prolonged periods.



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**Environment, Health And Safety**

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Delo[®] 400 SAE 40

Regional equivalents: Delo Silver SAE 40, Ursa LA 3 SAE 40, Ursa Heavy Duty SAE 40



Description

Delo 400 SAE 40 oil is a mixed-fleet motor oil recommended for older four-stroke gasoline and diesel engines. Delo 400 SAE 40 heavy duty motor oil is a premium quality engine oil. It is formulated utilizing advanced additive technology which helps provide outstanding engine protection for four-stroke diesel engines requiring a monograde engine oil.

Typical Characteristics

MPID	219338
Density at 15°C, kg/l	0.89
Kinematic viscosity at 100°C, mm ² /s	14.7
Pour point, °C	-24
Total Base Number, mg KOH/g	10.1
Sulphated Ash, %wt	1.5

Recommended Applications

Delo 400 SAE 40 monograde oil is a mixed-fleet motor oil recommended for older four-stroke gasoline and diesel engines that require a monograde engine oil. Delo 400 SAE 40 oil is formulated for exceptional performance in older engines using both normal, high, and low sulfur diesel fuels.

Delo 400 SAE 40 is not recommended for use in DDC two-stroke engines.

Delo 400 SAE 40 Is Approved For:

- ☒ **MAN Truck & Bus** M 3275-2
- ☒ **MTU** Category 2

Delo 400 SAE 40 Meets The Requirements Of:

- ☒ **API** CF
- ☒ **API** SJ
- ☒ **Daimler** MB-Approval 228.2
- ☒ **Detroit Diesel** DDC/MTU Category 2
- ☒ **MAN Truck & Bus** 270

Performance Benefits

1. Controlled Oil Costs

Minimal crownland deposits and good oxidation stability may help minimize oil consumption.

2. Long Engine Life

Good control of deposits and wear can optimize the engine overhaul intervals.

3. Exceptional Engine Cleanliness

High detergency provides good deposit and sludge control in the piston ring belt area.

Environment, Health And Safety

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Delo® 400 MGX SAE 15W-40

Regional equivalents: Delo 400 LE SAE 15W-40, Ursa Ultra LE SAE 15W-40



Description

Delo® 400 MGX SAE 15W-40 is a premium performance low SAPS technology heavy duty diesel engine lubricant, specifically formulated for on-highway and off-highway applications. It aims to provide protection for new low emission diesel engines with Selective Catalytic Reduction (SCR), Diesel Particulate Filter (DPF) and Exhaust Gas Recirculation (EGR). Additionally, it is designed for mixed fleets of on-highway and off-highway diesel engines and meets the performance requirements of a wide range of naturally aspirated and turbocharged four-stroke diesel engines. This product is formulated using advanced additive technology to help provide protection for on-highway and off-highway applications burning high or low sulphur diesel fuels.

Delo 400 MGX SAE 15W-40 is formulated using advanced low SAPS additive technology which helps to provide engine protection for diesel engines meeting Euro IV, V and Euro VI emission requirements and for 2007 and 2010 EPA exhaust particulate emissions standards for on highway diesel trucks, using Ultra Low Sulphur Diesel (ULSD).

Delo 400 MGX SAE 15W-40 is based upon ISOSYN® technology, which uses premium base oils with high viscosity index in combination with an optimal blend of latest technology in dispersant, detergent, oxidation inhibition, anti-wear, corrosion inhibition, viscosity improver, and de-foaming additives to give a product which rivals synthetic lubricants in critical engine tests.

Typical Characteristics

MPID	235105
Density at 15°C, kg/l	0.88
Kinematic viscosity at 100°C, mm²/s	14.6
Pour point, °C	-36
Flash point COC, °C	228
Total Base Number, mg KOH/g	9.6
Sulphated Ash, %wt	1.0

Recommended Applications

Delo 400 MGW SAE 15W-40 is a mixed fleet motor oil recommended for four-stroke naturally aspirated and turbocharged diesel engines but may also be used in four-stroke gasoline engines. This product is recommended for diesel engines meeting Euro I through VI emissions requirements. It can be used in new advanced engines equipped with features like four-valve heads, supercharging, turbocharging, direct injection, shorter piston crowns, higher power density, intercooling, full electronic management of fuel and emission systems, Exhaust Gas Recirculation (EGR), exhaust particulate filters (DPF) and for most engines fitted with SCR NOx reduction systems. It is also recommended for use in older engines as well as today's most modern low emission designs. It is formulated for exceptional performance with Ultra Low Sulphur Diesel but also with high, normal and low sulphur diesel fuels (10–5000 ppm sulphur).

Delo 400 MGW SAE 15W-40 is ideal for mixed commercial fleets, farm machinery, construction equipment, marine and other off-highway applications.



marine lubricants

Delo 400 MGX SAE 15W-40 Is Approved For:

- | | |
|-------------------------------------|-------------------------------|
| ✓ Cummins CES 20081 | ✓ MAN M3575 |
| ✓ Detroit Diesel DDC93K218 | ✓ MTU Oil Category 2.1 |
| ✓ Daimler MB-Approval 228.31 | ✓ Renault RLD-3 |
| ✓ DEUTZ DQC III-10 LA | ✓ Volvo VDS-4 |
| ✓ Mack EO-O Premium Plus | |

Delo 400 MGX SAE 15W-40 Meets The Requirements Of:

- | | |
|--------------------------------|---|
| ✓ ACEA E9-12 | ✓ Caterpillar ECF-3 |
| ✓ API CI-4, CI-4+, CJ-4 | ✓ Off-highway, construction or marine applications |
| ✓ Ford WSS-M2C171-E | which will require API CJ-4 and CI-4 |
| ✓ JASO DH-2 | |

Performance Benefits

1. Smooth Lock-Ups

Specially tuned friction characteristics, ensuring smooth shifting and lock-ups.

2. Good Fluid Lifetime

The friction durability helps make sure that this performance is retained throughout the fluid lifetime.

3. High Viscosity Index

High Viscosity Index means that the oil will retain sufficient viscosity for effective lubrication even at high operating temperatures.

4. Functions In Cold Weather

The low-temperature fluidity helps to provide transmission protection during cold weather start-up.

5. Prevents Harmful Sludge

The good oxidation stability helps to prevent formation of harmful sludge, lacquer or deposits.

6. Prevents Loss Of Fluid

Compatible with a wide variety of elastomer materials, preventing loss of fluid due to seal deterioration.

7. Corrosion Protection

Can prevent corrosion of automatic transmission fluid coolers.

Environment, Health And Safety

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Delo[®] Gold Ultra SAE 15W-40

Regional equivalents: Ursa Marine 15W-40, Delo 400 Multi-grade SAE 15W-40, Ursa Super TD SAE 15W-40, Delo Gold Ultra E SAE 15W-40



Description

Delo[®] Gold Ultra SAE 15W-40 is a high-quality, heavy-duty diesel crankcase lubricant. Manufactured from high-quality base oils and compounded with additives, Delo Gold Ultra SAE 15W-40 provides good lubrication for turbo-charged, high-speed diesel engines under severe operating conditions. It contains detergent/dispersant, antioxidation and anti-wear additives, and meets the API service classification CI-4.

Typical Characteristics

MPID	219933
Density at 15°C, kg/l	0.88
Kinematic viscosity at 40°C, mm ² /s	115.0
Kinematic viscosity at 100°C, mm ² /s	15.2
Viscosity Index	138
Pour point, °C	-39
Flash point COC, °C	230
Total Base Number, mg KOH/g	10.2

Recommended Applications

Delo Gold Ultra SAE 15W-40 is recommended for use in heavy-duty (turbo-charged), high-speed diesel engines operating under very severe conditions where an API CI-4 type oil is required. This grade is especially recommended for emergency equipment onboard seagoing vessels such as lifeboat engines and motor-driven fire pumps and emergency compressors.

Delo Gold Ultra SAE 15W-40 Is Approved For:

- | | |
|--|---|
| ☒ Daimler MB-Approval 228.3 | ☒ Deutz DQC III-10 |
| ☒ Detroit Diesel 93K215 | |

Delo Gold Ultra SAE 15W-40 Meets The Requirements Of:

- | | |
|--|---|
| ☒ API CI-4/SL | ☒ MAN Truck & Bus M 3275-1 |
| ☒ Caterpillar ECF-1-a | ☒ MTU Category 2 |
| ☒ JASO DH-1 | |

Performance Benefits

1. Oxidation Stability & Deposit Control

Minimal crownland deposits and good oxidation stability may help minimize oil consumption.

2. Corrosion Protection

Good control of deposits and wear may optimize the engine overhaul intervals.

3. Anti-Wear Properties

High detergency can provide good deposit and sludge control in the piston ring belt area.

4. Minimizing Operating Costs

Can prevent unscheduled downtime by providing efficient dispersion of soot particles. The protection against soot related wear and deposit can also prevent excessive viscosity increase and filter plugging.



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**Environment, Health And Safety**

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Delo[®] 400 XSP SAE 5W-40

Regional equivalents: Ursa Ultra X SAE 10W-40, Delo 400 LE Synthetic SAE 5W-40



Description

Delo[®] 400 XSP SAE 5W-40 is a mixed-fleet engine oil recommended for naturally aspirated and turbocharged four-stroke diesel engines and four-stroke gasoline engines. It helps keep piston rings clean and free for optimum combustion pressure and minimal wear.

A high level of ashless dispersants keeps fuel soot in suspension and helps to avoid filter plugging, cylinder head sludge, abrasive wear, viscosity increases, and oil gelation. These problems could cause excessive engine wear and bearing failure, without warning. Optimized additive chemistries combined with synthetic base stocks control oxidation, sludge, and undue thickening between oil drains. A de-foaming additive helps prevent air entrapment.

Typical Characteristics

MPID	TBD
Density at 15°C, kg/l	0.85
Kinematic viscosity at 40°C, mm ² /s	96.0
Kinematic viscosity at 100°C, mm ² /s	15.4
Viscosity Index	170
Pour Point, °C	-46
Flash Point COC, °C	223
Total Base Number, mg KOH/g	10
Sulfated Ash, %wt	1.0

Recommended Applications

Delo 400 XSP SAE 5W-40 with ISOSYN Advanced Technology is a mixed-fleet motor oil, recommended for naturally aspirated and turbocharged four-stroke diesel and gasoline engines in which the API CK-4, API SN or API SN PLUS service categories and SAE 5W-40 viscosity grade is recommended.

Delo 400 XSP SAE 5W-40 specifically formulated for all applications including 2017 greenhouse gas (GHG 17) compliant diesel engines with lower CO₂ emissions and improved fuel economy, in addition to EPA 2010 compliant low emission diesel engines with Selective Catalytic Reduction (SCR), Diesel Particulate Filter (DPF) and Exhaust Gas Recirculation (EGR) systems. It is fully compatible with previous engine models and previous API Oil Service Categories.

Delo 400 XSP SAE 5W-40 Is Approved For:

- ✓ **DEUTZ** DQC III-10 LA
- ✓ **Mack Trucks (Volvo)** EOS 4.5
- ✓ **Renault Trucks (Volvo)** RLD-4
- ✓ **API** CH-4, CI-4 Plus, CJ-4

Delo 400 XSP SAE 5W-40 Meets The Requirements Of:

- ✓ **Cummins** CES 20086
- ✓ **MAN Truck & Bus** M 3575



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**Performance Benefits****1. Low Viscosity Synthetic Base Stock**

Promotes consistent cold engine starting for gasoline and diesel engines operating in sub-zero temperatures.

2. Minimized Operating Costs

Good soot dispersancy and wear control protect the cylinders, pistons, rings, and valve train components against wear and corrosion, promoting optimum service life and minimal maintenance. Contributes to maximum vehicle utilization and minimal downtime.

3. Good Emission Control System Life

Promotes optimum Diesel Particulate Filter (DPF) life for minimal downtime and cleaning, thus helping to minimize maintenance costs.

4. Managed Inventory Costs

Compatible with previous API Oil Service Categories. Suitable for use in gasoline engines and naturally aspirated or turbocharged electronically controlled/low emission diesel engines. One oil that meets the engine performance requirements of most North American and European engine manufacturers. One oil that allows users with a wide mix of engine brands to enjoy simplified inventory and dispensing systems that help save money, space and handling time.



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Clarity® Synthetic Hydraulic Oil AW



Description

Clarity® Synthetic Hydraulic Oil AW is designed to help protect both mobile and stationary hydraulic equipment in industrial applications, as well as in environmentally sensitive areas. Clarity Synthetic Hydraulic Oil AW is formulated with synthetic base stock and an ash less, zinc-free additive system that provides oxidation stability, water separability, foam suppression, and helps protect against wear, rust and corrosion. Clarity Synthetic Hydraulic Oil AW is designed to meet or exceed the performance requirements of conventional anti-wear hydraulic oils, especially in severe, high-output applications such as axial piston pumps, while providing an additional level of safety in case of leaks or incidental discharge to the environment.

Typical Characteristics

ISO Viscosity Grade	32	46	68
MPID	219601	219603	219609
Kinematic viscosity at 40°C, mm²/s	32.5	46.5	68.5
Kinematic viscosity at 100°C, mm²/s	7.0	9.3	11.8
Viscosity Index	183	183	162
Pour point, °C	-45	-42	-42
Flash point COC, °C	220	225	240
Copper Corrosion, 3h/150°C	1B	1B	1B
FZG, Pass Stage, DIN 51354	11	>12	>12

Recommended Applications

Clarity Synthetic Hydraulic Oil AW is designed for use in mobile and stationary hydraulic vane, piston, and gear type pumps. The anti-wear performance of Clarity Synthetic Hydraulic Oil AW makes it especially suited for high performance industrial applications utilizing axial piston pumps where pressures may exceed 5,000 psi. It has a viscosity index much higher than typical conventional anti-wear hydraulic oils, provides optimal flow at low temperatures, and good oil film protection at high operating temperatures. Clarity Synthetic Hydraulic Oil AW is well suited for applications situated in environmentally sensitive areas. The ISO 32 and ISO 46 formulations of this product have good low-temperature pumpability properties that extend to temperatures as low as -30°C (-22°F).

Clarity® Synthetic Hydraulic Oils AW are not compatible with zinc/calcium containing fluids, and OEM recommended lubricant change-out procedures including drain and flush requirements need to be adhered to.

Clarity Synthetic Hydraulic Oils AW Meet The Requirements Of:

- | | |
|---|---|
| ✓ DIN 51524-3 (HVLP, 2006, Part 3) | ✓ Frank Mohn |
| ✓ ISO (11158 L-HV), ASTM (D6158, HV) | ✓ Framo hydraulic cargo pumping (ISO 46) |
| ✓ Eaton Vickers (35VQ25A, M-2950-S, I-286-S), | ✓ Arburg (ISO 46) |
| ✓ Cincinnati Machine P-68 (ISO 32), P-70 (ISO 46), | ✓ Krauss Maffei Kunststofftechnik (ISO 46) |
| P-69 (ISO 68) | ✓ McGregor Hatch Cover Systems (VG 32) |
| ✓ Bosch-Rexroth (former specification RE 90220-01) | |



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Performance Benefits**1. Premium Performance**

Ashless formulation provides wear protection, rust and corrosion protection, hydrolytic stability, water separability, foam inhibition, and filterability.

2. Long Oil Life

Ability of the synthetic base stock to withstand oxidation at high operating temperatures results in maximum service life for the oil.

3. Wear Protection at Start-up

Minimum change in viscosity over wide operating temperatures due to high viscosity index. Multi-viscosity performance minimizes the need to change viscosity grades for seasonal changes.

4. Environmental Sensitivity

Very low acute aquatic toxicity to both fish and invertebrates based on tests of water accommodated fractions. Ashless formulation facilitates conventional recycling programs.

5. Low Temperature Pumpability

The ISO 32 and ISO 46 formulations are specifically developed to ensure good low temperature fluidity for low temperature operations as low as -30°C (-22°F).

6. Zinc-free

Suited for applications involving yellow metals found in axial piston pumps.



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Clarity® Hydraulic Oil AW 100



Description

Clarity® Hydraulic Oil AW 100 is a high performance hydraulic oil designed with premium base oil technology in combination with an advanced zinc-free ashless additive system. It offers robust oxidation stability, water separation, foam suppression with dependable wear, rust and corrosion protection to both mobile and stationary hydraulic vane, piston and gear-type pumps operating in industrial applications and in environmentally sensitive areas. It is well-suited to applications where yellow metals are present in hydraulic systems. Clarity Hydraulic Oil AW 100 is a shear-stable high VI hydraulic oil designed to improve equipment efficiency and increase the operating temperature range.

Typical Characteristics

ISO Viscosity Grade	100
MPID	219611
Kinematic viscosity at 40°C, mm ² /s	100.0
Kinematic viscosity at 100°C, mm ² /s	13.8
Viscosity Index	145
Pour point, °C	-40
Flash point COC, °C	266
Copper Corrosion, 3h/150°C	1B

Recommended Applications

Clarity Hydraulic Oil AW 100 is designed to give reliable protection in mobile and stationary hydraulic vane, piston and gear-type pumps operating in high performance industrial applications as well as in environmentally sensitive areas. Many hydraulic systems are required to operate in environmentally sensitive areas where leaks or spills of hydraulic fluid may result in contamination of the soil or nearby waterways. Unlike Clarity Hydraulic Oil AW 100, conventional anti-wear hydraulic oils are formulated with metal-containing performance additives which can persist in the environment. Clarity Hydraulic Oil AW 100 is designed to meet or exceed the performance requirements of conventional anti-wear hydraulic oils, especially in severe, high-output applications such as axial piston pumps. The anti-wear performance of this oil makes it especially suited for high performance applications utilising axial piston pumps where pressures may exceed 5,000 psi. Clarity Hydraulic Oil AW 100 has offered good performance in applications involving servo-valves using multi-metal components.

Clarity Hydraulic Oil AW 100 Is Approved For:

- ☒ **Blohm+Voss** Stern tube applications
- ☒ **Wärtsilä-Japan** Stern tube applications

Clarity Hydraulic Oil AW 100 Meets The Requirements Of:

- ☒ **DIN 51524-2** (HLP)
- ☒ **DIN 51524-3** (HVLP)
- ☒ **ASTM** (D6158, HV)
- ☒ **ISO** (11158 L-HV)
- ☒ **Eaton Vickers** (M-2950-S, I-286-S)



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Performance Benefits**1. Premium Performance**

High performance ashless formulation is designed to meet or exceed major vane, piston and gear pump manufacturers' requirements for viscosity, rust and corrosion protection, hydrolytic stability, water separability, foam inhibition, and filterability.

2. Long Oil Life

Offers robust oxidation stability and longer service life than conventional zinc-based anti-wear or vegetable oil-based hydraulic oils.

3. Wear Protection

Reliable anti-wear formulation helps optimise wear protection in high efficiency, high speed, high temperature and high output equipment.

4. Environmental Sensitivity

Designed for low toxicity, biodegradable¹ performance and has very low acute aquatic toxicity to both fish and invertebrates based on tests of water accommodated fractions. Ashless formulation facilitates conventional recycling programs.

5. Zinc-free

Zinc-free, ashless design helps protect in applications where yellow metals are present in piston pumps.

1. As determined by OECD 301D (Closed Bottle Biodegradability Test), Chevron Clarity Hydraulic Oil AW 100 was shown to be inherently biodegradable. This test is normally run for 28 days. After completing this test period, Chevron Clarity Hydraulic Oil AW 100 was 38% degraded. Degradation of 20–59% after 28 days in OECD 301D is evidence that a product is inherently biodegradable. Chevron Clarity Hydraulic Oil AW 100 did not meet the criteria for readily biodegradable, which is a degradation of >60% after 28 days in OECD 301D.



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Hydraulic Oil 5606

Regional equivalent: Hydraulic Oil 5606A



Description

Hydraulic Oil 5606 is a high performance general purpose red-dyed hydraulic oil specially developed for a range of general purpose severe service industrial applications. It has a mineral base oil formulation with a robust additive system offering good low temperature fluidity; robust wear protection, oxidation and corrosion resistance with dependable shear stability. Hydraulic Oil 5606 contains a passivator and offers good anti-foam performance, making it suitable for a range of general purpose industrial hydraulic applications.

Typical Characteristics

MPID	219390
Density at 15°C, kg/l	0.87
Kinematic viscosity at 40°C, mm ² /s	15.0
Kinematic viscosity at 100°C, mm ² /s	5.5
Viscosity Index	300+
Pour point, °C	-63
Flash point COC, °C	82

Recommended Applications

Hydraulic Oil 5606 is formulated for use in systems where clean oil is required; for example, in autopilots and robotics. It can be used under a variety of weather conditions. Additionally, it can be used in severe operation conditions over a broad temperature range and is especially suitable for low temperature applications.

Hydraulic oil 5606 should not be used in systems where natural rubber elastomers are present.

Hydraulic Oil 5606 Meets The Requirements Of:

- ✓ **DIN** 51524 Part III
- ✓ **U.S. Military Specification** MIL H 5606 G
- ✓ **U.S. Military Specification** MIL-PRF-5606 H

Performance Benefits

1. High Viscosity Index

Designed with a high viscosity index (VI) to offer flexibility of use across a wide range of environmental and operating temperatures.

2. General Purpose Use

Specially developed for flexible general-purpose use, across a range of severe industrial applications, reducing inventory costs.

3. Low Operating Temperatures

Offers reliable fluidity and system protection in low environmental and operating temperatures, and as system start-up.

4. Wear and Corrosion Protection

Formulated for protection against system wear, corrosion and oxidation, helping reduce downtime.

5. Seal and Paint Flexibility

Can be used with a combination with generally available seals and paints, helping improve service uptimes.



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Rando® HDZ



Description

Rando® HDZ oils are high-viscosity, high-performance, anti-wear hydraulic oils, formulated specifically to cater to the widely varying operating temperatures in the marine environment. These oils are blended from high-viscosity index lubricating oil stocks and several specially selected additives designed to give robust protection to hydraulic pumps. Rando HDZ meets the requirements of major hydraulic equipment manufacturers for rust and oxidation inhibited hydraulic fluids, as well as for EP or anti-wear hydraulic fluids.

Typical Characteristics

ISO Viscosity Grade	15	22	32	46	68	100
MPID	219300	219383	219301	219302	219303	219304
Kinematic viscosity at 40°C, mm²/s	15.0	22.0	32.0	46.0	68.0	100.0
Kinematic viscosity at 100°C, mm²/s	3.9	5.0	6.3	8.2	11.0	14.2
Density at 15°C, kg/l	0.88	0.95	0.87	0.87	0.88	0.88
Viscosity Index	155	165	151	154	150	139
Pour point, °C	-60	-48	-48	-47	-42	-36
Flash point, °C	144	188	220	216	222	236
Copper Corrosion, 3h/150°C	1A	1A	1A	1A	1A	1A
Foam Seq. II (after blowing), ml	10	10	10	10	10	10
Foam Seq. II (after 10' standing), ml	0	0	0	0	0	0

Recommended Applications

Rando® HDZ oils are recommended for use in all shipboard hydraulic machinery and specifically for hydraulic equipment used under extreme operating temperatures such as deck machinery. The multi-viscosity feature promotes even and continuous power transmission over a wide temperature range with a minimum of shudder, and maximum accuracy.

Rando HDZ Oils Are Approved For:

- ✓ **Eaton-Vickers** I-286-S, M-2950-S, 35VQ25A (ISO 32, 46, 68)
- ✓ **Fives Cincinnati** (formerly MAG Cincinnati, Cin Machine, Cin Milacron) P-68 (ISO 32), P-70 (ISO 46), P-69 (ISO 68)
- ✓ **Besensoni** crane (ISO 46)
- ✓ **Japan IBUKI** horn (ISO 32)
- ✓ **Alfa Laval** (ISO 32)
- ✓ **Sibre** (ISO 32, 46 & 68)
- ✓ **Parker Hannifin (Denison)** HF0 (ISO 32, 46, 68)



marine lubricants

Rando HDZ Oils Meet The Requirements Of:

- | | |
|--|--|
| ✓ Arburg (ISO 46), ASTM D6158, HV (ISO 15, 22, 32, 46, 68, 100) | ✓ Sauer Bibus geared pump (ISO 46 & 68) |
| ✓ Bosch Rexroth former specification RE 90220-01 (ISO 32, 46, 68) | ✓ Dieckow pumps (ISO 46 & 68) |
| ✓ US Steel 127, 136 DIN 51524-3, HVLP (ISO 15, 22, 32, 46, 68, 100) | ✓ Europa regulateur, governor (ISO 68 & 100) |
| ✓ Frank Mohn, Framo hydraulic cargo pumping (ISO 46), ISO 11158 L-HV (ISO 15, 22, 32, 46, 68, 100), JCMAS HK-1 (ISO 32, 46) | ✓ Bremivi planetary gear (ISO 32) |
| ✓ Turblex compressor (ISO 46) | ✓ Bremivi winches (ISO 46) |
| ✓ Rehfuss gear (ISO 15 & 32) | ✓ Goizper pumps (ISO 32 & 46) |
| | ✓ Hatlapa deck machinery (ISO 46, 68 & 100) |
| | ✓ Mariner deck machinery (ISO 32 & 46) |
| | ✓ GEA Westfalia belt driven purifier (ISO 46) |
| | ✓ Manabe Zoki deck machinery (ISO 46 & 68) |
| | ✓ MarFlex pumps (ISO 32 & 46) |

Performance Benefits

1. Anti-Wear and EP Properties

Extends the life of hydraulic pump and motor parts in heavy-duty service and helps protect against destructive wear under overload conditions.

2. Ultra-High Viscosity Index

Contains a specially selected high shear-stable viscosity index improver, which gives the lubricant a superior operating temperature window, even under high shear-rate conditions. Rando HDZ oils provide real “crossgrading” benefits and stay in grade, even when subjected to the shearing condition of high-speed, high-pressure hydraulic systems in severe service.

3. Low Pour Point

Remains liquid at low operating temperatures.

4. Oxidation Stability

High oxidation stability helps ensure long life and prevent accumulation of sludge and deposits.

5. Corrosion Protection

Helps protect against rusting of close-fitting hydraulic system parts and prevents the regeneration of abrasive rust and corrosion.

6. Water Resistance

Water-separation characteristics assure speedy removal of water from leaks and condensation.

7. Foam Resistant

Combined with selected foam inhibitors, resists foaming, thus preventing accumulation of surface foam at high-oil circulation rates.

8. Filterability

Rando HDZ oils show good filterability properties even in the presence of water. They passed the AFNOR NFE 48 dry and wet filterability tests.



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Meropa®



Description

Meropa® lubricants are premium-quality gear lubricants that have been specially developed to meet the demanding load-carrying requirements of gear manufacturers. Meropa lubricants are manufactured from high-quality base oils and have low pour points. They contain an additive combination that enhances oiliness, extreme pressure, and anti-wear properties. Meropa lubricants have a high oxidation, thermal, and hydrolytic stability, good water-separating characteristics, good air release and anti-foam properties, which helps to protect against metal corrosion and rusting.

Typical Characteristics

ISO Viscosity Grade	68	100	150	220	320	460	680
MPID	219506	219510	219515	219522	219532	219546	219568
Kinematic Viscosity at 40°C, mm ² /s	68.0	100.0	150.0	220.0	320.0	460.0	680.0
Kinematic Viscosity at 100°C, mm ² /s	8.8	11.4	14.9	19.2	24.3	30.0	36.5
Viscosity Index	100	100	100	100	100	100	95
Flash Point, °C	200	200	215	215	215	215	240
Pour point, °C	-15	-15	-15	-15	-15	-15	-10
Density, 15°C, Kg/l	0.88	0.88	0.89	0.89	0.90	0.90	0.90
FZG load stage, A/8.3/90	>12	>12	>12	>12	>12	>12	>12

Recommended Applications

Meropa lubricants are recommended for a wide variety of industrial and mobile equipment. Typical applications include enclosed gear systems, chain drives, sprockets, plain and anti-friction bearings, slide guides, and flexible couplings. They are particularly recommended for enclosed gear drives and speed reducers, ranging from fractional kilowatt gear motors to large, high power units on metal rolling mills, cement mills, and mine hoists.

Meropa lubricants are also suitable for industrial hypoid-type gears and are also recommended for use in transmission gear cases and worm drive axles on automotive, construction and mining equipment. Additionally, they are suitable for bath, splash and circulation applications. Other specific applications for Meropa are in marine gearing such as main propulsion, centrifuges, and deck machinery including winches, windlasses, cranes, turning gears, pumps, elevators and rudder carriers.

Meropa Is Approved For:

- ✓ **GROB**
- ✓ **SMS Group** SN 180-2 (ISO 100, 150, 220, 320, 460, 680)
- ✓ **ZF** TE ML 04H (ISO 100/150)
- ✓ **ZF** TE ML 04F (ISO 220)
- ✓ **SEW Eurodrive** (planetary gear ISO 150, 220, 320, 460 & 680)
- ✓ **Tanktek** (towing system ISO 220)
- ✓ **Börger Pumps** (ISO 68, 220)
- ✓ **Bremivi** (planetary gear ISO 150, 220 & 320)
- ✓ **VHI** (deck machinery ISO 150)
- ✓ **Mariner** (deck machinery ISO 150)



marine lubricants

Meropa Meets The Requirements Of:

- ✓ **DIN** 51517/3 CLP (ISO 68, 100, 220, 320, 680)
- ✓ **US Steel** 224 (ISO 68, 100, 220, 320, 460, 680)
- ✓ **AGMA** 9005-E02-EP (ISO 68)
- ✓ **AGMA** 9005-E02-R&O (ISO 100, 220, 320, 460, 680)
- ✓ **Fives Cincinnati** P-63 (ISO 460), P-59 (ISO 320), P-63 (ISO 68), P-76 (ISO 100), P-74 (ISO 220), P-77 (ISO 150)
- ✓ **ISO** 12925-1 CKC/CKD (ISO 68, 100, 220, 320, 460, 680)
- ✓ **Zollern** (rope winch ISO 220)
- ✓ **Rehfuss** (ISO 100, 220 & 460)
- ✓ **Bremivi** (winches ISO 150)
- ✓ **ATEK** (bevel gear ISO 68, 100, 150, 220, 320, 460 & 680)
- ✓ **Graessner MS** (gear ISO 60, 100, 150 & 220)

Meropa Is Suitable For Use In:

- ✓ **Thrusters and propulsion systems** ABB Azipod, Brunvoll, Kawasaki, KTE, Schottel, SKF Blohm & Voss, Thrustmaster, Wartsila Cedervall, Wartsila UK
- ✓ **Centrifuges** Alfa Laval, Mitsubishi Kakoki, Samgong, Gea Westfalia
- ✓ **Various cranes** ACTA, BLM, Danish Crane, DMC, MHI, Sekigahara, TTS, Wuhan, Zhenjiang Marine
- ✓ **Davits and winches** A-Tech, Brohl, Davit International, DMC, Fukushima, Hatecke, Hatlapa, IHI, Kawasaki, TTS, MHI, Ned Deck Marine, Samgong, Schat-Harding, Shin Myung, Zhenjiang Marine, Zollern, Rolls-Royce Marine (RRM)

Performance Benefits

1. Load-Carrying Capacity

Offers extremely high load-carrying capacity, has good anti-wear properties, and cushions shock loads.

2. Thermal and Oxidation Stability

Intends to keep sludge formation and frequent cleaning in circulation systems to a minimum, thus often reducing expensive downtime. Recommended for continuous service for temperatures between 120–130°C.

3. Hydrolytic Stability

Aims to prevent sludge formation when in contact with water and retains compounding level for prolonged periods of time even in the presence of water.

4. Water Separation

Assures speedy separation of water in circulating systems.

5. Non-Foaming Characteristics

Readily dissipates foam under the most unfavorable conditions, such as violent agitation in the gear case.

6. Air Release Properties

Promotes fast release of entrained air bubbles which may be formed by frequently rotating gear components.

7. Rust Preventing Properties

Helps to prevent the rusting of gears and bearings in the presence of water.

8. Non-Corrosive to Copper and Copper Alloys

Aims to minimize wear-rates of copper alloys used in worm gears and bearings.



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Meropa® EliteSyn WS



Description

Meropa® EliteSyn WS is a synthetic industrial gear lubricant range showing superior performance under demanding operating conditions. It is based on water soluble polyalkylene glycols, thus providing great micro-pitting and EP performance. Furthermore, the product shows good thermal stability and corrosion protection.

Typical Characteristics

ISO Viscosity Grade	150	220	460	680
MPID	219421	219414	219423	219424
Kinematic Viscosity at 40°C, mm ² /s	159.0	230.0	470.0	690.0
Kinematic Viscosity at 100°C, mm ² /s	30.0	42.0	79.0	114.0
Viscosity Index	230	235	252	263
Flash Point, COC °C	>290	>290	>290	>290
Pour point, °C	-42	-42	-36	-36
Density, 15°C, Kg/l	1.05	1.06	1.07	1.07
FE8 bearing roller wear, <30 mg	Pass	Pass	Pass	Pass
FZG load stage, A/8.3/90	>14	>14	>14	>14
FZG micro-pitting, 90°C damage load stage	>10 High	>10 High	>10 High	>10 High

Recommended Applications

Meropa EliteSyn WS is an industrial gear oil range applicable with the following different gear designs: helical, bevel helical, planetary and worm gears, and marine gear units. The product is also suitable for the use of different applications, like: fill for life — disposable gearboxes, textile lubricants, chain and conveyor lubricants, kiln and oven lubricants, sliding bearings and roller bearings in high load/EP applications.

Meropa EliteSyn WS Is Approved For:

☒ **Flender** BA T 7300 A+B (revision 16)

Meropa EliteSyn WS Meets The Requirements Of:

- ☒ **DIN** 51517 part 3
- ☒ **David Brown** Type G lubricants
- ☒ **ISO 12925-1** CKPG

Meropa EliteSyn WS Is Suitable For Use In:

- ☒ **Macgregor-Cargotec** deck cranes
- ☒ **Smag-Peiner** crane grabs



marine lubricants

Performance Benefits**1. Protects Under Harsh Conditions**

Formulated to provide reliable micro-pitting resistance and component protection under demanding conditions.

2. Offers Component Protection

Designed to offer robust EP performance, which aims to improve component protection and system uptime.

3. High Thermal Stability

High thermal stability helps improve oil service life and maintenance intervals, often reducing downtime.

4. Offers Oxidation Protection

Reliable oxidation resistance often offers optimum keep-clean system protection.

5. System Reliability

Low sludge and deposit formation helps maintain system reliability.

6. Corrosion Protection

Good corrosion protection assists in keeping maintenance costs down.

PRODUCT MAINTENANCE AND HANDLING**Compatibility With Metals**

There is a incompatibility between PAGs and Al due to the high polarity of Polyglycol with regard to lubricated "tribo components" (friction partners steel to Al material) like bearing cages or worm gear drives and therefore the combination is not advised.

But Al-gearboxes — which have no bearing or sliding surfaces in direct contact with a steel shaft — are uncritical and can therefore be used with Meropa® EliteSyn WS.

The product is not miscible with mineral oils and should preferably not be mixed with other polyglycol based lubricants, in order to preserve the premium properties of Meropa EliteSyn WS.

Mixing Meropa EliteSyn WS and other PAG-based gear oils could result in a change in appearance. Please note that possible haziness has no influence on the performance of Meropa EliteSyn WS.

Meropa EliteSyn WS does not affect common seal and gasket materials. The use of Nitrile Rubber (NBR), Fluoro-Silicone or Vinyl-Methyl Polysiloxane (Q) is recommended for high temperature applications.

The product is not compatible with polyurethane-based elastomers, leather, cork, asbestos, paper and board.

It is recommended to use Meropa EliteSyn WS in gearboxes where the internal surface is unpainted or coated with resistant materials, for example a resistant two-pack epoxy formulation.

Service Considerations

Unlike mineral oil based lubricants which break down and form deposits at high temperatures, the polyalkylene glycol ("PAG") base fluid of Meropa EliteSyn WS tends to decompose to fluid components or volatile products, retaining its lubricating properties as long as any fluid film remains. The mixed polyalkylene glycol molecules in Meropa EliteSyn WS are also polar in nature, providing a solvent action on polar oxidation compounds which minimizes separation of insoluble sludges and deposits, helping to keep the lubrication system and machine surfaces clean.

PAGs are hygroscopic in nature, and under normal operating conditions Meropa EliteSyn WS can be expected to contain about 2000 ppm of water. Importantly, this is not free water, which can lead to loss of lubricating oil film and corrosion. With Meropa EliteSyn WS, by contrast, absorbed water is hydrogen-bonded to the PAG molecules and does not interfere with oil film retention.

FLUSH PROCEDURE

Warning: These products must never be mixed with mineral oil or PAO-based products.

The following procedure should be adhered to when changing from mineral oil or other type PAG based gear lubricant to Meropa EliteSyn WS:

Let the system run until the oil in service is warm. Drain as much as possible and pay attention to reservoirs, lines, etc., where oil may be trapped. Clean the system from residual sludge.

Flush the system with a minimum quantity of Meropa EliteSyn WS by operating under no load and drain the system while the fluid is warm. Repeat if necessary.

Seals that have been exposed to other oils may shrink when they are exposed to Meropa EliteSyn WS. Therefore, they should always be inspected. Often, careful inspection of the system for leaks can be sufficient, but it may be advantageous to replace the seals.

In case seals are deteriorated, they must be replaced.

It is recommended to inspect the lubricant after one or two days in use to make sure that it is free of extraneous materials. Contamination with significant quantities of other lubricants can, in some cases, lead to sludge formation, foaming and other problems.



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Meropa[®] MG



Description

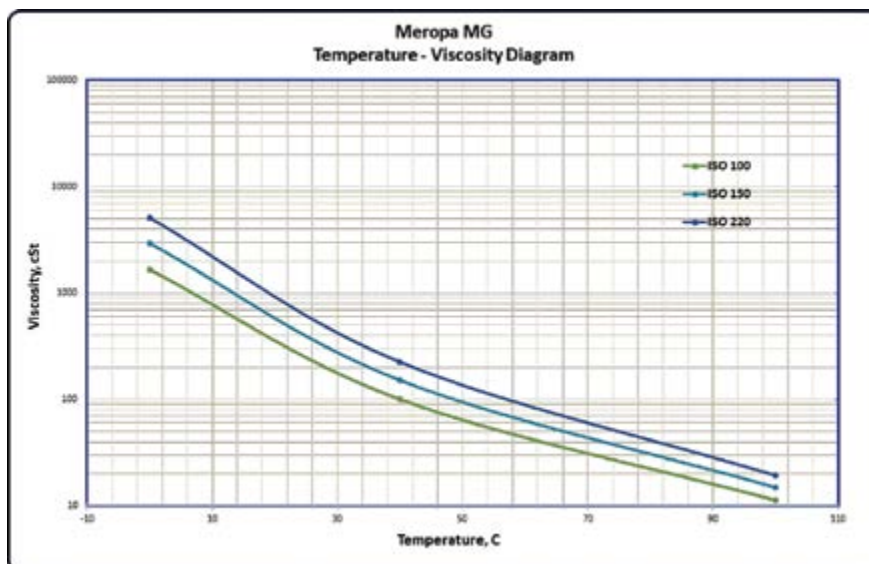
Meropa[®] MG gear oils are premium high-performance gear oils, offering long lubricant life, corrosion protection, good wear protection with high load carrying capacity and robust micro-pitting wear protection. They are designed for use in industrial and marine clutched gear systems, where extreme load and shock load protection is required.

Typical Characteristics

ISO Grade	100	150	220
MPID	219493	219494	219495
AGMA Grade	3EP	4EP	5EP
Density at 15°C, kg/l (ASTM D4052)	0.89	0.90	0.90
Viscosity, Kinematic at 40°C	100.0	150.0	220.0
Viscosity, Kinematic at 100°C	11.3	14.8	19.0
Viscosity Index	99	98	97
Flash Point, °C	234	254	268
Pour Point, °C	-24	-25	-26
Foam Properties Sequence I-III, D892			
Tendency, mL	<50	<50	<50
Stability, mL	0	0	0
Copper Corrosion, D130 (3 hr at 100°C)	1B	1B	1B
Rust Test, D665B	PASS	PASS	PASS
FAG FE-8 (D7.5-80/80-80), DIN 51819-3 Roller Weight Loss, (mg)	1.0	1.0	1.0
FZG Pass Stage, ASTM D5182	>12	>13	>12
FZG Micro-pitting, FVA 54, failure load stage	10/High	10/High	10/High

Minor variations in product typical test data are to be expected in normal manufacturing.

Meropa MG gear oils have the typical sulfur-phosphorus odor characteristic of industrial gear oils. A ventilated environment is recommended during use.





marine lubricants

Recommended Applications

Meropa® MG gear oils are designed to ensure optimal performance in RENK and Flender/Siemens clutched gear boxes extensively used in marine vessels. The advanced formulation is balanced to provide extreme pressure protection, while providing protection against yellow metal corrosion. The robust chemistry is compatible with multiple types of sealant and paint coatings and helps to minimize the possibility of leaking seals and paint blistering on the inside of the gearbox. Competitive products with over-aggressive chemistries may attack the paint coatings and cause filter plugging.

Meropa MG Is Approved For:

- ✓ **Ortlinghaus** clutch test
- ✓ **RENK Augsburg**
- ✓ **RENK Rheine**
- ✓ **Flender**
- ✓ **Reintjes**
- ✓ **Brunvoll**

Meropa MG Meets The Requirements Of:

- ✓ **AGMA** 9005-F16 AS
- ✓ **DIN** 51517-3 (CLP)
- ✓ **ISO 6743-6 CKC** ISO-L-CKC
- ✓ **ISO 12925-1** CKC/D
- ✓ **Fives Cincinnati** ISO 100-220
- ✓ **US Steel** 224
- ✓ **Zollern** (rope winch ISO 220)
- ✓ **Bremivi** (winch ISO 220)

Meropa MG Is Suitable For Use In:

- ✓ Marine vessels using clutched gear boxes
- ✓ Industrial enclosed gearing where an AGMA EP lubricant is specified
- ✓ Industrial enclosed gearing where DIN 51517 (CLP) lubricant is specified
- ✓ Bath, splash, circulating, or spray mist lubrication as applicable to the proper viscosity grade
- ✓ Marine gearboxes requiring an extreme pressure lubricant

Performance Benefits**1. Provides Thermal And Oxidative Stability**

The thermal and oxidative stability of Meropa MG minimizes deposit formation and can extend bearing and gear life. Good resistance to oil degradation at high temperatures, resulting in extended oil life and long drain intervals.

2. Rust And Corrosion Protection

Meropa MG offers rust and corrosion protection over long service periods.

3. Extended Gear And Bearing Life

Particularly effective in enclosed gear drives operating under extreme load, speed, and temperature conditions.

4. Less Wear

Ensures optimum wear protection with reduced maintenance and increased system uptime.

5. Provides micro-pitting resistance

Delivers reliable micro-pitting and wear protection with reduced maintenance and increased system uptime.

6. Keeps Components Clean

The advanced additive technology helps to prevent varnish and sludge and keeps the components clean. Clean components can contribute to long lubricant and equipment life.

5. Water Separation

Good demulsibility and corrosion protection for trouble-free operation in applications where water contamination is unavoidable.



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Meropa® Synthetic EP 150

Regional equivalent: Pinnacle® EP 150



Description

Meropa® Synthetic EP 150 is a premium performance, synthetic EP gear oil and circulating oil designed for use in a wide range of industrial equipment operating under severe conditions, such as heavy and/or shock loading and elevated temperatures, where short service life with conventional lubricants can be expected. It is formulated with a combination of poly-alpha-olefin and synthetic ester base fluids as well as selected additives to provide good EP performance and wear protection, increased thermal/oxidation stability and protection against corrosion and rust.

Typical Characteristics

MPID	219826
Kinematic Viscosity at 40°C, mm ² /s	150.0
Kinematic Viscosity at 100°C, mm ² /s	18.8
Viscosity Index	150
Flash Point, COC, °C	244
Pour point, °C	-48
Density at 15°C, Kg/l	0.85
FZG Damaged Load, A/16.6/90	>12
FZG Damaged Load, A/8.3/90	>12

Meropa Synthetic EP 150 Is Approved For:

- ☒ **GROB**
- ☒ **ZF** TE-ML 04H

Meropa Synthetic EP 150 Meets The Requirements Of:

- ☒ **ANSI/AGMA** Standard 9005-EO2-EP
- ☒ **DIN** 51517-3 (CLP)
- ☒ **US Steel** Specification No. 224
- ☒ **Fives Cincinnati** P-77
- ☒ **Bremivi** planetary gear & winch

Meropa Synthetic EP 150 Is Suitable For Use In:

- ☒ All types of gear systems in mobile and stationary industrial equipment where an EP lubricant is specified, including spur, bevel and worm gears.
- ☒ Plain and anti-friction bearings subjected to heavy-duty operating conditions.
- ☒ Circulating oil systems where an EP lubricant is required.
- ☒ Outdoor machinery exposed to wide ambient temperature conditions, such as crane, hoist and winch gearboxes.
- ☒ Speed reducers, chain drives, sprockets and flexible couplings.
- ☒ Bath, splash, circulating and spray lubrication systems.



marine lubricants

Performance Benefits**1. Minimizes Unscheduled Maintenance**

Good thermal and oxidation stability provides resistance to deposit formation, maintaining a cleaner gear/circulating oil system.

2. Extends Equipment Life in Severe Service

Special EP additive helps provide protection against wear of bearing and gear surfaces during heavy-duty operation. Effective rust and corrosion inhibitors help with protecting majority of system components.

3. Trouble-Free Operation

Good air and water separation characteristics reduce the risk of surface wear caused by loss of lubricating oil film. Compatibility with all conventional seal materials and mineral-type circulating oils helps to eliminate operational problems if changing oil types.

4. Long Lubricant Life

Improved thermal and oxidation stability assists with providing longer service life under adverse conditions than is possible with conventional mineral oils.



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Meropa[®] Synthetic WM 320



Description

Meropa[®] Synthetic WM 320 is formulated with synthetic hydrocarbons and a reliable sulphur-phosphorus Extreme Pressure additive package which is designed to minimize wear of enclosed industrial gears operated under heavy loads and shock conditions. It provides good foam resistance and water separating characteristics which make it ideal for circulating systems with incidental water contamination. The non-corrosive formula aims to protect gear and bear materials such as steel, copper, bronze, babbitt or cadmium-nickel. Meropa Synthetic WM 320 has good oxidative and thermal stability for long service life. The naturally high VI and low pour point provide improved performance and lower viscous drag losses at low operating temperatures compared to conventional industrial gear oils. It has been specially designed to provide high micro-pitting protection.

Typical Characteristics

MPID	219956
Kinematic Viscosity at 40°C, mm ² /s	320.0
Kinematic Viscosity at 100°C, mm ² /s	35.4
Viscosity Index	156
Flash Point, °C	240
Pour point, °C (ASTM D97)	-48
Density, 15°C, Kg/l	0.85
FZG Damaged Load, A/8.3/90	>12

Recommended Applications

Meropa Synthetic WM 320 is Chevron's primary recommendation for the lubrication of industrial gear systems. Meropa Synthetic WM 320 is recommended for the lubrication of heavily loaded enclosed industrial gear drives and reducers, spur, bevel, helical, worm and industrial hypoid gear cases, open pit and underground mining equipment, cement mills, ball mills, rolling mills, crushers, shakers, hoists, conveyors, kilns, winches, machine tools, skip lines and marine equipment. Meropa Synthetic WM 320 is successfully used for wind turbine applications.

Meropa Synthetic WM 320 Is Approved For:

☒ **Moventas** Wind Turbine Gearboxes

Meropa Synthetic WM 320 Meets The Requirements Of:

☒ **ANSI/AGMA** Standard 9005-EO2-EP
☒ **US Steel** Specification No. 224
☒ **DIN** 51517/3 CLP



marine lubricants

Performance Benefits**1. Minimizes Wear**

Extreme pressure properties to minimize wear.

2. Long Service Life

Oxidative and thermal stability promote long service life.

3. Rust and Corrosion Protection

Helps to protect against rust and corrosion.

4. High and Low Operating Temperature

Wide ambient operating temperature range due to the high VI and low pour point.

5. Good Demulsibility

Good demulsibility for rapid water separation.

6. Foam Resistant

Has foam resistant qualities.

7. Micro-Pitting Protection

High micro-pitting protection.



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marine lubricants

Meropa® WG 460

Regional equivalent: Cylinder Oil W 460



Description

Meropa® WG 460 is a proven performance, high viscosity industrial gear and steam cylinder oil, with low carbon residue, compounded with selected fatty oils and combined with rust and foam inhibitors. It is formulated for steam cylinder and valve lubrication, where the steam is wet or of poor quality.

Typical Characteristics

MPID	219548
Kinematic Viscosity at 40°C, mm ² /s	439.0
Kinematic Viscosity at 100°C, mm ² /s	30.0
Viscosity Index	97
Flash Point, °C	284
Pour point, °C (ASTM D97)	-9

Recommended Applications

Meropa WG 460 is recommended for use on heavily loaded industrial worm gear sets, low speed heavily loaded spur and helical gears, low speed or high temperature bearings and steam cylinder and valve lubrication where the seam is wet or of poor quality (see service consideration below).

Meropa WG 460 Is Approved For:

- ☒ **Certified/licensed by NSF** as lubricants where there is no possibility of food contact (H2) in and around food processing areas (applicable for Europe, plus the regional equivalent Cylinder Oil WG 460)

Meropa WG 460 Meets The Requirements Of:

- ☒ **ANSI/AGMA** Standard 9005-E02-CP (in Europe, plus the regional equivalent Cylinder Oil WG 460)

Meropa WG 460 Is Suitable For Use In:

- ☒ **Ariel and other types of gas compressors** cylinder lubrication

Performance Benefits

1. Helps to Promote Gear Longevity

High oil film strength and viscosity offers protection against worm gear, steam cylinder and valve surface wear, rust and corrosion.

2. Robust Protection Over Surfaces

Reliable steam and condensate separation and good atomization properties helps to ensure oil offers robust protection over surfaces.

3. Smooth Lubricant Delivery

Dependable anti-foam performance promotes smooth lubricant delivery to vulnerable working surfaces.

4. Good Oxidation Stability

Good oxidation and thermal stability helps resist oil breakdown and promotes improved performance with extended oil service life.



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Pinnacle® Marine Gear 220



Description

Pinnacle® Marine Gear 220 is a fully formulated, quality synthetic gear lubricant based on a mixture of polyalphaolefins and diesters. It offers oxidation stability at elevated temperatures, extended oil drain life and good wear protection.

Typical Characteristics

MPID	219401
Kinematic Viscosity at 40°C, mm ² /s	220.0
Kinematic Viscosity at 100°C, mm ² /s	22.7
Viscosity Index	115
Flash Point, °C	250
Pour point, °C (ASTM D97)	-45
Density, 15°C, Kg/l	0.89
FZG failure load stage, A/8.3/90	>12
FZG grey staining test, failure load stage	>10

Recommended Applications

Pinnacle Marine Gear 220 is recommended not only for lubricating plain and roller bearings, but also open and closed gears at high temperatures. It can be applied by bath, splash or circulation systems, and is specially targeted for the lubrication of purifier gears and reduction gears.

Pinnacle Marine Gear 220 Is Approved For:

- ☒ **Börger Pumps**

Pinnacle Marine Gear 220 Meets The Requirements Of:

- ☒ **Various types of reduction gears** Rolls-Royce Marine, Lohman-Stolterfoht Zollern Rope Winch, Ateck Bevel Gear, Kongsberg Winches
- ☒ **Elevators** Ushio, Hyundai Elevator

Pinnacle Marine Gear 220 Is Suitable For Use In:

- ☒ **Centrifuges** Alfa Laval, Westflia, Mitsubishi Kakoki
- ☒ **Inert gas blowers** Robushi, Aalborg, Air products
- ☒ **Several deck applications** where mineral gear oils cannot be used because of too high/low operating temperatures, or if extended drain intervals are required



marine lubricants

Performance Benefits**1. Thermal and Oxidation Stability**

Synthetic hydrocarbon base oils help to provide oxidation and thermal stability.

2. Bearing and Gear Protection

Bearing and gear protection combined with good copper compatibility at elevated temperatures were shown in the FZG test. Helps to protect against the formation of micro-pitting as a result of fatigue stress, as tested in the FZG grey staining test.

3. Compatibility

Compatible with most mineral oil-based EP and R&O gear lubricants, as well as with most PAO-based synthetic EP and R&O gear lubricants.

4. Low Friction

Unique low friction coefficient promotes improved gear efficiency, energy savings, less friction, less wear, and lower operating temperatures compared to conventional mineral oils.

5. Extended Drain Intervals

Aims to provide longer lubricant life, less maintenance costs, and less used oil disposal.



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Capella® A 68



Description

Capella® A is a premium synthetic compressor oil specifically designed for the lubrication of ammonia refrigeration compressors operating at high discharge temperatures in systems with extremely low evaporator temperatures. Capella® A is formulated from specially synthesized polyalphaolefin (PAO) base fluids.

Typical Characteristics

ISO Viscosity Grade	68
MPID	219415
Density 15°C, kg/l	0.83
Flash Point, °C	260
Pour Point, °C	-57
Viscosity, kinematic	
mm²/s @ 40°C	68.7
mm²/s @ 100°C	10.6
Viscosity Index	143
Acid No., mg KOH/g	0.01

Recommended Applications

Lubrication of compressors in refrigeration and air-conditioning systems filled with ammonia, especially where the minimum evaporator temperatures are down to -60°C. The product is particularly suited for reciprocating and screw ammonia compressors operating at discharge temperatures exceeding 100°C.

Capella A 68 Is Approved For:

- ☒ ABB Stal Refrigeration AB
- ☒ Sabroe
- ☒ Broedrene Gram

Capella A 68 Meets The Requirements Of:

- ☒ DIN 51503
- ☒ British Standard 2626/1992



marine lubricants

Performance Benefits**1. Efficient, Trouble-free Operation**

Extremely low pour point and freon floc point (below -50°C) help enable fluidity without wax or deposit formation at very low minimum evaporator temperature, even with low solvency of the lubricating oil in the refrigerant. This further contributes to evaporator efficiency and cleanliness of the flow lines.

Synthetic polyalphaolefin base fluid provides a very low pour point (-57°C) and less oil thickening even at extremely low temperatures. This helps make the product suitable for operation at the very low evaporator temperatures typical in modern ammonia refrigeration systems, where in addition the solvency of the lubricating oil in the refrigerant is very low. Further, the low oil volatility of the synthetic polyalphaolefin base fluid reduces oil consumption and limits the amount of lubricant carry-over to the evaporator, which results in increased heat transfer efficiency. Additive free formulation prevents production of sludge caused by ammonia soap formation.

Low moisture content helps prevent icing in refrigeration expansion valves and deliver maximum corrosion protection.

2. Minimum Downtime

Synthetic polyalphaolefin base fluid provides excellent thermal and chemical stability in the presence of ammonia, avoiding the formation of gum, varnish and sludge deposits.

3. Lower Maintenance Costs

Ultra high viscosity index of synthetic polyalphaolefin base fluid helps provide highest oil viscosity at elevated operating temperatures and maintain fluid film strength for greatest protection against compressor wear.

4. Easier Cold Start-up

Ultra high viscosity index of synthetic polyalphaolefin base fluid helps provide lower viscosity at cold temperatures, reducing cold start-up power requirements.



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Capella® HFC



Description

Capella® HFC is a premium-grade, fully synthetic oil for the lubrication of compressors used in refrigeration and air conditioning systems. Capella HFC is blended exclusively with specially selected polyolesters. It has a high viscosity index ensuring a good lubricity over a wide temperature range.

Typical Characteristics

	Capella HFC 32	Capella HFC 55	Capella HFC 100
ISO Viscosity Grade	32	46/68	100
MPID	219405	219411	219404
Density 15°C, kg/l	1.00	1.01	0.97
Flash Point, COC, °C	>240	>270	>260
Pour Point, °C	-57	-51	-30
Viscosity, kinematic			
mm²/s @ 40°C	32.0	53.0	100.0
mm²/s @ 100°C	5.7	8.4	11.4
Viscosity Index	119	132	100
Acid No., mg KOH/g	0.03	0.03	0.03

Recommended Applications

Capella HFC lubricants have been developed in cooperation with major refrigerant compressor manufacturers worldwide, specifically for use with chlorine-free hydrofluorocarbon (HFC) refrigerants, such as R134a, R404a, R410a or R507, etc. The product series are especially suited for the first-fill and retrofit lubrication of refrigeration compressors in provision and industrial refrigeration plants, as well as in air-conditioning systems and heat pump equipment.

Capella HFC grades are not recommended for use in ammonia refrigerating systems, where Capella WF or Capella A are recommended instead.

Note: Capella HFC lubricants readily absorb moisture from the ambient air, which can cause system performance problems. Capella HFC packages should be kept sealed until time of use and should not be reused once opened.

Capella HFC Meets The Requirements Of:

✓ **DIN** 51503-1 Groups KC, KD, KE

Capella HFC Is Recommended For Use In:

✓ **Bitzer**
 ✓ **Bock**
 ✓ **Dorin**
 ✓ **GEA**
 ✓ **Grasso**
 ✓ **Sabro**

✓ **ABB Stal Refrigeration AB**
 ✓ **Sulzer**
 ✓ **Ushio Reinetsu**
 ✓ **Carrier**
 ✓ **York**



marine lubricants

Performance Benefits**1. Efficient, Trouble-free Operation**

Exhibits excellent oil-refrigerant miscibility properties with HFC-refrigerants over a wide range of operating temperatures, which helps ensure adequate lubrication of the compressor bearings and to facilitate oil return from the refrigeration system.

2. Minimum Downtime

Provides excellent thermal and chemical stability in the presence of hydrofluorocarbon (HFC) refrigerants. Demonstrated excellent compressor cleanliness with absence of any copper transfer in numerous compressor tests.

3. Lower Maintenance Costs

High resistance to oxidation, even at high operating temperatures, which helps guarantee a long service life. Provides excellent lubricity, even in the presence of refrigerants.



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Capella® Low Temp AB 68

Formerly known as Refrigeration Oil Low Temp



Description

Capella® Low Temp AB is a synthetic refrigeration compressor oil based on alkylbenzene components of the branched type. The product is recommended for use with ammonia (R717) and systems using older chlorofluoro- and hydrochlorofluorocarbon (CFCs & HCFCs — freon) refrigerants. It is suitable for a wide temperature range, including installations with very low evaporating temperatures, where mineral based products do not perform adequately.

Typical Characteristics

ISO Viscosity Grade	68
MPID	219828
Density 15°C, kg/l	0.87
Flash Point, °C	190
Pour Point, °C	-42
Viscosity, kinematic mm²/s @ 40°C	68.0
Floc point (R50), °C	-58
Floc point (R12), °C	<-73

Recommended Applications

Capella Low Temp AB can be applied in screw and piston compressors in refrigeration and air-conditioning systems filled with ammonia (R717) and systems using older CFC (chlorofluorocarbon, such as R12 and R502) and HCFC (hydrochlorofluorocarbon, such as R22) refrigerants.

Capella Low Temp AB is particularly recommended in case of high compressor discharge temperatures and/or very low evaporator temperatures — temperatures below -35°C with R22, -25°C for R502.

For systems containing hydrofluorocarbon (HFC) refrigerants such as R134a, R404a, R507, etc., Capella HFC is recommended instead.

Capella Low Temp AB Is Approved For:

- | | |
|--|--|
| ☒ Bock R22 (CFC) and R717 (ammonia) | ☒ Mycom (Mayekawa) R717 (ammonia) |
| ☒ Howden Compressors R717 (ammonia) | ☒ Sabroe R717 (ammonia) |

Capella Low Temp AB Is Suitable For Use In:

- | | |
|--|--|
| ☒ Bitzer* | ☒ Dorin*, Danfoss* Tamrotor Marine Compressor |
| ☒ Carrier* | ☒ Necchi/ERC* |
| ☒ Thermoking* | |

* approved under former name Refrigeration Oil Low Temp 68



marine lubricants

Performance Benefits**1. Wide operating temperature window**

Compared to mineral based refrigerating oils Capella Low Temp AB deploys higher thermal stability and lower volatility, which makes the product the better choice in case of high compressor discharge temperatures. At the same time, the low pour point and very low floc points enable lower minimum evaporator temperature over mineral based refrigerants.

2. Extended lifetime and lower maintenance cost

The thermal stability and lower volatility over mineral based refrigerating oils result in longer service life and reduced lubricant carry-over to the evaporator, where the higher solvency promotes improved system cleanliness. The formulation is free of additives which prevents the production of sludge caused by ammonia soap formation, critical for ammonia refrigeration systems.

3. Optimum lubrication

The product is miscible with CFC and HCFC refrigerants and maintains lubricity. It is formulated to protect cast iron and remains stable in the presence of CFC and HCFC as well as with ammonia.



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Capella® WF 32, 68



Description

Capella® WF is a high-quality essentially wax-free oil for the lubrication of compressors used in refrigeration and air-conditioning systems. The product series are recommended for use with ammonia, carbon dioxide and halogenated refrigerants.

Capella WF is manufactured from naphthenic base oils selected to meet refrigeration compressor manufacturers' requirements. The product series offers particularly good low temperature properties and high stability, minimizing varnish and sludge formation over extended operating periods.

Capella WF is dehydrated and packaged to resist moisture.

Typical Characteristics

ISO Viscosity Grade	32	68
MPID	219356	219354
Density 15°C, kg/l	0.91	0.91
Flash Point, °C	168	179
Pour Point, °C	-39	-33
Viscosity, kinematic		
mm ² /s @ 40°C	30.0	64.0
mm ² /s @ 100°C	4.4	6.5
Viscosity Index	6	13
Acid No., mg KOH/g	0.03	0.03
Floc point, °C	-50	-50

Recommended Applications

Refrigeration compressor oil recommended for use with ammonia, carbon dioxide and chlorofluoro- and hydrochlorofluoro carbons (CFCs & HCFCs — freon) as well as sulfur dioxide and ethylene chloride refrigerants.

Capella WF product series delivers very low freon floc and pour point performance and offers chemically stable performance in presence of ammonia and fluorinated hydrocarbons. For this they make an excellent choice for ammonia systems with the minimum evaporator temperature as low as -50°C (provided evaporator hot flush capability), and fluorinated hydrocarbon refrigerants with minimum evaporator temperatures of -45°C (R12), -35°C (R22) and -25°C (R502) respectively.

For ammonia systems with minimum evaporator temperatures of -60°C, Capella A is recommended.

For systems containing hydrofluoro carbon (HFC) refrigerants such as R134a, R404a, R507, etc., Capella HFC is recommended.



marine lubricants

Capella WF Meets The Requirements Of:

- ✓ **DIN** 51503
- ✓ **British Standard** BS 2626:1992 type A

Capella WF Is Recommended For Use In:

- | | |
|---------------------------|-------------------------------------|
| ✓ Bitzer | ✓ Matsushita |
| ✓ Bock | ✓ Mc Quay |
| ✓ Carrier | ✓ Mycom NH3 – screw & piston |
| ✓ DWM Copeland | ✓ Robert Bosch |
| ✓ Dorin | ✓ Sabroe |
| ✓ Broedrene Gram | ✓ ABB Stal Refrigeration AB |
| ✓ Grasso | ✓ Sullair |
| ✓ Heinrich Huppman | ✓ Sulzer |
| ✓ J & E Hall | ✓ Tecumsec |
| ✓ Kelvinator | ✓ Trane |
| ✓ Linde | ✓ York |

Performance Benefits

1. Efficient, Trouble-free Operation

Extremely low pour point and freon floc point (below -50°C) enable fluidity without wax or deposit formation at very low minimum evaporator temperature, even with low solvency of the lubricating oil in the refrigerant. This further contributes to evaporator efficiency and cleanliness of the flow lines.

Low moisture content helps prevent icing in refrigeration expansion valves and delivers maximum corrosion protection.

2. Minimum Downtime

Robust thermal and oxidation stability protect against in-service oil thickening and minimize formation of harmful gum, varnish and sludge in the system, helping to ensure extended drain intervals.

3. Lower Maintenance Costs

Reliable lubricity helps protect against vulnerable component wear, reducing maintenance downtime and costs. The product is further compatible with a wide range of refrigerants, helping reduce inventories and potential misapplications.



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Cetus® DE 100



Description

Cetus® DE 100 is a premium performance, synthetic compressor oil based on diester technology. This offers outstanding thermal and oxidative stability with an effective oil film to protect loaded parts against corrosion and wear, even in case of high discharge temperatures and pressures. This advanced formulation also offers good low temperature performance and energy saving properties.

Typical Characteristics

ISO Viscosity Grade	100
MPID	219400
Density 15°C, kg/l	0.96
Flash Point, °C	252
Pour Point, °C	-39
Viscosity, kinematic	
mm²/s @ 40°C	96.0
mm²/s @ 100°C	10.1
Viscosity Index	92

Recommended Applications

Cetus DE 100 is recommended for stationary and portable reciprocating compressors, as well as for rotary screw and rotary vane compressors. The product is also suitable for the lubrication of anti-friction bearing assemblies operating under high temperature conditions (e.g. fans, blowers & process pumps). Cetus DE 100 can be used in compressors with the following gases: process air, benzene, butadiene, carbon dioxide (dry), carbon monoxide, ethylene, furnace (crack) gas, helium, hydrocarbon gases, hydrogen, inert gases, methane, natural gas, nitrogen, propane, sulphur hexafluoride and synthesis gas.

Cetus DE 100 can be used in contact with the following seals, paints and plastics: Viton®, High nitrile Buna N®, Teflon®, epoxy paint, oil-resistant alkyd, nylon, Delrin®, Celcon®. Cetus DE 100 is compatible with conventional non-detergent petroleum oils, although mixing will reduce the performance of the product.

The product should not be used with: neoprene, SBR rubber, low nitrile Buna N®, acrylic paint, lacquer, polystyrene, PVC, ABS and galvanized components. Cetus DE 100 is not recommended for use in breathing air compressors.

Cetus DE 100 Is Approved For:

- ☒ Hamworthy
- ☒ Matsubara
- ☒ Sperre
- ☒ Tanabe
- ☒ Yanmar
- ☒ Deno

Cetus DE 100 Meets The Requirements Of:

- ☒ ISO 6743-3 ISO-L-DAB & ISO-L-DAJ

Cetus DE 100 Is Suitable For Use In:

- ☒ Hatlapa
- ☒ Sauer & Sohn



marine lubricants

Performance Benefits**1. Efficient, Trouble-free Operation**

The good oxidation stability of the formulated oil helps to resist oil degradation, even in newer, more efficient compressors with higher output. In addition to the low sludge and varnish and the low carbon deposit formation tendency on the valves and pistons in reciprocating compressors, the high solvency of the product aids to keep the compressor parts clean. This results in minimal compressor maintenance and cleaner discharge lines, filters and air vessels.

2. Long Life

The advanced formulation with higher oil film strength minimizes oil carry over and promotes reduced oil consumption. The advanced thermal and oxidative stability permits oil drain intervals to be extended beyond those achieved with conventional lubricants.

3. Rust Protection

Effective corrosion inhibition helps to protect against rust caused by moisture entering the system, particularly during shutdown and intermittent operation.

4. Anti-Foam and Air Release Properties

Helps to prevent accumulation of surface foam in the crankcase and promotes adequate lubrication of the compressor components.

5. Increased Safety Margins

High flash and fire points over conventional lubricants in combination with cleaner compressor operation reduces the risk of fire and explosions in discharge systems.



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marine lubricants

Cetus® PAG

Formerly known as LPG Compressor Oil



Description

Cetus® PAG is a synthetic compressor oil based on polyalkylene glycol. It is designed for use in reciprocating compressors for chemical and hydro-carbon gases, including natural gases such as LNG and LPG. Because the solubility of these gases in Cetus PAG is low, the oil maintains its viscosity, unlike mineral oil base lubricants which will dilute.

Typical Characteristics

MPID	219827
Density 15°C, kg/l	1.06
Flash Point, °C	260
Pour Point, °C	-30
Viscosity, kinematic	
mm²/s @ 40°C	185.0
mm²/s @ 100°C	35.0
Viscosity Index	238

Recommended Applications

Cetus PAG is recommended for lubrication of the cylinders and/or crankcase bearings of reciprocating compressors for multiple gases, including natural gases such as methane and ethane; petroleum gases such as propane and butane; hydrocarbon chemical gases such as ethylene, propylene and butylene; and chemical gases such as ammonia, butadiene, vinylchloride and dry inert gases.

Cetus PAG easily mixes with water, therefore contact with humid air should be avoided.

Cetus PAG contains polyalkylene glycols and is not compatible with mineral oil or other synthetic fluids. When changing to or from Cetus PAG, the oil system should be completely drained and thoroughly flushed.

Cetus PAG does not affect common seal and gasket materials such as butyl, nitrile, neoprene, fluoro-elastomers (e.g. Viton) and fluoro-silicones. Ordinary industrial paints soften in the presence of this oil. Two-pack epoxy formulations are normally resistant.

Cetus PAG Is Approved For:

- ✓ **Howden Compressors**
- ✓ **Linde AG**
- ✓ **Burckhardt Compression AG** K- & Laby type compressors

Cetus PAG Meets The Requirements Of:

- ✓ **EPA** VGP 2013 EAL
- ✓ **Burckhardt** Lubricating Oil Specification (VSB) 1001301



marine lubricants

Performance Benefits**1. Low solubility of multiple gases**

The solubility of above-mentioned gases is much lower in Cetus PAG than in mineral based lubricants. Therefore, the viscosity drop of the lubricant in service is minimal. Oil film thickness, anti-wear and anti-foam performance of the formulation are maintained, and proper wear protection can be guaranteed, even at low cylinder feed rates.

2. Moisture tolerance

Cetus PAG will easily mix with water, for which the gases should be dry. The product tolerates up to 4%wt water before hazing at 80°C however, and has been evaluated for corrosion resistance with 2.5%wt water content.

3. Extended lubricant life

The robust formulation offers reliable, extended lubricant service life.

4. Reducing inventory

Formulated to resist dimerization of butadiene and to prevent the generation of solid deposits. Switching to mineral based compressor oil is no longer required in this case, which can help to reduce inventory and operational complexity.



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Cetus® PAO 46, 68



Description

Cetus® PAO oils are synthetic compressor lubricants formulated with the highest-quality polyalphaolefin PAO base fluid. The PAO base fluid provides thermal and oxidation stability, high viscosity index, low pour point and good hydrolytic stability. A high-performance additive package further enhances these qualities. The products are designed to meet the requirements of compact, high output rotary air compressors where mineral products are not effective any longer and make an ideal choice for large diesel engine turbocharger applications as well.

Typical Characteristics

ISO Viscosity Grade	46	68
MPID	219403	219402
Density 15°C, kg/l	0.84	0.85
Flash Point, °C	232	240
Pour Point, °C	-46	-47
Viscosity, kinematic		
mm ² /s @ 40°C	46.0	68.0
mm ² /s @ 100°C	8.1	10.4
Viscosity Index	150	140
Rust test, distilled seawater	Pass	Pass
Copper Corrosion, 3h, 100°C	1b	1b
Air release @ 50 °C, min	6	9

Recommended Applications

Cetus PAO 46 and Cetus PAO 68 have specifically been designed for the lubrication of oil-injected screw and rotary sliding vane air compressors operating at high discharge temperatures (>100°C) and high discharge pressures (>15 bar).

The products are also recommended for application in other types of compressors such as single and multistage reciprocating and centrifugal compressors where ISO VG 46 respectively 68 grades are required, especially in the where continuous high temperature operation is in use with discharge temperatures up to 200°C.

The products are also suitable for applications where a synthetic bearing and circulating oil is needed, such as turbochargers in low and medium speed diesel engines with separate lubricating oil circuit for the bearings. Cetus PAO 68 for example is approved by ABB for VTR turbochargers and fulfils the requirements for a 5,000-hour drain interval and for a low-friction lubricating oil.

Cetus PAO products are not recommended for use in breathing air compressors.

Cetus PAO Products Are Approved For:

- | | |
|------------------------------|--|
| ✓ Alup Kompressoren | ✓ Tanabe Pneumatic Machinery |
| ✓ Donghwa Pneotec | ✓ ABB VTR.4 Turbochargers – 5000 h drain interval (ISO VG 68) |
| ✓ Nanjing compressors | ✓ Deno compressors |
| ✓ Sauer compressors | ✓ GEA Wesfalia purifier |
| ✓ Shung Shin | |



marine lubricants

Cetus PAO Products Meet The Requirements Of:

☒ **DIN** 51506 VDL☒ **Hatlapa**☒ **TMC** Tamrotor Marine Compressor☒ **Cryostar**

Performance Benefits

1. Good Thermal and Oxidation Stability

The robust oxidation stability promotes high temperature performance and protection, even in case of high output oil flooded screw air compressors. In this type of compressor, the lubricant is not only subject to the high temperatures resulting from the compression but also mixed with air. This promotes oil oxidation, where a standard mineral based lubricant cannot always offer satisfactory drain interval any longer. Cetus PAO continues to offer extended drain potential.

The thermal stability further enables a low carbon deposit formation tendency, maintaining compressor performance and keeping discharge lines and air vessels clean, even under severe operating conditions.

2. Long Machinery Life and Maximum Compressor Efficiency

The high viscosity index and load carrying capacity help to maintain effective lubrication and minimize wear on highly loaded parts, at both low and high operating temperatures. An effective inhibitor system further provides excellent rust and corrosion protection.

3. Anti-Foam and Air Release Properties

The air release properties and very low foam tendency aid performance in oil rotary air compressor and turbocharger applications.

4. Low Evaporation Loss

The low evaporation rate helps to reduce oil carryover and guarantees minimum oil consumption.



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Compressor Oil EP VDL 100



Description

Compressor Oil EP VDL 100 is a mineral compressor lubricant, meeting DIN 51506 class VDL specifications and exhibiting high load-carrying capacity and strong aging resistance. Compressor Oil EP VDL 100 is blended from selected high-quality paraffinic base oils, supported with a well-balanced additive package to provide reliable oxidation resistance, corrosion protection and extreme pressure performance.

Typical Characteristics

ISO Viscosity Grade	100
MPID	219320
Density 15°C, kg/l	0.89
Flash Point, °C	248
Pour Point, °C	-12
Viscosity, kinematic	
mm ² /s @ 40°C	100.0
mm ² /s @ 100°C	11.3
Viscosity Index	97
Acid No., mgKOH/g	0.1
Rust test, distilled seawater	Pass
Copper Corrosion, 3h, 100°C	1a
Air release @ 50 °C, min	15

Recommended Applications

Compressor Oil EP VDL 100 is recommended for stationary and portable air compressors, operating at compression temperatures up to 220°C, including compressors with oil-lubricated pressure space such as single and multistage reciprocating compressors. Subject to specific OEM recommendations, Compressor Oil EP VDL 100 can also be applied for compression of dry hydrogen or nitrogen.

Compressor oil EP VDL 100 is not recommended for use in breathing air compressors.

Compressor Oil EP VDL 100 Meets The Requirements Of:

- ✓ **DIN** 51506 VDL
- ✓ **SMS Group** SN180-2

Compressor Oil EP VDL 100 Is Recommended By:

- ✓ **DongHwa Pneutec**
- ✓ **Hatlapa** V-Line, W-type and L-type
- ✓ **Howden Compressors**
- ✓ **Sauer Compressors**
- ✓ **Sperre**
- ✓ **Tanabe**
- ✓ **Hamworthy**



marine lubricants

**Performance Benefits****1. Efficient, Trouble-free Operation**

The high temperature oxidation stability of the product resists oil breakdown at high discharge temperatures. This contributes to a low carbon deposit formation tendency on valves and pistons in reciprocating compressors, maintaining compressor performance and keeping discharge lines and air vessels clean, even under severe operating conditions.

2. Rust Protection

Effective corrosion inhibition protects against rust caused by moisture entering the system, particularly during shutdown and intermittent operation.

3. Anti-Foam and Air Release Properties

Prevents accumulation of surface foam in the crankcase and guarantees adequate lubrication of the compressor components.

4. Low Evaporation Loss

The oil's low evaporation rate guarantees minimum consumption.



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Coupling Grease



Description

Coupling Grease is a dark brown, tacky lithium grease specifically designed for lubrication of industrial flexible couplings. Formulated with a special polymer thickener, EP additives and corrosion and oxidation inhibitors.

The rotating action of a coupling has a centrifuge effect on the grease inside. If the lubricant used is a general-purpose grease in which the thickener is of higher density than the oil, the thickener and the oil may separate. This phenomenon is quite different from oil separation caused by 'bleeding' of the oil out of the grease. 'Bleeding' takes place slowly and involves only a portion of the oil in the grease. Centrifugal separation can be very rapid and result in substantial separation of oil and thickener.

One problem with separation of the oil and thickener is that the oil will tend to leak out of the coupling. A much greater problem however, is that the thickener which is separated out is moved by centrifugal force to the outer part of the grease reservoir against the torque transmission elements (e.g., the gear teeth in a geared flexible coupling). The thickener coats the transmission elements and keeps the oil component of the grease from lubricating them. This situation worsens with frequent relubrication and leads to component wear.

Coupling Grease is manufactured using a special thickener system which is exceptionally resistant to separation from the oil. As a result, Coupling Grease can resist separation, even under the high centrifugal forces encountered in couplings. This ensures reliable coupling lubrication over long periods, even during high speed operation.

Typical Characteristics

NLGI Grade	1
MPID	219575
Dropping Point, °C	190
Oil Viscosity,	
mm ² /s @ 40°C	885.0
mm ² /s @ 100°C	41.0
Penetration, Worked @ 25°C	330
Timken OK Load, kg	18
Four Ball Weld, kg	315
Centrifugal Oil Separation 24h, vol %	<3

Recommended Applications

Correct application of the lubricant is crucial to successful operation of flexible couplings. Due to its tacky nature, Coupling Grease should be packed by hand into newly installed couplings to ensure complete coating of all moving elements. After assembly, and at relubrication, the coupling should be filled in accordance with manufacturer's instructions.

Operating temperature : -10°C to 120°C with temperature peaks up to 160°C.



marine lubricants

Coupling Grease Meets The Requirements Of:

- ✓ **DIN** 51502 KP 0/1 K-30
- ✓ **ISO 6743-9** ISO-L-XCCIB 0/1
- ✓ **AGMA** CG-1, CG-2 and CG-3

Performance Benefits

1. Maintains Continuous Lubrication

Lithium/polymer thickener system effectively resists oil separation and maintains continuous lubrication of coupling elements under conditions of high speed and high centrifugal force.

2. Protects Metal Surfaces

High viscosity base fluids and EP additives provide reliable film strength and help protect contacting surfaces, minimizing wear under heavy and/or shock loads, or where shaft misalignment may be high.

3. Enhances Service Life

Superior resistance to oil separation and oxidation allows extended relubrication intervals relative to conventional greases.

4. Improves Equipment Life

Effective rust and corrosion inhibitors help protect coupling components in wet conditions.

Environment, Health And Safety

Information is available on this product in the Safety Data Sheet (SDS) and Customer Safety Guide. Customers are encouraged to review this information, follow precautions and comply with laws and regulations concerning product use and disposal. To obtain an SDS for this product visit chevronmarineproducts.com.



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Delo® Starplex® EP2

Equivalent products: Starplex 2 in Brazil and Starplex EP2 in Europe



Description

Delo® Starplex® EP is a premium, multi-purpose EP automotive wheel bearing and chassis grease containing an ISO 220 mineral base oil, a lithium complex thickener, EP additives, rust and oxidation inhibitors and tackiness additives. It is dark red in colour. Delo Starplex EP has a very high dropping point, which enables effective lubrication at temperatures beyond those possible for conventional lithium soap greases.

Typical Characteristics

NLGI Grade	2
MPID	219951
Dropping Point, °C	230+
Oil Viscosity,	
mm ² /s @ 40°C	220.0
mm ² /s @ 100°C	21.0
Penetration, Worked @ 25°C	280
Thickener	
(Lithium Complex), m %	11
Timken OK Load, kg	20
Ball, weld point kg	315
Corrosion Preventive Properties	pass
Water Washout, %	2.2

Recommended Applications

Extended service life at elevated temperatures required frequent lubrication to prevent oxidative degradation of the mineral base occurring. Delo Starplex EP is not recommended for constant-velocity joints of front wheel drive vehicles.

Operating temperature : -35°C to 140°C, with temperature peaks up to 180°C.

Delo Starplex EP Meets The Requirements Of:

- ✓ **NLGI 2 - NLGI** GC/LB
- ✓ **NLGI 2 - DIN 51502** KP 2 N-30
- ✓ **NLGI 2 - ISO 6743-9** ISO-L-XCDHB 2

- ✓ **NLGI 3 - DIN 51825** KP 3 P-20
- ✓ **NLGI 3 - ISO 6743-9** ISO-L-XBDEB 3

Delo Starplex EP Is Recommended For Use In:

- ✓ **Automotive wheel bearings**
- ✓ **Chassis lubrication**
- ✓ **Highway and off-highway applications**
- ✓ **Construction equipment**
- ✓ **Agricultural tractors**
- ✓ **Heavy-duty transport**
- ✓ **General industrial greasing**
- ✓ **Marine application**



marine lubricants

Performance Benefits**1. Saves Maintenance Costs**

The effective EP additive helps protect against bearing wear under severe conditions and shock loading. Rust and corrosion inhibitors help protect metal surfaces, even in conditions of severe water exposure.

2. Minimizes Downtime

High dropping point minimizes leakage from bearings at elevated temperatures and oxidation resistance ensures long grease life. Natural water resistance of the lithium complex thickener, combined with the additional tackiness additive, prevents water washout.

3. Minimizes Inventory Costs

Multi-purpose capability allows use in a wide range of automotive and industrial applications, reducing the number of different greases required and eliminating product misapplication.

Environment, Health And Safety

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marine lubricants

Molytex[®] EP 2

Equivalent products: Moly Grease EP 2 in America and Multifak[®] Moly EP 2 in Asia



Description

Molytex[®] EP 2 is a high performance extreme pressure multi-purpose lithium grease, formulated with a sheer stable lithium-12-hydroxy-stearate soap. Molytex EP 2 contains solid lubricant MoS₂ to contribute to good lubricity, high load carrying capability and assist seizure prevention under high load conditions. It is also formulated to help protect against corrosion, oxidation, softening in service, and offer robust assistance to water washout.

Molytex EP 2 increases the life of propeller shafts by up to 30%, when compared with a standard lithium EP grease and is especially developed for use in constant-velocity joints. Molytex EP 2 has been successfully used in constant velocity joints (CV-joints) in front wheel drive automobiles, universal joints (U-joints) and for chassis lubrication. The presence of Moly helps provide added shock protection. It is formulated to perform well in high load conditions and temperature extremes and help provide resistance to rust and water washout.

Typical Characteristics

NLGI Grade	2
MPID	219573
Type of soap	Lithium
Colour	Dark Grey
Concentration MoS ₂ , %wt	3
Penetration worked, 60x, mm/10	280
Dropping Point, °C	210
Base Oil Viscosity at 40°C, mm ² /s	200.0
Base Oil Viscosity at 100°C, mm ² /s	15.0
Emcor corrosion test, distilled, stage	0-0
Copper Corrosion, 24 hrs at 100°C	1B
Four Ball Wear, method E Scar diameter, mm	0.4
Four Ball Weld Load, N	>3600

Recommended Applications

Molytex EP 2 is a multi-purpose grease suitable for wide range of applications. It can be applied to lubrication points found on dozers, scrapers, earthmovers, cranes, shovels, rollers, combines and cotton pickers. These lubrication points include most types of antifriction bearing arrangements from plain sleeve-types, to rolling element bearings, as well as bushings and other sliding surface or pivot points.

Working Temperature: -25°C up to 120°C with re-lubrication up to 140°C.



marine lubricants

Molytex EP 2 Meets The Requirements Of:

- ✓ **DIN 51502** KPF2K-20
- ✓ **ISO 6743-9** L-XCCEB 2

Performance Benefits

1. Protects Metal Surfaces

Effective EP additive and molybdenum disulfide solid film lubricant protect against component wear under high load conditions and/or shock loading. Rust and corrosion inhibitors protect metal surfaces in wet operating conditions. Even if insufficient grease is used, some molybdenum disulfide tends to stay in place and protect metal surfaces.

2. Enhances Service Life

Excellent oxidation resistance ensures enhanced grease service life.

3. Ease of Application

NLGI 2 grade provide suitable flow properties for grease pump application systems.

4. Reduces Complexity

Multipurpose capability allows use in a wide range of heavy-duty automotive and industrial applications, reducing the number of different greases required and eliminating product misapplication.

Environment, Health And Safety

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Multifak® EP



Description

Multifak® EP is a multi-purpose EP grease containing highly refined mineral base oils, lithium thickener, extreme pressure (EP) additives and rust and oxidation inhibitors. Suitable as a multi-purpose automotive grease for general purpose applications.

Typical Characteristics

NLGI Grade	0	1	2	3
MPID	219572	219589	219571	219577
Dropping Point, °C	180	195	195	205
Oil Viscosity,				
mm ² /s @ 40°C	208.0	208.0	208.0	208.0
mm ² /s @ 100°C	18.2	18.2	18.2	18.2
Penetration, Worked @ 25°C	370	325	280	235
Thickener (Lithium), m %	4	6	7.5	10
Timken OK Load, kg	18	18	18	18

Recommended Applications

Industrial plain and rolling element bearings, general plant lubrication, centralized lubrication systems (NLGI 0 & 1), construction equipment bearings, earthmoving, quarrying and mining, agricultural equipment, automotive wheel bearings, chassis grease point lubrication and marine applications.

Working temperature : -30°C up to 120°C, with relubrication up to 140°C.

Multifak EP Is Approved For:

- | | |
|---|--|
| <ul style="list-style-type: none"> ✓ Masada ✓ SEW Eurodrive planetary gear motor (NLGI 2) ✓ VHI deck machinery (NLGI 2) | <ul style="list-style-type: none"> ✓ Alfa Laval Tofteford (NLGI 2) ✓ Heisin pumps (NLGI 2) ✓ Manabe Zoki deck machinery (NLGI 2) |
|---|--|

Multifak EP Meets The Requirements Of:

- | | |
|--|--|
| <ul style="list-style-type: none"> ✓ NLGI 0 - DIN 51502 KPOK-30 ✓ NLGI 0 - ISO 6743-9 ISO-L-XCCEB 0 ✓ NLGI 1 - DIN 51502 KP1K-30 ✓ NLGI 2 - Bloom winch ✓ NLGI 1 - ISO 6743-9 L-XCCEB 1 ✓ NLGI 2 - Zollem rope Winch | <ul style="list-style-type: none"> ✓ NLGI 2 - NLGI LB ✓ NLGI 2 - DIN 51502 KP2K-30 ✓ NLGI 2 - ISO 6743-9 L-XCDEB 2 ✓ NLGI 2 - Kongsberg winch ✓ NLGI 3 - DIN 51502 KP3K-30 ✓ NLGI 3 - ISO 6743-9 L-XCCEB 3 |
|--|--|



marine lubricants

Performance Benefits**1. Protects Metal Surfaces**

The effective EP additive helps protect against component wear under high load conditions. Rust and corrosion inhibitors help protect metal surfaces.

2. Resist Oxidation

Formulated with antioxidants to resist oxidation and enhance grease service life.

3. Good Pumpability

Good pumpability characteristics of the lithium thickener provide suitable flow properties for grease pump application systems (NLGI 2).

4. Reduces Complexity

Multi-purpose capability allows use in a wide range of industrial and automotive applications, helping to reduce the number of different greases required and eliminate product misapplication.

Environment, Health And Safety

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Novatex[®] EP 2



Description

Novatex[®] EP 2 is a proven performance water resistant extreme pressure calcium-12-hydroxystearate grease, formulated in combination with a high viscosity mineral base oil. It offers protection through robust extreme pressure, anti-wear and anti-corrosion additives, with calcium soap to assist in reliable water resistance.

Typical Characteristics

NLGI Grade	2
MPID	219500
Type of soap	Calcium anhydrous
Colour	Light yellow
Penetration worked, 60x, mm/10	280
Dropping Point, °C	>140
Base Oil Viscosity at 40°C, mm ² /s	250.0
Base Oil Viscosity at 100°C, mm ² /s	14.0
Emcor corrosion test, distilled, stage	0-0
Copper Corrosion, 24 hrs at 100°C	1B
Four Ball Wear, method E Scar diameter, mm	0.4
Four Ball Weld Load, N	>3600

Recommended Applications

Novatex EP 2 is specifically recommended for the lubrication of plain and roller bearings of steel and paper mill equipment, which operate at temperatures up to 120°C. Use at temperatures above 120°C are not recommended because beyond the specified maximum temperature Novatex EP 2 does not reconstitute on cooling. However, Novatex EP 2 is also recommended for other industrial applications where an extreme pressure grease having robust water resistance is required. It is particularly good under heavy water-washing conditions where extreme pressure properties must be maintained.

Operating temperature : -30°C up to 110°C, with relubrication up to 120°C.

Novatex EP 2 Is Approved For:

☒ **Hoesch Rothe Erde**

Novatex EP 2 Meets The Requirements Of:

- ☒ POM, HDPE, Perbunan and Viton and all plastic parts used by Hoesch Rothe Erde up to 70°C
- ☒ The seals (Perbunan, Viton) have been tested for 168h at 70°C, the distance keepers (POM, HDPE) 24 weeks at 70°C
- ☒ **DIN 51502** KP2K-30
- ☒ **ISO 6743-9** L-XCCIB 2



marine lubricants

Performance Benefits**1. Protects Metal Surfaces**

The effective EP additive helps protect against component wear under high load conditions. Rust and corrosion inhibitors help protect metal surfaces.

2. Resist Oxidation

Formulated with antioxidants to resist oxidation and enhance grease service life.

3. Robust Water Resistance

Good adhesive properties and effective resistance to water wash out minimize loss of lubricant in service.

Environment, Health And Safety

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Rust Proof Compound L



Description

Rust Proof Compound L is a soft film rust preventive for relatively long-term protection of iron and steel components. Formulated from a high melting point petrolatum and a special rust inhibitor system with penetrating and water displacing capabilities. Rustproof Compound L® contains a petroleum solvent to make application easier.

Typical Characteristics

Grade	L
MPID	219574
Colour	Dark Brown
Flash Point, COC, °C	85
Penetration, Undisturbed @ 25°C	280
Solvent Content, m %	20

Recommended Applications

Application of Rust Proof Compound L can be used over rust, scale, paint or other rust proofing materials. However, it will be easier to apply, and long-term protection will be obtained if heavy rust and other deposits are removed prior to application. Rust Proof Compound L should not be heated above 55°C. If the required consistency cannot be obtained by heating, it can be thinned with Stoddard Solvent to any consistency for easy application. It can be applied via brush, drip or spray.

Rust Proof Compound L can be used on but not limited to the following; undercoating of vehicles, transformer casing, bridges and floating bridge pontoons, storage vessels (non-food), non-potable water tanks, ballast tanks, gas holders, hoisting equipment, farm implements, and iron and steel exposed to atmospheric conditions before, during and after manufacturing into finished parts.

Spraying of Rust Proof Compound L can be accomplished with conventional pressure-feed, air-atomizing spray equipment. Where indoor spraying is to be performed, the use of airless spraying equipment is recommended in well ventilated area. Rust Proof Compound L is not suitable for use on surfaces carrying pedestrian or vehicular traffic.

Performance Benefits

1. Superior Long-term Rust Protection

Petrolatum and special additive system form a non-hardening, self-sealing film to protect surfaces against the elements. Good water displacing capabilities helps ensure that the protective film is also waterproof. The special rust inhibitor system ensures maximum protection against corrosive attack. Good penetrating characteristics ensure difficult-to-reach seams and crevices receive effective corrosion protection.

2. Requires Minimum Surface Preparation

Ability to penetrate existing flaky or heavy rust means that little or no preliminary cleaning of metal surfaces is required before application. This penetrating ability makes existing rust easier to remove.

3. Self-sealing Film

Self-sealing properties of the protective film minimizes the need for touch-ups when film damage occurs through scratches or brush marks.

4. Easy Removal

Soft protective film is readily soluble in petroleum solvent to enable easy removal when required.

**Environment, Health And Safety**

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SRI Grease



Description

SRI Grease is a specially formulated grease containing a highly refined paraffinic base oil, synthetic polyurea ashless organic thickener and high-performance rust and oxidation inhibitors, for the lubrication of anti-friction ball, needle and roller bearings operating at speeds up to and above 10,000 rpm, operating at higher temperatures, or where water or salt water may penetrate bearings.

Typical Characteristics

NLGI Grade	2
MPID	219586
Corrosion Preventive Properties, D1743	Pass
Dropping Point, °C	243
Oil Viscosity,	
mm ² /s @ 40°C	116.0
mm ² /s @ 100°C	12.3
Penetration, Worked @ 25°C	280
Thickener (Polyurea), m %	8

Recommended Applications

SRI Grease can be used in temperatures ranging from -20 to 140°C for continuous service. However, for short term exposure temperatures should not exceed 150°C.

Applications can include high speed bearings operating under high or low temperature conditions, unsealed bearings where there is the likelihood of fresh or salt water getting into the bearings, sealed-for-life bearings, industrial ball and roller bearings, electric motor, fan, and air-conditioning unit bearings, automotive alternator, generator and starter motor bearings, water pump bearings and boat trailer wheel bearings.

Operating temperature: -20°C up to 140°C, with short peaks up to 150°C.

SRI Grease Meets The Requirements Of:

- ✓ **DIN 51502** KU2-20+140M+100
- ✓ **ISO 6743-9** L-XBFA2L-XBFA2



marine lubricants

Performance Benefits**1. Enhanced Oxidation Stability**

Synthetic polyurea thickener is stable at elevated temperatures. Coupled with a high dropping point, highly refined base oil and anti-oxidant components, this enables extended operation periods at high temperatures.

2. Protects Metal Surfaces

Special rust and corrosion inhibitors provide protection to metal surfaces in wet conditions, even in a salt water environment. Passes Bearing Rust Test, ASTM D1743-73 with 5% synthetic sea water. Good oxidation stability prevents the formation of corrosive oxidation by-products.

3. Superior Resistance to Water Washout

Synthetic polyurea thickener has inherent water resistance.

Environment, Health And Safety

Information is available on this product in the Safety Data Sheet (SDS) and Customer Safety Guide. Customers are encouraged to review this information, follow precautions and comply with laws and regulations concerning product use and disposal. To obtain an SDS for this product visit chevronmarineproducts.com.



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Starplex® EP 3



Description

Starplex® EP 3 Starplex EP 3 is a high performance long-service multipurpose lead-free grease, formulated for long-term service in roller-and ball-bearing applications, operating at high temperatures and under high loads.

With a wide operating temperature range, Starplex EP 3 is formulated with mineral base stocks with temperature resistant lithium complex soap thickener, combined with EP additives and wear, corrosion and oxidation inhibitors. Starplex EP 3 offers good mechanical stability and is suited to bearing lubrication under conditions where strong vibrations are present.

Typical Characteristics

NLGI Grade	3
MPID	219952
Colour	Brown
Texture	Smooth
Soap type	Lithium Complex
Penetration worked, mm/10	220-250
Dropping Point, °C	>250
Base oil type	Mineral
Base oil viscosity at 40°C, mm ² /s	115.0
Copper corrosion, 24h/100°C	1
Emcor distilled water	0/0
Four ball weld load, N	2800
Four Ball Wear, mm	0.3
Water resistance static	1-90

Recommended Applications

Starplex EP 3 grease is used for lubricating machines and components which are subjected to high thermal and mechanical loads over a long service life. It has been tested in applications involving extreme pressures, vibrations and impact stress, wet conditions, dust, and in the presence of plastic seals. This product largely covers the applications of conventional lithium, sodium and calcium greases, as well as of aluminum and calcium complex greases.

Starplex EP 3 can be a substitute for various grease types, therefore reducing the number of greases that must be kept in storage.

Operating temperature: -20°C up to 150°C with frequent re-lubrication up to 200°C for a short period of time.

Starplex EP 3 Meets The Requirements Of:

- ✓ **DIN 51825** KP 3 P-20
- ✓ **ISO 6743-9** ISO-L-XBDEB3



marine lubricants

Starplex EP 3 Is Recommended For Use In:

- | | |
|--|---|
| ☒ Automobile wheel bearings and generators | ☒ Rollers in drying plants |
| ☒ Clutch thrust bearings | ☒ Paper machines |
| ☒ Brake cylinders | ☒ Washing and dish washing machines |
| ☒ Fan bearings | ☒ Special do-it-yourself machines |
| ☒ Electric motors | ☒ Household appliances |
| ☒ Kiln cars | |

Performance Benefits

1. Wide Temperature Range Application

Formulated to promote long-term lubrication performance in wide temperature conditions and reliable thermal performance contributes robust protection under high temperature conditions.

2. Long Bearing Service Life

Mechanical stability helps maintain lubrication performance in bearings which are subject to strong vibrations. High pressure load capacity promotes long-term wear resistance.

3. Protects Metal Surfaces

Assists long-term corrosion protection where moisture, water or aggressive atmospheres are present.

4. Improves Equipment Life

Good sealing characteristics help protect lubrication points from dust, dirt and water. Tough, adhesive oil film performance aids long-term component protection.

Environment, Health And Safety

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Texclad®



Description

Texclad® is a high performance calcium grease that contains adhesive open gear grease based on a water-stabilized calcium thickener and high viscosity mineral oils. It contains graphite and molybdenum disulfide additives to offer reliable protection in heavy duty operations. The formula is a smooth and buttery texture and is black in colour.

Typical Characteristics

NLGI Grade	2
MPID	219570
Dropping Point, °C	88
Graphite, m %	22
Molybdenum Disulfide, m %	3
Oil Viscosity,	
mm ² /s @ 40°C	875.0
mm ² /s @ 100°C	36.5
Penetration, Worked @ 25°C	280
Thickener (Calcium), m %	9

Recommended Applications

Texclad can be used continuously in temperatures ranging -10 to 60°C. It can also be exposed to; gears in construction, mining and industrial equipment, dipper sticks on excavating shovels, automotive fifth wheels (tractor-trailer turntables), steel girth gears (girth tires) on rotary kilns and crushing mills, sugar mill plain bearings, when fluid lubricants have shown a tendency to leak and marine wire ropes.

Operating temperature : -10°C up to 60°C.

Texclad Is Approved For:

☒ Masada

Performance Benefits

1. Effective Water Resistance

Good adhesive properties and effective resistance to water wash out minimize loss of lubricant in service.

2. Protect Metal Surfaces

High load-carrying capacity and anti-wear additives extend gear tooth life in heavy duty service. Resistance to flaking at low temperatures maintains surface protection.

Texclad Meets The Requirements Of:

- ☒ DIN 51502 MF 2 C-10
- ☒ DIN 51502 KF 2 C-10
- ☒ ISO 6743-9 L-XAIB 2

3. Solid Film Protection

Graphite and molybdenum disulfide provide solid-film protection in event of loss or degradation of the fluid lubricant.



marine lubricants

Environment, Health And Safety

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Ulti-Plex® Synthetic EP



Description

Ulti-Plex® is a high performance, high temperature industrial and automotive EP grease specially formulated from an ISO 320 synthetic base oil, lithium complex thickener, EP additives, a tackiness agent and special corrosion and oxidation inhibitors. For EP ball and roller bearing applications, especially in continuous high temperature service up to 230° where conventional greases tend to harden, or low temperature conditions down to -30°C where conventional greases are no longer pumpable.

Typical Characteristics

NLGI Grade	1.5
MPID	219412
Dropping Point, °C	280
Oil Viscosity,	
mm ² /s @ 40°C	405.0
mm ² /s @ 100°C	41.0
Penetration, Worked @ 25°C	-315
Viscosity Index	150
Thickener (Lithium Complex), m %	13
Timken OK Load, kg	23

Recommended Applications

Due to the heavy base oil viscosity and adhesive properties of Ulti-Plex, it is recommended that a heavy follower plate be used in air-driven grease pumps. Depending on pipe sizing and distance, pumping rates will be lower than for conventional greases of the same NLGI grade. It may be necessary to use Ulti-Plex where pumpability is a primary requirement.

Application can include: pulp and paper applications (high temperature felt roll bearings, lime kilns, sludge press bearings, pulp refiner bearings and pump and exhaust fan bearings), steel industry applications (roll bearings, conveyor bearings, furnace and coiler grease points and pump and exhaust fan bearings), mining industry (conveyor bearings, pins and bushings on buckets and loaders, shaker screens and crushers) and marine (deck equipment, shaft bearings, crane and windlass winches, water exposed bushings, wire ropes).

Operating temperature: -30°C up to 230°C.

Ulti-Plex Synthetic EP Meets The Requirements Of:

- ✓ **DIN 51502** KPHC2N-30
- ✓ **ISO 6743-9** L-XCDEB 2



marine lubricants

Performance Benefits**1. Long Bearing Service Life**

Combination of a lithium complex thickener, oxidation inhibitor, and synthetic base oil helps provide resistance to hardening in service. EP additives provide good wear protection under heavy and/or shock loads. Effective rust and corrosion inhibitors help protect metal surfaces in wet conditions.

2. Wide Temperature Range Application

The high viscosity index synthetic base oil resists thickening at low temperatures and enables use over a wide temperature range. The oxidation stability of the base fluid components enables operation in continuous high temperature environments.

3. Protects Against Equipment Failure

High viscosity index synthetic base oil and tackiness additive maintain oil viscosity and provide adhesive properties which help prevent oil leakage in high speed and high temperature conditions.

4. Superior Water Resistance

Lithium complex thickener and tackiness additive produces good resistance to water washout.

Environment, Health And Safety

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Clarity[®] Synthetic EA Gear Oil 100



Description

Clarity[®] Synthetic EA Gear Oil 100 is a readily biodegradable high-performance gear oil that meets EPA Vessel General Permit (VGP 2013) requirements for environmentally acceptable lubricants. It is designed to give maximum protection in industrial gear applications on vessels and in environmentally sensitive areas.

Clarity Synthetic EA Gear Oil 100 is formulated with synthetic base stock and an ashless, zinc-free additive system that can provide good oxidation stability, water separability, foam suppression, and protection against wear, rust and corrosion. It is a high VI synthetic product which allows for operation over a wide temperature range.

Typical Characteristics

MPID	803121
VG 100	
Kinematic Viscosity at 40°C, mm ² /s	100.0
Kinematic Viscosity at 100°C, mm ² /s	18.0
Viscosity Index	199
Flash point, COC, °C	185
Pour Point, °C	-39
Copper Corrosion 3hrs/100°C	1B
Rust test, distilled water	PASS
Rust test, salt water	PASS
Water separability at 82°C	<3 ml emulsion at 30 minutes
Foam Seq I, ml	50/0
Foam Seq II, ml	50/0
Foam Seq III, ml	50/0
FZG, load failure stage	>12
Timken OK Load, lb	>60
Elastomer Compatibility	
Buna-N (100°C, 168 hrs)	Pass
Viton (150°C, 168 hrs)	Pass
Biodegradability, %	>60
Aquatic Toxicity	
Fathead minnow, OECD 203, mg/L	>1000
Daphnia magna, OECD 202, mg/L	>130
Algae, OECD 201, mg/L	>120
Bioaccumulation	NEGATIVE



marine lubricants

Recommended Applications

This lubricant is readily biodegradable, non-bio accumulative, and minimally toxic. In the event of a spill, the product biodegrades by more than 60% within 28 days, minimizing the impact to the environment. Clarity® Synthetic EA Gear Oil 100 is designed to give maximum protection in marine gear equipment used on vessels and in environmentally sensitive areas.

Clarity Synthetic EA Gear Oil 100 Is Approved For:

✓ Aegir	✓ IHC Merwede
✓ AGMA EP 9005-E02	✓ James Walker
✓ Berg	✓ Kamewa
✓ Blohm+Voss	✓ Kemel
✓ Cincinnati Milacron P-76	✓ Ortlinghaus
✓ David Brown S1.53.101	✓ Schottel
✓ DIN 51517 (Part 3)	✓ Wärtsilä

Clarity Synthetic EA Gear Oil 100 is miscible with common mineral based gear oils, however, following good practice, in-service oils should be completely drained to avoid any risk of additive incompatibility and ensure that the full performance benefits are achieved. Do not use in high pressure systems near flames, sparks, and hot surfaces. Use only in well ventilated areas. Keep container closed.

Performance Benefits**1. Environmentally Acceptable**

Meets the requirements of the EPA Vessel General Permit (VGP 2013) for biodegradation, low toxicity and low bioaccumulation.

2. Premium Performance

Ashless formulation helps to provide protection against wear of industrial gears, as well as rust and corrosion protection, water separability, foam inhibition, EP protection and shear stability.

3. Long Oil Life

Good ability of the synthetic base stock to withstand oxidation at high operating temperatures results in maximum service life for the oil relative to vegetable-based readily biodegradable products.

4. Low Temperature Pumpability

Specifically developed with high viscosity index to help ensure good fluidity for low operating temperatures.



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Clarity[®] Synthetic EA Grease



Description

Clarity[®] Synthetic EA Grease is an anhydrous calcium thickened lubricating grease based on biodegradable synthetic esters. The grease contains antioxidants, corrosion inhibitors and EP/AW additives.

The thickener, together with the biodegradable esters, makes the product suitable for the lubrication of bearings in wet and corrosive environments, even at low temperatures. The lubricating grease has excellent adhesion and water resistance.

Typical Characteristics

NLGI Grade	2
MPID	803296
Colour	Yellow
Texture	Smooth
Thickener type	Anhydrous Calcium
Base oil type	Synthetic ester
Base oil viscosity at 40°C, mm ² /s	500.0
Base oil viscosity at 100°C, mm ² /s	53.0
Dropping point, °C	>140
Density at 15°C, kg/l	0.94

Recommended Applications

Clarity Synthetic EA Grease is a modern and versatile, high performance EAL grease developed for a wide variety of applications where environmental sensitivity and biodegradability may benefit operations or actually be a requirement due to legislative demands.

Whilst primarily aimed at the marine market, Clarity Synthetic EA Grease can also be used in various markets, for example it can be used to lubricate the steering or chassis components of Forestry, Agriculture and Construction vehicles as well as saw chains within the Forestry segment, where a biodegradable grease is required.

For the Marine market Clarity Synthetic EA Grease can be recommended for a range of plain and rolling element bearings or slide ways on a variety of on-deck equipment.

It is also important to note that Clarity Synthetic EA Grease has good low temperature mobility, and is therefore suitable for use in most modern centralised lubrication systems.

The product is especially suited for applications where risks of contamination of the soil, waters or channels can occur.

Note: Maintaining a clean work environment is critical when equipment greasing is performed. Grease fittings should be wiped clean prior to grease injection to prevent contaminants from entering the equipment. Bearing housings should be maintained one-third to one-half full of grease. Over-greasing should be avoided because it can result in an excessive amount of heat being produced. Periodic relubrication via grease gun or centralized system should be supplemented by complete cleaning and packing with fresh grease on an appropriate schedule.



marine lubricants

Operating temperature: -40°C up to 100°C (Max. 100°C for a short period)

Clarity® Synthetic EA Grease Is Approved For:

- | | |
|---|--|
| ☒ SS 155470-listing Eco-label | ☒ Dongtai Oceangoing Marine Fittings Rudder carrier |
| ☒ Van der Velden Rudder carrier | ☒ Nakashima Propeller |
| ☒ Nippon Pillar Packing Rudder carrier | ☒ Masada Crane |
| ☒ Wärtsilä Japan Rudder carrier | |

Clarity® Synthetic EA Grease Meets The Requirements Of:

- | | |
|--|--|
| ☒ 2013 VGP | ☒ DIN 51 502 KPE2G-40 |
| ☒ ISO 12924 L-XD(F)BIB2 | ☒ Becker Marine systems |

Clarity® Synthetic EA Grease Is Suitable For Use In:

- | | |
|--|---|
| ☒ Boom pins and pulleys on cranes | ☒ Thruster and rudder bearings |
| ☒ Anchor winches | ☒ Open gear or rack & pinion systems where the conditions of operation do not require dedicated products containing solid lubricant technology |
| ☒ Wire ropes | |
| ☒ Bearings of deck equipment | |
| ☒ Cargo door hinges | |

Performance Benefits

1. Readily biodegradable

Meets the requirements of the EPA Vessel General Permit (VGP 2013) for biodegradation, low toxicity and low bioaccumulation.

2. Excellent water resistance

High dropping point minimizes leakage from bearings at elevated temperatures and oxidation resistance ensures long grease life. Natural water resistance of the thickener, combined with the additional tackiness additive, prevents water washout.

3. Good corrosion resistance

Provides long-life protection against most forms of corrosion on the majority of metals.

4. Multipurpose

Satisfies all grease requirements of the majority of marine equipment.



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Clarity® Synthetic EA Hydraulic Oil 100



Description

Clarity® Synthetic EA Hydraulic Oil 100 is an ash free readily biodegradable high performance hydraulic oil that meets EPA Vessel General Permit (VGP 2013) requirements for environmentally acceptable lubricants. It is designed to give maximum protection in hydraulic equipment used on vessels and in environmentally sensitive areas.

Clarity Synthetic EA Hydraulic Oil 100 is designed to give maximum protection in hydraulic equipment used in vessels and in both mobile and stationary hydraulic pumps in high-performance industrial applications. It is formulated with synthetic base stock and an ashless, zinc-free additive system that can provide good oxidation stability, water separability, foam suppression, and protection against wear, rust and corrosion. Clarity Synthetic EA Hydraulic Oil 100 is a high VI synthetic product which allows for operation over a wide temperature range.

Typical Characteristics

MPID	219013
Viscosity, Kinematic cSt at 40°C	100.0
Viscosity, Kinematic cSt at 100°C	18.8
Viscosity Index	210
Flash Point, °C	193
Pour Point, °C	-48
Copper Corrosion	1b
Rust Test, Synthetic Sea Water	PASS
FZG, Fail Load Stage	12
Elastomer Compatibility	
Buton-N, Viton, Polyurethane	PASS
Biodegradability, OECD 301B, % in 28 days	>60
Aquatic Toxicity	
Fathead minnow, OECD 203, mg/L	>10.000
Daphnia magna, OECD 202, mg/L	>120
Algae, OECD 201, mg/L	>10.000
Bioaccumulation	Negative

Recommended Applications

Clarity Synthetic EA Hydraulic Oil 100 is designed to give maximum protection in hydraulic equipment used on vessels and in environmentally sensitive areas. This lubricant is readily biodegradable, non-bio accumulative, and minimally toxic. In the event of a spill, the product biodegrades by more than 60% within 28 days, minimizing the impact to the environment.

Clarity Synthetic EA Hydraulic Oil 100 Is Approved For:

✓ SKF

✓ Wärtsilä

✓ B&V

✓ Kobleco



marine lubricants

Clarity Synthetic EA Hydraulic Oil Is Recommended For Use In:

☒ **Blohm+Voss**☒ **HEPR** in mobile and stationary hydraulic vane-piston gear-type pumps

Clarity® Synthetic EA Hydraulic Oil 100 is miscible with common mineral based hydraulic oils, however, following good practice, in-service oils should be completely drained to avoid any risk of additive incompatibility and ensure that the full performance benefits are achieved. Do not use in high pressure systems near flames, sparks, and hot surfaces. Use only in well ventilated areas. Keep container closed.

Performance Benefits**1. Environmentally Acceptable**

Meets the requirements of the EPA Vessel General Permit (VGP 2013) for biodegradation, low toxicity and low bioaccumulation.

2. Zinc-Free

Suited for applications involving yellow metals found in axial piston pumps.

3. Long Oil Life

Good ability of the synthetic base stock to withstand oxidation at high operating temperatures can result in maximum service life for the oil relative to vegetable-based readily biodegradable products.

4. Low Temperature Pumpability

Specifically developed with high viscosity index to help ensure good fluidity for low operating temperatures.

5. Premium Performance

Ashless formulation helps to provide good protection against wear of hydraulic pumps, as well as rust and corrosion protection, hydrolytic stability, water separability, foam inhibition, and filterability.



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1000 THF



Description

1000 THF is a high quality, multifunctional tractor hydraulic fluid, specially formulated for use in transmissions, final drives, wet brakes, and hydraulic systems of tractors and other equipment employing a common fluid reservoir. It is also a great choice for wet brake transaxles in off-road equipment. This type of fluid is also referred to as Universal Tractor Transmission Oil (UTTO). It is formulated using highly refined base oils, a viscosity index improver, oxidation and corrosion inhibitors, anti-wear and film strength additives, an antifoaming agent, and a pour point depressant. Its distinctive orange colour allows for easy product identification and leak detection.

1000 THF replaces the former product Textran TDH Premium.

Typical Characteristics

MPID	219920
Density at 15°C, kg/l	0.87
Flash point COC, °C	235
Pour point, °C	-42
Kinematic viscosity at 40°C, mm ² /s	59.0
Kinematic viscosity at 100°C, mm ² /s	9.3
Viscosity Index	145

Recommended Applications

1000 THF meets the needs of modern tractors for a multi-functional lubricant. It is designed for many uses, such as lubrication of the transmission and final drive, and also serves as a hydraulic fluid to operate power steering units, brakes, implements, and attachments. It is formulated to suppress brake “chatter” and excessive brake facing wear. It offers smooth operation of clutch packs and wet brakes, offers good shifting action, aims to provide exceptional rust and corrosion protection for vital parts, and minimizes leakage because of good compatibility with seals, O-rings, and packing materials.

It helps prevent sludge and varnish formation, helps to protect metal surfaces against scuffing and wear, and provides good lubrication for spur, helical, and spiral bevel final drive gears. 1000 THF is compatible with equipment manufacturer's proprietary fluids and other fluids of this type.

1000 THF Is Approved For:

- ✓ **Volvo** 97303 [WB 101]
- ✓ **ZF** TE-ML 03E / TE-ML 05F / TE-ML 17E / TE-ML 21F

1000 THF Is Suitable For Use In:

- ✓ **Deck cranes/deck machinery applications**
Hydralift/TTS, Norsafe



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1000 THF Meets The Requirements Of:

- ✓ **ABB Dodge** Controlled start-up transmissions
- ✓ **Non-hypoid API GL-4 applications** (under low-speed high-torque conditions)
- ✓ **Hitachi** Mid-sized wheel loader axle applications, transfer case and hydraulics
- ✓ **AGCO** improved power fluid 821XL
- ✓ **Case Corporation** JIC-143/JIC-145/MS 1206/MS 1207/MS 1209/MS 1210 (TCH)
- ✓ **Case New Holland** MAT 3505/MAT 3525
- ✓ **Caterpillar** TO-2

- ✓ **Ford New Holland** ESN-M2C134-D/FNHA-2-C-201
- ✓ **International Harvester** B6
- ✓ **John Deere** JDM J20C
- ✓ **Kubota** UDT
- ✓ **Massey Ferguson** M1135/M1141/M1143/M1145
- ✓ **Minneapolis-Moline** Q-1722/Q-1766/Q-1766B
- ✓ **Oliver** Q-1705
- ✓ **Renk Doromat** 874A/874B
- ✓ **White Farm Equipment** Q-1826

Performance Benefits

1. Long Equipment Life

Special additives help to protect metal surfaces against scuffing and wear even under severe operating conditions, which helps to maximize equipment life.

2. Smooth Operation

Formulated to suppress brake “chatter” and transmission “slip” for quiet and efficient action of brakes and transmission.

3. Low Inventory Cost

One fluid does the job of a full range of tractor hydraulic systems. It can be used to replace multiple products and free up shelf space too.

4. Reliable Operation

Formulation helps keep metal parts clean and free of varnish and sludge deposits that could result in premature breakdown.

5. Minimizing Weather And Storage Concerns

Aims to protect against rust and corrosion of highly finished precision parts when operating in humid conditions and during seasonal shutdown periods.

6. Minimal Downtime

Good compatibility with seals, O-rings, and packing materials maintains their good condition and helps to keep leakage at a minimum.



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marine lubricants

Delo® Gear EP-5 SAE 80W-90

Regional equivalents: Geartex® EP-C SAE 80W-90, Geartex EP-5 SAE 80W-90, Multigear® EP-5 80W-90, Thuban® GL-5 EP 80W-90, Gear Oil GL-5 SAE 80W-90



Description

Delo® Gear EP-5 SAE 80W-90 is an automotive gear lubricant suitable for API GL-5 applications. It is formulated with mineral base oils in combination with a high performance additive system.

Typical Characteristics

MPID	219941
Density at 15°C, kg/l	0.89
Flash point COC, °C	212
Pour point, °C	-33
Kinematic viscosity at 40°C, mm²/s	135.0
Kinematic viscosity at 100°C, mm²/s	14.3
Viscosity Index	101

Recommended Applications

Delo Gear EP-5 SAE 80W-90 is designed for use in automotive hypoid drive axles, steering systems, non-synchronized transmissions and transaxles which require a fluid with API GL-5 performance. Operating temperatures of above 100°C will lead to a significant reduction in the fluid service life. Peak operating temperatures should not exceed 120°C. Note that Daimler axle oil specifications include a minimum viscosity requirement that is not met by Delo Gear EP-5 SAE 80W-90.

The friction characteristics of Delo Gear EP-5 SAE 80W-90 make it generally unsuitable for use in synchronized manual transmissions and transaxles, and it should not be used in these applications unless a GL-5 fluid is specifically recommended.

Delo Gear EP-5 SAE 80W-90 And Regional Equivalents Meet The Requirements Of:

- | | |
|---|--|
| <ul style="list-style-type: none"> ✓ Volvo 97321 Delo Gear EP-5 SAE 80W-90, MultiGear EP-5 SAE 80W-90, Gear Oil GL-5 SAE 80W-90 ✓ Volvo 97310-90 Geartex EP-C SAE 80W-90, Geartex EP-5 SAE 80W-90 ✓ ZF TE-ML 05A Multigear EP-5 80W-90 ✓ ZF TE-ML 12M MultiGear EP-5 SAE 80W-90 ✓ ZF TE-ML 16B Geartex EP-5 SAE 80W-90, MultiGear EP-5 SAE 80W-90 ✓ ZF TE-ML 17B Geartex EP-5 SAE 80W-90, MultiGear EP-5 SAE 80W-90 | <ul style="list-style-type: none"> ✓ ZF TE-ML 19B Geartex EP-5 SAE 80W-90, MultiGear EP-5 SAE 80W-90 ✓ ZF TE-ML 21A Geartex EP-5 SAE 80W-90, MultiGear EP-5 SAE 80W-90 ✓ ZF TE-ML 07A Geartex EP-C SAE 80W-90, Geartex EP-5 SAE 80W-90 ✓ Bosch TE-ML 08 Geartex EP-C SAE 80W-90, Geartex EP-5 SAE 80W-90 ✓ US Military MIL-L-2105D Geartex EP-C SAE 80W-90, Geartex EP-5 SAE 80W-90 ✓ API GL-5 |
|---|--|

Delo Gear EP-5 SAE 80W-90 Is Suitable For Use In:

- ✓ **Deck cranes** Liebherr
- ✓ **Non-synchronized reduction gearboxes and propeller shaft gearboxes of life saving equipment** Hyundai Life Boat, Fassmer, Hatecke, Beihai, Mansei, Norsafe, Yamaha, Tohatsu



marine lubricants

Performance Benefits**1. Protection Against Wear And Tear**

High performance additives provide EP protection, protecting components against scuffing and wear.

2. Premium Stability

Premium shear stability, ensuring that the viscosity is retained throughout the fluid lifetime.

3. Fast Circulation In Cold Weather

Good low-temperature fluidity, superior to a standard SAE 90 product, allowing fast circulation during cold weather start-up.

4. Prevents Thickening Of Oil

Reliable oxidation stability, preventing oil thickening during service and formation of harmful varnish and deposits.

5. Prevents Loss Of Fluid

Compatible with a wide variety of elastomer materials, preventing loss of fluid due to seal deterioration.

6. Rust Protection

Good rust protection.

7. Foam Resistance

Good resistance to foaming.



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Havoline® ATF III-H

Regional equivalents: Texamatic® 7045E, Texamatic 1888, Automatic Transmission Fluid MD-3



Description

Havoline® ATF III-H is a proven performance Automatic Transmission Fluid formulated for applications that call for the former GM DEXRON®-III H, MERCON® and Allison C-4 fluids. It is formulated with high performance mineral base oils and a specially balanced additive combination to provide exceptional oxidation resistance, extended oil life and good wear protection.

Typical Characteristics

MPID	219957
Density at 15°C, kg/l	0.86
Kinematic viscosity at 40°C, mm²/s	34.1
Kinematic viscosity at 100°C, mm²/s	7.0
Viscosity Index	171
Pour Point °C	-50
Colour	RED

Recommended Applications

Havoline ATF III-H is designed for use in automatic transmissions that require a GM DEXRON®-III H type fluid. Although this specification has been made technically obsolete by GM itself, many equipment manufacturers continue to recommend fluids of this type. It can be used in transmissions that require a Ford MERCON® fluid. The product is not recommended for transmissions that require a Ford MERCON® V fluid (this is a separate specification to MERCON®). Due to fundamental differences in frictional properties, it should not be used in applications that require a Ford M2C33-F/G fluid.

Havoline ATF III-H is also suitable for use in power steering systems that require a mineral-type Power Steering Fluid. It should not be used in steering or active suspension systems that call for specific semi-synthetic or synthetic fluids, as the response speed may not be sufficiently fast. Havoline ATF III-H may also be used as a wide temperature range anti-wear hydraulic fluid for mobile, industrial and marine applications. The viscosity corresponds to ISO VG 32.

Havoline ATF III-H And Regional Equivalents Are Approved For:

- ✓ **MAN Truck & Bus** 339 Typ V1 (Texamatic 7045E)
- ✓ **Voith** H55.6335.3X (Texamatic 7045E/Texamatic 1888)

Havoline ATF III-H And Regional Equivalents Meet The Requirements Of:

- ✓ **Allison** C-4
- ✓ **Ford** Mercon
- ✓ **GM** DEXRON-III H (DEXRON IIIG for regional equivalent Texamatic 7045E)

Havoline ATF III-H Is Suitable For Use In:

- ✓ **Deck cranes/deck machinery applications** MacGregor/Cargotec
- ✓ **Automatic reduction gearboxes of life boats and other high speed diesel engines** Hyundai Life Boat, Fassmer, Hatecke, Beihai, Norsafe, Schat-Harding, Sabb, Steyr



marine lubricants

**Performance Benefits****1. Smooth Lock-Ups**

Specially tuned friction characteristics, helping to ensure smooth shifting and lock-ups.

2. Good Fluid Lifetime

Good friction durability, making sure that this performance is retained throughout the fluid lifetime.

3. Effective Lubrication At High Temperatures

High Viscosity Index, meaning that the oil will retain sufficient viscosity for effective lubrication even at high operating temperatures.

4. Low-Temperature Fluidity

Great low-temperature fluidity, providing transmission protection during cold weather start-up.

5. Prevents Harmful Sludge

Good oxidation stability, preventing formation of harmful sludge, lacquer or deposits.

6. Protects Against Corrosion

Helps prevent corrosion of automatic transmission fluid coolers.



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Havoline® Outboard 2T

Regional equivalents: MOTEX 2T OUTBOARD, Havoline 2-Cycle Engine Oil TC-W3, Super Outboard 3, TC-W3



Description

Havoline® Outboard 2T is an efficient premium performance, two-stroke marine outboard oil, formulated with an ashless additive system. It is pre-diluted with a high flashpoint low aromatic solvent which aids easy mixing with gasoline across a wide temperature range.

Typical Characteristics

MPID	219821
Density at 15°C, kg/l	0.87
Kinematic viscosity at 40°C, mm ² /s	54.0
Kinematic viscosity at 100°C, mm ² /s	8.7
Viscosity Index	138
Pour point, max °C	-39
Flash point COC, °C	134
Total Base Number, mg KOH/g	5.7
Sulphated Ash, %wt	<0.01

Recommended Applications

Havoline Outboard 2T is recommended for water-cooled two-cycle outboard engines and personal water craft applications. It is formulated for use at most engine manufacturers fuel/oil ratios and is well suited for use in oil-injected engines as well as in engines where the oil is mixed with gasoline. It is miscible with gasoline, even at low temperatures.

Havoline Outboard 2T Meet The Requirements Of:

☒ **NMMA TCW-3**

Performance Benefits

1. High Power Output

Highly refined mineral oil and ashless additives offer piston cleanliness and help maintain engine performance.

2. Keep-Clean Performance

Formulated to offer protection against ring sticking thus, maintaining combustion efficiency and power output.

3. Reduced Maintenance Costs

Robust additive system helps protect against wear under high speed, peak performance operation.

4. High Power Output

Highly refined mineral oil and ashless additives offer piston cleanliness and help maintain engine performance.

5. Optimum Spark Plug Life

Ashless additive system helps reduce spark plug fouling under a wide range of operating conditions.



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HDAX[®] 5200 Low Ash Gas Engine Oil SAE 40



Description

HDAX[®] 5200 Low Ash Gas Engine Oil SAE 40 is an advanced performance, premium quality, bright stock free engine oil. It is formulated with premium base oil technology and an additive package containing ash less dispersant, oxidation inhibitors, metallic detergents and a metallic anti wear agent.

HDAX 5200 Low Ash Gas Engine Oil SAE 40 provides great oxidation and nitration resistance, which minimizes the build-up of insoluble particles and helps to provide long oil and filter life. Additionally, it gives protection against ring and liner scuffing and wear. It also minimizes valve recession in four-stroke engines and provides admirable piston and ring belt deposit control and effectively protect against the formation and build-up of engine sludge.

Typical Characteristics

MPID	219910
Density at 15°C, kg/l	0.88
Kinematic viscosity at 100°C, mm ² /s	13.5
Pour Point, °C	-33
Total Base Number, mg KOH/g	4.2
Sulfated Ash, %wt	0.5

Recommended Applications

HDAX 5200 Low Ash Gas Engine Oil SAE 40 is recommended for four-stroke and selected two-stroke stationary engines fuelled by natural gas. It is formulated to meet catalyst compatibility requirements and are especially suited for installations requiring low phosphorus oil to prevent exhaust catalyst poisoning. HDAX 5200 Low Ash Gas Engine Oil SAE 40 is suitable for use with fuels containing low levels of sulphur.

HDAX 5200 Low Ash Gas Engine Oil SAE 40 Is Approved For:

- | | |
|--|--|
| ☒ Caterpillar CG gas engines | ☒ GE Jenbacher Type 6CE Class A, Class S Fuel |
| ☒ GE Jenbacher Type 2/3 Class A, Class S Fuel | ☒ GE Jenbacher Type 6HK Class S |
| ☒ GE Jenbacher Type 4A Class A, Class S Fuel | ☒ MWM Gas engines |
| ☒ GE Jenbacher Type 4B Class A, Class B, Class C, Class S Fuel | ☒ Wärtsilä Natural gas |
| ☒ GE Jenbacher Type 4CS, Class A Fuel | ☒ Waukesha 220GL |
| ☒ GE Jenbacher Type 6FJ Class A, Class B, Class C, Class S Fuel | ☒ Waukesha COGEN Application |
| | ☒ Indonesia Lemigas NPT Number |



marine lubricants

Performance Benefits**1. Cost Effective**

Low maintenance cost and long engine life.

2. Low Wear

Helps to provide protection against piston, ring, and liner scuffing, scoring, and wear.

3. Valve Protection

The level and type of ash producing additives in the oils help to provide minimum valve recession with low levels of combustion chamber deposits to minimize the potential for preignition and spark plug fouling.

4. Clean Pistons

Aims to provide piston cleanliness to help prevent ring sticking and maintain clean, varnish-free piston skirts.

5. Clean Crankcases and Top Decks

Minimizes the formation of crankcase and valve cover/top deck sludge.

6. Catalyst Compatibility

Formulated to be compatible with exhaust emissions reduction systems.



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HDAX[®] 9700 SAE 40



Description

HDAX[®] 9700 is a premium performance, uniquely designed engine oil recommended for dual fuel, medium-speed, four-stroke cycle trunk piston engines burning natural gas with diesel pilot fuel ignition and up to 100 percent low sulfur diesel fuel (<1000 ppm sulfur).

HDAX 9700 is a premium dual fuel gas engine oil with proven field service experience in dual fuel engines operating with diesel pilot ignition natural gas mode and up to 100 percent diesel mode for extended operational periods. It offers reliable deposit control, corrosion resistance and wear protection. The formulation is designed to control ash accumulation in combustion chambers and exhaust after treatment while providing sufficient alkalinity to protect against acidic corrosion.

Typical Characteristics

MPID	219911
Density at 15°C, kg/l	0.87
Kinematic viscosity at 40°C, mm ² /s	117.0
Kinematic viscosity at 100°C, mm ² /s	13.4
Viscosity Index	110
Pour Point, °C	-36
Flash Point COC, °C	268
Total Base Number, mg KOH/g	5.8
Sulfated Ash, %wt	0.7

Recommended Applications

HDAX 9700 is recommended for dual fuel, natural gas/ultra low sulfur diesel medium-speed trunk piston engines in coastal marine, inland marine, railroad and power generation applications. These high output engines may be turbocharged and equipped with exhaust catalysts systems. HDAX 9700 SAE 40 has field service experience in Wärtsilä dual fuel engines in coastal marine operations.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practice.

Performance Benefits

1. Smooth Engine Operation

Fit for purpose formulation suitable for use with wide range of fuels, allowing switching from gas to diesel without need to change oil.

2. Long Oil Life

A combination of premium base oils and high performance additives offer excellent oxidation and nitration resistance over extended oil life. Used oil analysis is recommended for establishing and maintaining oil service intervals.

3. Clean Pistons

Very low combustion chamber and piston deposits help protect liners from scoring and extend engine top-end maintenance cycles.



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Texatherm® 32 & 46



Description

Texatherm® is a heat transfer fluid formulated to meet the requirements of hot circulating systems operating at temperatures of up to 320°C. Based on highly refined paraffinic base oils with inherently good thermal stability, Texatherm contains selected additives which help to enhance oxidation stability, protect against rusting or corrosion of steel and copper, and prevent air entrainment and foaming.

Typical Characteristics

ISO Viscosity Grade	32	46
MPID		
Density at 15°C, kg/l	0.86	0.86
Density at 100°C, kg/l	0.80	0.80
Density at 200°C, kg/l	0.73	0.73
Density at 300°C, kg/l	0.67	0.67
Pour point, °C	-15	-15
Flash point COC, °C	220	235
Oxidation (ASTM D943), hrs to TAN = 2.0 mg KOH/g	3500	3500
Rust test, synthetic seawater	PASS	PASS
Kinematic viscosity at 0°C, mm²/s	313.0	545.0
Kinematic viscosity at 40°C, mm²/s	32.0	46.0
Kinematic viscosity at 100°C, mm²/s	5.5	6.9
Viscosity Index	106	105
Copper corrosion, 3h at 100°C	1a	1a
Water by Karl Fischer, mg/kg	<50	<50
TAN, mg/KOH/g	0.08	0.1
Air release ag 50°C, min.	2.3	2.3
Foam Seq II, after blowing, ml	0	0
Foam Seq II, after 10 minutes, ml	0	0

Recommended Applications

Texatherm is recommended for use as a heat transfer fluid in temperatures ranging from -15°C to a maximum bulk temperature of 288°C. The maximum recommended film temperature is 316°C (the film or skin temperature is the temperature of the oil film that it in direct contact with the internal wall of the heat exchangers tubes in the heater).

Suitable For Open Or Closed Heat Transfer Systems With Forced Circulation Operating Under The Following Conditions:

- ☒ **Maximum bulk oil temperature** 288°C
- ☒ **Maximum film temperature on heater surfaces** 316°C
- ☒ **Maximum temperature of oil surface in contact with air in open system** 107°C



marine lubricants

Texatherm 32 Is Approved For:

**Performance Benefits****1. Thermal and Oxidation Stability**

Exhibits good thermal and oxidation stability, allowing operation at high temperatures for extended periods.

2. Heat Transmission

Maximum heat transmission to the process vessel or equipment allows the use of smaller circulating system pumps, valves and heating coils.

3. High Thermal Conductivity

High thermal conductivity and low viscosity at the relevant operating temperatures helps to ensure high heat transfer rates with limited pumping energy.

4. Low Vapor Pressure

Low vapor pressures at the elevated temperatures minimize evaporation, vapor lock and cavitation, and eliminates the need to high-pressure piping and equipment.

5. Low Temperature Operation

Low temperature fluidity assists rapid system start-up.



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GST[®] Premium 32



Description

GST[®] Premium 32 is formulated with premium base oil technology designed to meet the critical demands of HPS (Mitsubishi Hitachi Power Systems), formerly MHI (Mitsubishi Heavy Industries), non-geared gas and steam turbines requiring a MS04-MA-CL002 product. It is suitable for use in gas and steam turbines where extreme temperatures are experienced and require circulation systems with high temperature stability.

GST Premium turbine oil combines highly refined group II base stocks and unique additive package minimizing the formation of deposits in reservoirs, high temperature bearings and other hot areas of the turbine.

Typical Characteristics

MPID	219345
Flash Point, °C	224
Pour Point, °C	-14
Kinematic viscosity at 40°C, mm ² /s	31.5
Kinematic viscosity at 100°C, mm ² /s	5.4
Viscosity Index	105
Copper Corrosion	1b
Oxidation Stability, TOST life, hrs. to 2.0 Acid No.	1.4
RPVOT, mins	10,000
Total Oxidation Product (TOP), m %	1,500

Recommended Applications

GST Premium 32 is formulated to meet the critical demands of non-geared gas, steam and hydroelectric turbine bearing lubrication and R&O service in marine reduction gears. They are additionally suitable for industrial severe service requiring an R&O, ISO 32 circulating oil with extended service capability.

GST Premium 32 Is Approved For:

- ✓ **Alstom** HTGD 90117 (for non-geared turbines)
- ✓ **Mitsubishi Hitachi Power Systems** MS04-MACLO02
- ✓ **Siemens** TLV 901304 and TLV 901305

GST Premium 32 Meets The Requirements Of:

- ✓ **ANSI/AGMA** 9005-E02 R&O,
- ✓ **ASTM D4304** Type 1
- ✓ **British Standard** 489:1999
- ✓ **DIN** 51515/1 and 51515/2
- ✓ **General Electric** (GEK-32568j, GEK-28143b, GEK-27070 and GEK-46506e)
- ✓ **ISO** 8068 L-TGA
- ✓ **MAN Diesel**
- ✓ **Turbo TQLT2 and Solar Turbine** ES 9-224 Class II



marine lubricants

Performance Benefits**1. Exceptional Oxidation and Thermal Stability**

Provides long service life at severe temperatures with minimal Deposit Formation as dictated by the stringent MHPS MS04-MA-CL001 / CL002 specification. Formulated with premium base oil technology and an ash less, zinc-free formulation.

2. Rust and Corrosion Protection

Helps ensure minimum viscosity change when variations in temperature occur.

3. High Viscosity Index

Aims to protect against corrosion or rusting of costly precision parts.

4. Minimum Foaming

Helps prevent sump overflow or erratic governor operation.

5. Fast Air Release

Helps to minimize possibility of pump cavitation in systems with high circulation rates and lesser residence time.

6. Rapid Water Separation

Facilitates water removal.

7. Hydraulic Fluid Service

For systems requiring an ISO 32 viscosity oil and pressures not exceeding 1000 psi.

8. Air Compressor Lubricant

For systems requiring an ISO 32 viscosity R&O oil.



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Regal® R&O



Description

Regal® R&O is a premium-quality rust- and oxidation-inhibited turbine oil. It is manufactured from highly refined paraffinic base oils. It contains oxidation, corrosion, and foam inhibitors. The oil has good water separating properties, high oxidation stability, first-rate anti-corrosion properties, and low carbon forming tendency.

Typical Characteristics

ISO Viscosity Grade	32	46	68	100	320
MPID	219342	219343	219341	219344	219940
Density at 15°C, kg/l	0.88	0.87	0.86	0.88	0.89
Kinematic viscosity at 40°C, mm²/s	30.4	43.7	64.6	95.0	43.7
Kinematic viscosity at 100°C, mm²/s	5.2	6.5	8.4	10.8	6.5
Viscosity Index	100	98	99	97	98
Pour point, °C	-15	-15	-15	-15	-15
Flash point COC, °C	220	224	245	215	252
Oxidation (ASTM D 943), hrs to TAN = 2.0 mg KOH/g	3000+	3000+	3000+	5500+	1800+
Rust test, synthetic seawater	PASS	PASS	PASS	PASS	PASS
FZG, Pass Stage, DIN 51354	10	10	10	10	—
Air release @ 50°C, mins	2.1	2.0	3.0	10	—

Recommended Applications

Regal R&O is recommended primarily for use in marine turbines of all types. These include steam, hydraulic and gas turbines. Regal R&O also provides good performance in hydraulic machinery, circulating oil systems, all applications where a high-quality, stable lubricant with good water-separating characteristics is required and non-heavy duty hydraulic systems where OEM recommends R&O type oils (for heavy duty hydraulic systems, customers should consider Rando HDZ hydraulic oil). These products can also be used as a general-purpose machine oil for shop use when R&O type oil is needed or is recommended. The multifunctional characteristics of Regal R&O type oils may allow them to replace other special application lubricants, which can result in reduced inventory and operating cost.

Regal R&O Meets The Requirements Of:

- ✓ **Alstom** HTGD 90117
- ✓ **ASTM** D4304

- ✓ **British Standard** 489
- ✓ **DIN** 51515

Regal R&O Is Approved For:

- ✓ **Heisin Pumps** (VG 68)
- ✓ **Regulateur Europa** (VG 68 & VG 100)

- ✓ **IMI Norgen** (VG 46)



marine lubricants

Performance Benefits**1. Oxidation Stability**

Aims to provide long service life free from deposits, sludge, and acidic oxidation products, thus avoiding sticking valves, and ensuring good bearing protection.

2. Rust Protection

Aims to protect against corrosion or rusting of costly precision parts.

3. Water Separation

Assists with speedy removal of contaminating water from leaks and condensation.

4. Foam Inhibited

With an effective surface-foam suppressant, it often resists foaming which can generally ensure smooth functioning of governors and minimizes the risk of sump overflow.

5. Air Release Properties

A balanced combination of inhibitors prevents air locking of oil circulating pumps due to entrained air. This often provides smooth and trouble-free operation of lubricating oil systems.

6. Potential inventory savings

Rust and oxidation inhibited formulation has multipurpose capability in a wide range of industrial applications for which this type of product is recommended, helping to simplify oil inventories and reduce the possibility of using the wrong lubricant.



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Regal® SGT 22



Description

Regal® SGT 22 is designed for use in modified aviation type gas turbines in non-aviation stationary applications such as industrial power generation and marine service. Regal SGT 22 is formulated with synthetic polyol ester base fluids in combination with an advanced additive design offering high temperature system protection and oxidation resistance.

Typical Characteristics

MPID	219420
Acid No., mg KOH/g	0.16
Pour point, °C	-57
Flash point COC, °C	270
Kinematic viscosity at -40°C, mm²/s	9,468.0
Kinematic viscosity at 40°C, mm²/s	25.6
Kinematic viscosity at 100°C, mm²/s	5.12

Recommended Applications

Regal SGT 22 is recommended for aero derivative gas turbines exposed to severe operating environments in non-aviation applications such as industrial power generation, gas transmission and marine propulsion.

Regal SGT 22 Is Approved For:

- | | |
|--|--|
| ☒ U.S. Military Specification MIL-PRF-23699G, Class STD
☒ General Electric LM Series Aeroderivative Turbines
☒ Siemens (Allison) 501K | ☒ Siemens (Rolls Royce) Avon, Olympus, Tyne and Spey models
☒ Siemens (Rolls Royce) RB 211 Gas Turbines |
|--|--|

Regal SGT 22 Meets The Requirements Of:

- ☒ **Turbomeca Makila TL**

Regal® SGT 22 is compatible with other lubricants approved under MIL-PRF-23699G. Regal SGT 22 is compatible with metals, paints, coatings and elastomers such as Viton, Teflon, fluorosilicone, and not to be used in aircraft service Buna N (NBR).

Regal SGT 22 is not recommended for gas turbines that require MIL-PRF-23699F, Class C/I (Corrosion Inhibiting) or HTS (High Thermal Stability). Regal SGT 22 is not to be used in aircraft service.



marine lubricants

Performance Benefits**1. Long Service Life**

Good oxidation and thermal stability of the synthetic ester base fluid and special additive system helps resist oil breakdown under severe high temperature and high load conditions. The low volatility of the synthetic polyolester helps minimize evaporative losses.

2. Minimal Maintenance and Downtime

Minimal coking tendency of the synthetic ester base fluid and additive system helps minimize deposit formation on bearings and other areas exposed to the heat of the hot gases. High load carrying capacity helps ensure protection against wear. The oil is compatible with normal engine and accessory metallic construction materials and elastomeric sealing compounds.

3. All-Temperature Performance

Viscosity-temperature characteristics of the synthetic ester help promote low temperature fluidity to facilitate starting at low temperatures, while helping to ensure that an effective lubricant film is available under the most severe, high temperature conditions to protect.



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marine lubricants

Delo® XLC Antifreeze/Coolant – Concentrate

Regional equivalents: Havoline Xtended Life Coolant – Concentrate



Description

Delo® XLC Antifreeze/Coolant – Concentrate (Delo XLC) is a non-nitrated cooling fluid and corrosion inhibitor for combustion engines and heat transfer systems. Delo XLC is an ethylene glycol-based fluid that helps to provide maintenance-free protection against freezing, boiling and corrosion. With patented silicate-free aliphatic acid technology, Delo XLC encourages long-life corrosion protection for all engine metals, including aluminum and ferrous alloys. During extensive fleet testing Delo XLC has proven to provide protection for at least 32.000 hours in stationary engines.

Typical Characteristics

MPID	219900	
Ash content, mass %, ASTM D 1119	1.1	
Nitrate, amine, phosphate, borate, silicate	Nil	
Colour	Orange	
Density at 20°C, kg/l, ASTM D 1122	1.11	
Equilibrium boiling point, °C, ASTM D 1120	172	
Reserve alkalinity (pH 5.5), ASTM D 1121	6.2	
Shelf life of the concentrated product stored in original and unopened containers at the recommended temperature window	8 Years	
	50% Dilution	33% Dilution
pH, ASTM D 1287	—	8.3
Foaming properties at 25°C, break time, sec., ASTM D 1881	5	—
Freeze protection, °C	-37	-20
Effect on non-metals, GME 60 255	None	None
Staining characteristics, ASTM D 1882	—	None
Hard water stability, VW PV 1426	No precipitate	—

Recommended Applications

Delo XLC provides long-life freeze and corrosion protection. To ensure good corrosion protection it is recommended to use at least 33 volume percent of Delo XLC in solution. Delo XLC may be used in engines manufactured from cast iron, aluminum or a combination of the two metals, and in cooling systems made of aluminum or copper alloys. Delo XLC is compatible with most other ethylene glycol-based cooling water treatments. The use of soft water is preferred for dilution, though lab testing has shown that acceptable corrosion results are still obtained with water of 20°dH, containing not up to 500 ppm chlorides and 500 ppm sulphates.

Delo XLC Is Approved For:

- ✓ **Deutz/MWM** 0199-2091
- ✓ **MAN Diesel** D36 5600
- ✓ **WinGD (formerly Wärtsilä)**
- ✓ **Rolls-Royce** 2.13.01
- ✓ **Wärtsilä Finland** 32-9011
- ✓ **Caterpillar-MaK** A4.05.09.02

Delo XLC Is Suitable For Use In:

- ✓ **Deutz** Stationary Diesel Engines
- ✓ **GE – Jenbacher** Stationary Natural Gas Engines
- ✓ **MTU** 2000/4000 Diesel Engines
- ✓ **Wärtsilä** Stationary Diesel Engines
- ✓ **European HD OEMs** requiring both phosphate-free and nitrite-free formulations
- ✓ **Japanese HD OEMs** requiring silicate-free formulations



marine lubricants

Delo XLC Meets The Requirements Of:

- ✓ **ASTM** D3306
- ✓ **ASTM** D6210
- ✓ **DAF** 74002
- ✓ **Detroit Diesel** DFS93K217

- ✓ **MAN** 324 Type SNF
- ✓ **Mercedes Benz** 325.3 under DBL 7700.30
- ✓ **MTU** MTL 5048
- ✓ **TMC** RP 364

Performance Benefits

1. Corrosion Protection

Provides long-life protection against most forms of corrosion on the majority of all metals including the aluminum heat transfer surfaces contained in modern engines.

2. Cavitation Protection

Offers cavitation protection without using nitrite or nitrite-based supplemental coolant additives (SCAs).

3. Seal Compatibility

Has no adverse effect on rubber hoses and gasket materials as shown in testing a wide range of seal materials.

4. Heat Transfer Efficiency

The carboxylic acid inhibitor forms a targeted mono-molecular protective layer on metal surfaces, thus helping to provide efficient heat transfer.

5. Economics

Corrosion protection and low additive depletion often results in less maintenance and repair costs.



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marine lubricants

Delo® XLI Corrosion Inhibitor – Concentrate

Regional equivalents: Havoline XLI



Description

Delo® XLI Corrosion Inhibitor – Concentrate (Delo XLI) is a water-based, low toxicity, readily biodegradable, nitrite-free carboxylate inhibitor package. Based on patented Organic Additive Technology (OAT), Delo XLI provides long-life corrosion protection in aqueous solutions for all engine metals, including aluminum, iron, copper and solder alloys. Mixed with the appropriate amount of water, Delo XLI is recommended as a cooling water treatment. Delo XLI has been proven to provide effective protection for at least 32,000 hours in marine and stationary applications. It is compatible with glycol-based engine coolants.

Typical Characteristics

MPID	219900
Nitrate, amine, phosphate, borate, silicate	Nil
Colour	Green
Specific gravity, 20°C, kg/l, ASTM D 1122	1.06 Typical
pH, ASTM D 1287	9.4 Typical
Storage stability	12 months if stored in non-opaque containers 36 months if stored in opaque containers
Modified ASTM D1384 glassware corrosion tests	PASS (XLI 5% solution)
5% Dilution	
Specific gravity, 20°C, kg/l, ASTM D 1122	1.00 Typical
pH, ASTM D 1287	8.1 Typical
Effect on non-metals, GME 60 255	No Effect
Hard water stability, VW PV 1426	No Precipitate

Recommended Applications

Delo XLI can be used as an engine cooling water treatment, a flushing fluid, or a hot test fluid for new engine blocks. It is recommended for cooling water treatment operating below 100°C. For marine application the dosage may vary from 6.0–7.5% but a minimum of 5% volume of Delo XLI in water should be used. As an engine cooling water treatment, Delo XLI provides long-life corrosion protection. If Delo XLI is replenished regularly to compensate for leakage, the cooling water can be considered as fill for life. The use of soft water is preferred for dilution, though lab testing has shown that acceptable corrosion results are still obtained with water of 20°dH, containing not up to 500 ppm chlorides and 500 ppm sulphates.

Delo® XLI Is Suitable For Use In:

- ✓ **Detroit Diesel**
- ✓ **Deutz** TR0199-99-2091
- ✓ **GEC Alsthom Ruston**
- ✓ **Liebherr** MD 1-36-130 (DCA)
- ✓ **MaK**
- ✓ **MAN** 248
- ✓ **MAN Energy Solutions** 2-stroke engines (operating with cooling water temperature below 100°C)
- ✓ **MAN Energy Solutions** 4-stroke engines

- ✓ **MB** 312.0
- ✓ **MTU** 2000 & 4000 series engines
- ✓ **MWM**
- ✓ **Newman-Haas Racing**
- ✓ **Scania** TI 2-98 0813 TB
- ✓ **Ulstein Bergen**
- ✓ **Wärtsilä** 32-9011 and ZBS0503
- ✓ **Yanmar**
- ✓ **Hyundai-Himsen**



marine lubricants

Performance Benefits**1. Environment**

Delo XLI is based on low toxicity inhibitors and is readily biodegradable. The extended service life characteristic of this product reduces waste due to less frequent fluid disposal. The toxicological and environmental properties of Delo XLI were evaluated by an independent laboratory.

The results are listed below:

- LD50 >2000 mg/kg
(Oral toxicity according to OECD Guideline No. 401)
- LC50 >1000 mg/l
(Fish toxicity according to OECD Guideline No. 203)
- Biodegradability: 92% (18 days)
(Test according to OECD Guideline No. 301E)

2. Corrosion Protection

Provides long-life protection against most forms of corrosion on the majority of metals including the aluminum heat transfer surfaces contained in modern engines.

3. Cavitation Protection

Offers cavitation protection without using nitrite or nitrite-based supplemental coolant additives (SCAs).

4. Seal Compatibility

Has no adverse effect on rubber hoses and gasket materials as shown in testing a wide range of seal materials.

5. Heat Transfer Efficiency

The carboxylic acid inhibitor forms a targeted mono-molecular protective layer on metal surfaces, thus providing efficient heat transfer.

6. Economics

Long life corrosion protection and low additive depletion often result in less maintenance and repair costs.



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marine lubricants

MCLA



Description

MCLA is an additive package for marine cylinder lubricants.

Typical Characteristics

MPID	219858
Density at 15°C, kg/l, ASTM D4052	1.18
Kinematic viscosity at 100°C, mm ² /s, ASTM D445	86.0
Flash Point COC, °C, ASTM D93	200
Base Number, mg KOH/g, ASTM D2896	400

Recommended Applications

The base number (BN) of the marine cylinder lubricant produced with MCLA should align with the sulphur content of the fuel used. It is important that the additive is mixed with a proper feedstock, to ensure it performs efficiently.

Performance Benefits

1. Wear Protection

Ensures protection against excessive cylinder liner and piston ring wear resulting from the use of bunker fuels containing various levels of sulphur.

2. Detergent/Dispersant Properties

Helps to prevent ring sticking and minimizes deposit formation throughout the combustion chamber exhaust areas.

3. Good Lubrication Properties

Maintains an oil film under severe, high load conditions, therefore reducing frictional wear and preventing scuffing of liners, pistons and rings.

4. Storage Stability

Completely stable at various ambient temperatures and during long-term storage.

5. Compatibility

Miscible and compatible with alkaline diesel cylinder lubricants generally known to the international marine trade.



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marine lubricants

information bulletins





marine lubricants information bulletin 1

lubricant storage, stability, and estimated shelf life



Most lubricating oils and greases deteriorate with time. However, good storage practices promote sufficient stock turnover so that lubricants are used before performance loss occurs.

Storage conditions

The storage environment greatly affects the shelf life of lubricants and greases. The conditions to monitor are:

Temperature: High heat (greater than 45°C) and extreme cold (less than -20°C) can affect lubricant stability. Heat increases the rate of oil oxidation, which can lead to deposit formation and viscosity increase. Cold temperatures can cause wax and possible sediment formation. Additionally, alternating product exposure to heat and cold may draw air into drums, which may result in moisture contamination. A temperature range of -20°C to 45°C is acceptable for storing most lubricating oils and greases. Ideally, the storage temperature range should be from 0°C to 25°C.

Light: Exposure to light can change the color and appearance of lubricants. To prevent this change, keep lubricants in their original metal or plastic containers.

Water: Some lubricant additives may react with water, forming insoluble matter. Water can also promote microbial growth at the oil/water interface. Store lubricants in a dry location, preferably indoors.

Particulate Contamination: Do not store drums and pails in areas where there is a high level of airborne particles. This is especially important when storing a partially used container.

Atmospheric Contamination: Oxygen and carbon dioxide can react with lubricants and affect their viscosity and consistency. Keep lubricant containers sealed until the product is needed.

Storage conditions affecting grease

Grease properties may change during storage depending on thickener type, its concentration, the base fluids and the additives used. One condition that commonly affects greases is:

Oil Separation: Oil naturally separates from most grease. Temperatures in excess of 45°C can accelerate oil separation. If grease is removed from drums or pails, the surface of the remaining grease should be smoothed to prevent oil separation into the cavity.

Recommended storage conditions and practices

- Store lubricating oils and greases in a cool, dry indoor area where airborne particles are at a minimum. Indoor storage also prevents label deterioration and the container from weathering. The ideal storage temperature range is from 0°C to 25°C.
- If drums must be stored outside, apply one of the following options:
 - Store drums on their side or “blocked” into a tilted position, with drum bungs at the three and nine o'clock positions, to allow water to run off.
 - Place a plastic cover on top of the drum to keep the top protected from dust and water.
 - Use other equivalent methods to prevent the ingress of water or dust.



Refrigeration oils and brake fluids are highly sensitive to water contamination and must not be stored outside. Always store grease upright to prevent oil separation.

- When necessary, bring grease to satisfactory dispensing temperature just before it is used.
- Rotate the inventory. Check the container fill date and use the oldest container first.
- Keep containers tightly covered or closed to avoid contamination.
- Wipe off the tops and edges of containers before opening them to avoid contamination.
- Use clean tools and equipment when pumping or handling lubricants and grease.

Products exceeding the estimated shelf life

A product in an unopened container, which is beyond the estimated shelf life, may still be suitable for service.

The product should be tested and evaluated against the original product specifications. Thoroughly mix the container to ensure a uniform, representative sample is taken for testing. If the product's test results fall within the original specifications, it should be suitable for use. Following testing, if the product is not consumed within a year, the product should be marked for reclamation or disposal.

As a final note, the user should validate the product's performance claims against the equipment manufacturer's recent specifications. Equipment designs and specifications can change over time, making an old product obsolete for use with new equipment. Call your local Chevron supplier if there are questions concerning specification obsolescence. ■

Estimated shelf life of base oils, lubricating oils, and greases

Product	Years
Base Oils	5+
Lubricating Oils (mineral or synthetic)	5
Greases (mineral or synthetic)	3
Coolants (general)	5
Known Exceptions:	
Rust Preventatives	2
Open Gear Lubricants	2



marine lubricants information bulletin 2

what about water?



Chevron's FAST™ Service is a comprehensive equipment condition monitoring program which reports the condition of oil in service and plots the trends of important properties, including presence of water.

The used oil report, issued by Chevron's laboratory, lists the test results obtained and includes comments and recommendations on the suitability of the oil for continued service. Each used oil sample is tested for water presence.

Testing the oil

The water content of used lubricating oils can be measured in a number of ways. A simple test for water is the "crackle test." A few drops of oil are placed on an electric hot plate. If the oil starts to bubble and spatter, water is present. This test can detect as little as 0.1% water in the oil. However, the test does not indicate the exact amount of water in the oil.

A rapid and accurate test method for the quantitative measurement of the water content in oil is based on the chemical reaction of water with calcium hydride. The reaction releases a small amount of hydrogen gas, which is captured in a container. The pressure increase in the container is measured and then converted to the amount of water present in the oil sample. Many onboard test kits for water determination are based on this principle.

Test method ASTM D-95 is based on a different principle. For this test, equal volumes of oil sample and diluent solvent are subjected to a distillation test. The water and solvent vapors are condensed in a cooler and the condensed liquid is collected in a trap. The water separates from the solvent at the bottom of the trap because of its higher density. At the end of the test, the total volume of water collected in the trap is recorded and converted to the water content in the oil.

Another well-known test method, which determines very low quantities of water, is ASTM D-6304-04a, or the Karl Fischer method. This procedure can detect water

levels as low as 10 mg/kg (ppm). The method is based on a chemical reaction of the water with the Karl Fischer reagent.

Finally, a number of laboratory test methods are based on the use of a centrifuge to separate the water from oil samples.

Origin of water contamination

The water contamination of fresh and used lubricating oils may originate from various sources. Lube oil storage tanks are continuously breathing because of differences between day and night temperatures. During the night, when temperatures are lower than in the daytime, ambient air containing a certain amount of water vapor is drawn into the tank's vapor space. Some of the water vapor will condense on the tank walls. As a result, a significant amount of water may collect at the bottom of a storage tank over time.

Inside a ship, temperatures are more stable because the surrounding seawater temperatures do not greatly vary and engine room temperatures are stable. Condensation has a smaller impact in this case. In-board and double-bottom tanks, however, usually de-aerate toward the deck and seawater can enter through the venting pipes. Therefore, tank vents should be shielded in heavy weather to prevent the ingress of rain or seawater. It is important to regularly check for the presence of water. If a significant amount of water is detected, it should be removed.



In some equipment, free water and/or water vapor is unavoidably generated during operation. Air compressors are very prone to water contamination, because during compression, the water vapor present in the air condenses under certain unfavorable operating conditions. Regular removal of condensed water is of utmost importance to protect the equipment.

Diesel engines produce water vapor during fuel combustion. Under adverse operating conditions this water vapor, and the moisture from humid combustion air, may condense in the crankcase and mix with the oil. Large quantities of water sometimes enter the crankcase from leaking cooling systems.

Another well-known problem area is stern tube seals. Even though most systems are equipped with gravity tanks or pressurized systems, which should keep any water out, it is very common to see water ingress in stern tube systems. Damaged seals usually cause this problem; however, a pumping effect caused by wear grooves in the shaft bushing can also allow water to enter the system.

Why all this attention to water?

Water is the most common contaminant present in used lubricant oil samples. Excessive water contamination over a prolonged period of time eventually leads to equipment failure from the following problems:

- Sludge formation in the oil, followed by possible oil line plugging
- Reaction of the lubricant additives with water that impairs the effectiveness of the additives, which, in extreme cases, may result in precipitation of the additives
- Rusting and corrosion leading to high wear and bearing failures
- Impaired lubrication film from water or steam pockets in heavily loaded bearings
- Formation of emulsions that impede oil purification and lubrication
- Bacterial growth on the water/oil interface leading to corrosion and undesired changes in the lubricating oil characteristics

The nature of water

In some cases, it is very important to know if the ingress of water is pure seawater or fresh water. In many cases when seawater is detected, the vessel will have to be dry-docked.

The nature of water is determined by performing a routine spectrographic element analysis on the oil sample. When water is detected, the amount of sodium (Na) and chlorine (Cl) can be extrapolated and their concentrations in the water phase can be calculated. Sodium chloride (NaCl) is the predominant salt in seawater. Typical deep ocean seawater contains about 55% chlorine (Cl) and 31% sodium (Na).

To determine the nature of water, we must focus is on its chlorine content. Sodium is also present in water cooling treatments and lubricant additives, and sodium content can be influenced by sediments and rocks and fuel-related materials. Based on international studies, water can be subdivided into various salinity levels. Depending on measured chlorine concentration, water can be defined as salt, brackish or fresh, as shown in Table 1.

Table 1: Salinity levels

	mg/l Cl	Nature of Water
Very Fresh	< 110	FRESH
Fresh	+ 110 to 220	
Slightly Fresh	+ 220 to 440	
Rather Fresh	+ 440 to 880	
Slightly Brackish	+ 880 to 1,760	BRACKISH
Brackish	+ 1,760 to 3,520	
Very Brackish	+ 3,520 to 7,040	
Slightly Salt	+ 7,040 to 14,080	SALT
Salt	+ 14,080	

Example: A sample containing 0.5% water and measuring 100 ppm Cl will show a chlorine content of 20,000 ppm in the water phase. This means that the nature of water is "salt".

Determining the nature of water provides valuable information for establishing the source of water ingress, especially in stern tubes, thrusters, or settling and storage tanks. The nature of water is displayed on the FAST™ used oil analysis reports for these systems.

In-service warning limits

The maximum tolerated level of water contamination differs for the various types of equipment being lubricated, kinds of lubricating oils, and operating conditions. Table 2 contains a summary of the warning limits for water contamination of in-service lubricating oil. This information is based on general experience and manufacturer's requirements.

Table 2: Warning limits for water (%)

Equipment	Attention	Urgent
Medium-speed Diesel Engines	0.2	0.5
Slow-speed Engine System Oil	0.2	0.5
Turbo Chargers	0.05	0.5
Turbo Generators	0.05	0.5
Steam Turbines	0.05	0.5
Gear Boxes	0.05	0.5
Hydraulic Systems	0.05	0.5
Air Compressors	0.05	0.5
Refrigeration	0.05	0.5
Compressors	0.01	0.05
Stern Tubes	1.0	3.0

Finally, the best recommendation is to be alert and stop water ingress as soon as possible to keep your oils dry. ■



marine lubricants information bulletin 3

elemental analysis



Most laboratories in the oil industry are equipped with an emission spectrometer (ICP-AES or rotating disk spectroscopy), which can be used for analyzing impurities in marine lubricants.

Detection

Analysis techniques using emission spectrometers measure the light energy emitted by metal atoms when subjected to high levels of energy such as heat. All metals emit light of their own specific wavelength. Modern equipment is designed so that up to 20 different

elements (i.e., metals) can be detected simultaneously. Lubricating oil samples often have to be diluted with a solvent before they can be tested. Lubricating greases and deposit samples should be ashed, and the resulting ash must be dissolved in water.

Table 1: Common sources of elements in lubricating oil

	Equipment	Cooling system	Environment	Lubricating oil	Grease	Fuel oil
Aluminum (Al)	✓				✓	✓
Antimony (Sb)	✓				✓	
Barium (Ba)		✓		✓	✓	
Boron (B)		✓		✓	✓	
Calcium (Ca)		✓	✓	✓	✓	
Chromium (Cr)	✓	✓				✓
Copper (Cu)	✓					
Iron (Fe)	✓	✓				
Lead (Pb)	✓			✓	✓	
Magnesium (Mg)	✓	✓	✓	✓		
Manganese (Mn)	✓					
Molybdenum (Mo)	✓			✓	✓	
Nickel (Ni)	✓					✓
Phosphorus (P)		✓		✓	✓	
Potassium (K)		✓	✓	✓	✓	
Silicon (Si)			✓			✓
Sodium (Na)		✓	✓	✓	✓	✓
Tin (Sn)	✓					
Vanadium (V)						✓
Zinc (Zn)	✓			✓	✓	



Limitations

Even modern techniques, however, have their limitations. One such limitation is that the origin of the chemical compound containing a particular metal present in the lubricant stays unknown. For example, zinc found in a lubricating oil sample could originate from the equipment as well as from a lubricating oil additive or from a tank coating material. Not all elements detected and reported originate from a single source. To make an educated guess, consult Table 1 when interpreting wear metal analysis.

Another limitation is the maximum particle size of the wear metals and contaminants that can be measured. Not all particles over five microns are detected. Particles over ten microns are not detected at all because these larger particles settle out in the equipment and in the test solutions and are not carried along into the energy source. For an accurate detection of metals in particles larger than five microns, other techniques such as X-ray spectrometry should be used. Normally wear particles range in size up to ten microns. However, excessive wear like piston or bearing seizures generate even larger particles and wear chips. These larger particles, as well as system debris, are often not detected because they may be removed by filters or settle out in places where the oil is stagnant.

Factors to consider

Only a few equipment manufacturers have established maximum limits for wear metals. Those that have only mention a few metals such as iron and copper. This can be expected because manufacturers do not know what

kind of oil or grease will be used in their equipment. Therefore, the amount of wear metals is less important than the trending over time. An increase might indicate a change that has to be monitored. Additionally, spare parts installed during repairs may be manufactured with different alloys. Finally, it is important to consider the oil consumption of the equipment involved and, for some applications, purification and treatment of the oil during use.

Interpretation

To make wear metal analysis a useful tool in assessing the oil and/or equipment condition, be sure to monitor the results over a prolonged time period and look for sudden changes. Chevron's FAST™ used oil analysis service offers the possibility to view the four most recent results immediately on the report. Graphical representation is provided for the most important elements: iron and copper. Some types of failures occur so suddenly that metal analysis performed at any practical frequency might not provide an advanced warning. Also, some failures, such as bearing fatigue, can generate large particles that settle out or are removed by filters. The sample, however, will still show normal wear metal results.

Conclusions and possible corrective measures should always be taken based on trend changes in element concentrations in combination with the existing knowledge of the equipment and of the operating conditions onboard. ■



marine lubricants information bulletin 4

base number



Lubricating oils for modern diesel engines are not only designed to provide adequate lubrication under varying temperatures and operating conditions, they also keep the engine clean and provide protection against chemical corrosion from acidic combustion products. These important properties are “added” to the lubricating oil by means of alkaline additives often referred to as detergents and dispersants.

Base Number (BN)

A lubricant's BN measures its potential to neutralize the acidic products formed during combustion. These products are caused by sulphur in the fuel oil.

The BN is often referred to as “alkalinity.” More specifically, it is the quantity of acid — expressed in terms of the equivalent number of milligrams of the alkaline potassium hydroxide — that is required to neutralize all alkaline constituents in one gram of sample. A BN of 70 for a typical slow-speed engine cylinder oil means that a quantity of acid equivalent to 70 milligrams of potassium hydroxide is required to neutralize the alkaline additives present in one gram of this oil.

Marine fuel oils contain varying amounts of sulphur, which can range from 0.3 to 4.5% by weight. During fuel combustion, the sulphur is oxidized to SO_2 and SO_3 . Part of these sulphur oxides combine with water during combustion and form sulphurous and sulphuric acids. These acids are extremely corrosive to engine components and need to be neutralized to prevent corrosive wear. Bases are needed to neutralize acids. This means that oil-soluble bases must be present in lubricating oils used in internal combustion engines.

Oil-soluble bases

The most commonly used basic detergents in these bases are organic soaps and salts of alkaline earth metals such as calcium, barium and magnesium. Calcium and magnesium sulfonates and calcium phenates are widely applied. The trick is to connect an alkaline metal compound such as calcium carbonate, which is not soluble in lubricating oil, to other molecules so that the new compound is oil soluble and can neutralize acids without creating harmful side effects. Oil-soluble bases, such as calcium sulfonate and calcium phenate, are also excellent deposit control additives.

The most critical areas for deposit formation in diesel engines are the piston crown and ring area. Excessive deposit formation on the piston crown may cause bore polishing, whereas deposits building up in the piston ring area may result in ring sticking. These deposits cause improper sealing of the combustion chamber and result in loss of compression, blowby, loss of oil control, increased wear and subsequent problems. The deposits formed on the piston are a mixture of soot and ash. Soot originates from the incomplete combustion of hydrocarbons, and ash contains those components that cannot be further oxidized. These combustion by-products are not oil soluble.



To protect against deposit formation, the substances must be prevented from forming or the particles formed must be kept very small and be dispersed in oil to be removed, for example, through the centrifugal filter or separator or when the oil is drained. The oil-soluble bases, such as calcium sulfonates and calcium phenates, prevent the particles from coagulating and keep them in suspension.

Selecting the correct BN for a diesel engine lubricant depends on various factors such as engine design, specific application in the engine, and sulphur content of the fuel. The type of fuel applied also plays a major role in this decision.

Slow-speed engine cylinder lubricants

Slow-speed engine cylinder oils, used for once-through lubrication of cylinders and liners, must have a high BN to manage the acids formed during combustion of the heavy fuel oils burned in these engines. The engines sometimes have extremely large bores and long strokes and the surface to protect is huge. Therefore, sufficient alkalinity must be available close to the oil quill as well as far below.

The amount of alkalinity introduced in the combustion chamber is directly linked with the oil feed rate and the BN of the applied cylinder oil. The amount of sulphuric acid generated from the combustion process is directly linked to the sulphur content in the fuel and the engine load. It is important to maintain a correct balance between them. Excess alkalinity may potentially cause deposit formation, whereas a shortage in alkalinity leads to excessive corrosion. In a correctly balanced system, corrosion is controlled rather than prevented, preserving a proper liner surface structure, which allows a strong oil film to build up.

Engines operating continuously with heavy fuel oil with high sulphur content ($> 2\text{wt}\%$) typically use 70 BN products. However, engines operating continuously with low sulphur content heavy fuel oil ($< 1\text{wt}\%$) typically use a 40 BN cylinder oil. These are only guidelines; for specific cases, please refer to the engine manufacturer's documents.

Slow-speed engine system oils

Slow-speed engine system oils, used in engines with oil cooled pistons, must possess some degree of detergency/dispersancy to ensure clean crankcase and piston interiors. A moderate alkalinity level in the oil also neutralizes the acidic combustion products that may leak into the crankcase through the stuffing box seals. The average BN levels for fresh system oils range from five to ten.

There are no minimum limits set for the BN of used slow-speed engine system oils. It is normal to see the BN of these oils increase over time from the ingress of used cylinder oil. However, a sudden increase in BN may indicate severe leakage through the stuffing box seals.

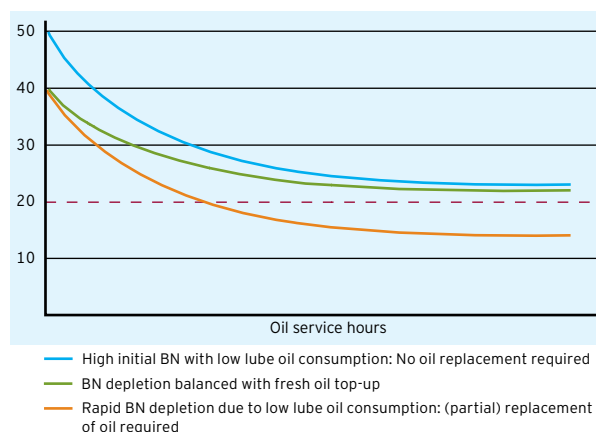
Medium-speed engine lubricants

Medium-speed engine oils, used for the lubrication of cylinders, liners, and bearings, are available with various BN levels. The BN requirements are specified by the engine manufacturer.

Table 1 presents a summary of typical BN requirements for medium-speed engines shown by function of the applied type of fuel and its sulphur content. The information in this table should only be used as a guideline. For specific cases, please refer to the engine manufacturer's documents.

Oil consumption is an important factor to consider when selecting the appropriate BN level of a lubricant. Lube oil in low-consuming engines depletes faster because less BN is topped-up during operation. Examples of typical medium-speed engine BN depletion curves are shown in Figure 1.

Figure 1: BN depletion of medium-speed engines



Other features in engine design also play roles in the selection of the appropriate BN level. An engine equipped with bore polishing rings can use higher BN oil because the deposit buildup on the piston is mechanically limited.

Many engine manufacturers specify the minimum required BN level of the oil in service in relation to the fuel in use. Their limits should be considered when judging used oil analysis results. As guideline, the BN of used diesel engine oil should be greater than 50% of the fresh oil value. ■

Table 1: Base number requirement guidelines — medium-speed engine oils

Fuel type	Sulphur, mass %	Fresh Oil BN
Gas Oil	< 0.5	5 – 15
Marine Diesel Oil	0.5 – 1.8	10 – 20
Intermediate Fuel Oil	1.0 – 3.0	15 – 30
Heavy Fuel Oil	0.3 – 3.0	20 – 40
Heavy Fuel Oil	> 3.0	30 – 60



marine lubricants information bulletin 5

cleanliness of hydraulic oils



The hydraulic systems onboard every vessel range from small systems for operating the engine room skylight to huge central systems to operate cargo pumps, deck machinery, and steering gears. Common in these systems is the hydraulic oil used to transport “fluid power” to the equipment.

Characteristics of hydraulic oils

Along with transporting “fluid power,” hydraulic oil must adequately lubricate the moving parts, such as the pumps, motors, and valves, present in hydraulic systems.

A critical property of a hydraulic fluid is its viscosity. Low internal friction is desirable, and an oil with a low viscosity at the system operating temperature is usually recommended. However, each hydraulic system has individual viscosity requirements based on the requirements of the hydraulic pump.

Other important characteristics of hydraulic oils are:

Oxidation Stability: Enables operation of the oil during long periods of time, even under severe conditions

Rust Prevention: Protects vital system parts against corrosion in the presence of water

Demulsibility: Rapidly separates any water from the oil

Anti-wear: Provides adequate lubrication of moving parts, even under boundary lubrication conditions

Air Release: Readily releases entrained air

Anti-foam: Prevents buildup of a stable foam layer, especially in the reservoir

Low Pour Point: Permits low temperature operations

High Viscosity Index: Minimizes viscosity changes with temperature and allows a wider operating temperature range

Oil cleanliness

Taking care of the oil in the system will prevent the untimely replacement of the oil, save considerable costs, and protect the hydraulic equipment. Selecting the proper viscosity grade is best done in cooperation with the equipment manufacturer and the lubricant supplier.

New systems often need to be flushed before entering service to remove the system debris accumulated during construction and the oil-soluble rust preventatives applied onsite. If flushing is prescribed, do not overlook or take shortcuts in the procedure because system debris may result in pump failures within a very short operating time. Additionally, oil-soluble rust preventatives negate some hydraulic oil characteristics such as foam, air release, and demulsibility properties.

After commissioning, hydraulic systems must be checked on a regular basis for the presence of water, especially in the oil reservoir. A considerable amount of water can accumulate there from the air-breathing action that occurs in varying temperatures. Free water should be thoroughly drained to avoid the buildup of a water bottom, which can result in corrosion, sludge formation, and, possibly the hydrolysis of the oil's additive components. Also, hydraulic oils must be kept as clean as possible before and during use.



It can safely be stated that the cleaner the oil, the longer the system will function. Not only do large, hard particles cause detrimental effects, such as abrasive wear leading to pump failures, but the buildup of small, soft particles (silt) eventually results in pump wear or valve sticking.

To avoid the buildup of particulate matter in hydraulic systems, most systems are equipped with filters to protect vital components from damage by particulate matter. These filters should be serviced and/or changed frequently in accordance with the manufacturer's instructions. Using dirty or malfunctioning filters results in undesirable system wear. Small systems, without filters, require more frequent oil changes to avoid the buildup of particulate matter and provide prolonged equipment life.

Monitoring hydraulic oil cleanliness

The cleanliness of the hydraulic oils in use must be monitored on a regular basis. Large systems should be sampled once a year to monitor the oil condition and contamination level, and the basic properties to check are: viscosity, water content, and amount of particulate matter.

There are several methods available to establish the amount of particulate matter present in hydraulic oils: gravimetric analysis for particulate matter (filter residue), microscopic examination (sizing and counting of particles) of filter residues, and automatic particle counting in a representative oil sample.

Some generally accepted warning limits for contamination levels are shown in Table 1.

The following particle count limits are generally accepted for high-pressure systems:

NAS 1638 Class: 8 or 9
ISO Code: 16/12

Seventy-five percent of hydraulic system failures are related to particulate matter contamination of the hydraulic oil. Contact your Chevron marine sales representative for detailed information about our line of hydraulic oils. ■

Table 1: Warning limits for contamination levels

Filter residue (using 0.8-micron membrane filters)	
0 – 50 mg/kg	Oil is clean
50 – 150 mg/kg	Oil is generally acceptable
150 – 300 mg/kg	Oil is suspect; filters need to be changed; monitoring recommended
300 – 400 mg/kg	Oil is heavily contaminated and should be severely filtered
Above 400 mg/kg	Oil is heavily contaminated and should be replaced
High-pressure system (above 70 bar) limits	
0 – 30 mg/kg	Oil is clean
30 – 100 mg/kg	Oil is suspect; filters should be changed; monitoring recommended
Above 100 mg/kg	Particulate matter content is too high. Oil should be changed unless the amount of particulate matter can be rapidly reduced by filtration.



marine lubricants information bulletin 6

viscosity classifications



The first and most important task of lubricating oil is to keep moving metal parts separated from each other, thus avoiding metal-to-metal contact, which leads to destructive wear. Even finely machined metal surfaces have a certain roughness.

Contact of these minute metal projections should be minimized; however, some contact always occurs and results in normal wear of the metal surfaces. If contact is not minimized, heat is generated when the metal parts touch. The heat causes local welding and transfer of metal, which creates scuffing or seizing of the equipment. These actions are called adhesive wear. The oil property that governs the thickness of the separating oil film is the viscosity.

Viscosity

The commonly used kinematic viscosity is defined as a measure of the restrictive flow of a fluid under gravitational force. The “cgs” unit of kinematic viscosity (one centimeter squared per second), is called one stoke (St). The SI unit for kinematic viscosity is one meter squared per second and is equivalent to 10,000 St. Usually, centistokes (cSt) is used ($1 \text{ cSt} = 0.01 \text{ St} = 1 \text{ mm}^2/\text{s}$).

The absolute or dynamic viscosity is equal to the kinematic viscosity, multiplied by the density of the fluid. It is usually expressed in centipoise (cP) ($1 \text{ cP} = 0.001 \text{ Pa}\cdot\text{s}$).

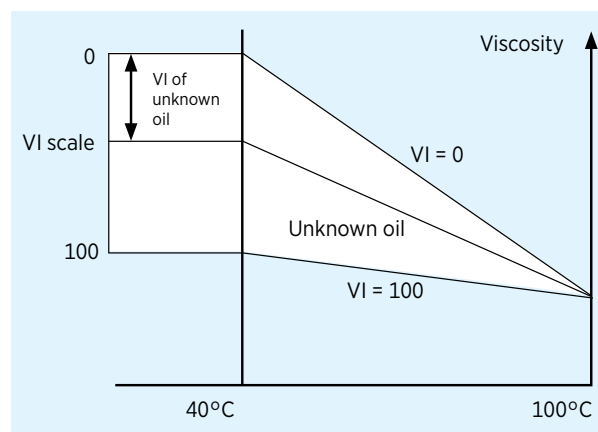
Viscosity index (VI)

The viscosity of lubricating oil changes with temperature and the rate of change depends on the composition of the oil. Naphthenic base oils change more than paraffinic base oils. Certain synthetic lubricants change much less than paraffinic oils.

To assess this lubricating oil property, the American Society for Testing and Materials (ASTM) created a method to provide a number called the Viscosity Index (VI). The VI correlates the amount of viscosity change for a given oil, compared to two reference oils having the highest and lowest viscosity indices at the time the VI scale was first introduced (1929). A standard paraffinic oil was given a VI of 100 and a standard naphthenic oil a VI of 0.

Figure 1 shows the relationship between viscosities at 40°C and 100°C. The method has been updated and revised several times to include VI values higher than 100.

Figure 1: Schematic Representation of Viscosity Index





A low VI means a relatively large viscosity change with temperature and a high VI denotes a smaller change of viscosity with temperature. Hence, the VI of an oil is important in applications where an appreciable change in temperature of the lubricating oil could affect the startup or operating characteristics of the equipment. Deck machinery and emergency equipment are examples of typical applications onboard ships.

Viscosity classification

As the selection of the proper viscosity grade is extremely important, various viscosity classification systems have been developed over the years. The viscosity classification for engine oils was developed by the Society for Automotive Engineers (SAE) in 1911. After many revisions and updates, this classification system is still in place.

The current SAE J300 Viscosity Classification is shown on the next page in Table 1. SAE grades 0W through 25W, where W stands for winter, have a maximum viscosity specified at low temperatures (–5°C through –35°C), to ensure easy starting under low temperature conditions, and a minimum viscosity requirement at 100°C to ensure satisfactory lubrication at the final operating temperature. Only SAE grades 20W through 60W have limits set at 100°C, because these grades are not intended to be used in low temperature conditions.

For marine applications, monograde oils (i.e., oils without the addition of VI improvers of SAE 30 or SAE 40) are used because of the steady operating conditions in a ship’s engine room.

Conversely, automotive oils are normally formulated by adding VI improvers to provide multigrade performance and thus deliver excellent temperature/viscosity relations. VI improvers are very large molecules, which are chemically made by linking together smaller molecules into so-called polymers. The use of these special polymers makes it possible to meet the low temperature viscosity requirements of the W grades, as well as the high temperature requirements of the non-W grades. In a 15W-40 multigrade engine oil, the typical viscosities are:

Viscosity at –15°C, cP	3,000
Viscosity at 40°C, mm²/s (cSt)	105
Viscosity at 100°C, mm²/s (cSt)	14
Viscosity Index	135

This example shows that the high VI offers a relatively small change in viscosity with temperature, and, as a result of the high VI, the multigrade oil meets the 15W grade low temperature viscosity requirements, as well as the 40 grade high temperature viscosity requirements.

Viscosity classification: industrial oils

Many different viscosity classification systems have been used in the past in different parts of the world. It has been difficult to reach agreement on the number of different grades to be included, the viscosity limits for these grades, and the temperature at which the viscosity should be specified. It is only since 1972 that a worldwide viscosity classification system for industrial lubricants came into place.

The current ISO 3448 viscosity classification system, which is also adopted by the ASTM, is shown on the next page in Table 2. The classification is based on a series of viscosity grades, each being approximately 50% more viscous than its preceding grade, while the viscosity deviation within a grade is plus or minus 10% of the nominal viscosity of that grade.

Used oil viscosities

The viscosity is determined on every oil sample tested in Chevron’s FAST™ used oil analysis service. Used lubricating oils may show an increase of the viscosity because of oxidation/nitration or contamination such as the soot loading of a diesel engine oil. Dilution with high viscosity heavy fuel oil or the use of a higher viscosity grade lubricant are other possible causes.

A viscosity decrease of a used lubricating oil may be related to the use of a lower viscosity grade lubricant or dilution with low viscosity fuel oil. Viscosity results of used lubricating oil samples are compared to the original equipment manufacturer’s (OEM’s) requirements whenever possible. If this is not feasible, the generally accepted limit for viscosity change is ±15% of the fresh oil value at 40°C. For large diesel engines, an increase of the engine oil’s kinematic viscosity at 40°C up to 45% is still accepted. ■



Table 1: Engine oil viscosity classification — SAE J300 revised May 2004

SAE viscosity grade	Low-temperature (°C) cranking viscosity ² , mPa.s max.	Low-temperature (°C) pumping viscosity ³ , mPa.s max. with no yield stress	Low-shear-rate kinematic viscosity ⁴ (mm ² /s) at 100°C min.	Low-shear-rate kinematic viscosity ⁵ (mm ² /s) at 100°C max.	High-shear-rate viscosity (mPa.s) at 150°C and 10 ⁶ s-1 min.
0 W	6,200 at -35	60,000 at -40	3.8	—	—
5 W	6,600 at -30	60,000 at -35	3.8	—	—
10 W	7,000 at -25	60,000 at -30	4.1	—	—
15 W	7,000 at -20	60,000 at -25	5.6	—	—
20 W	9,500 at -15	60,000 at -20	5.6	—	—
25 W	13,000 at -10	60,000 at -15	9.3	—	—
20	—	—	5.6	< 9.3	2.6
30	—	—	9.3	< 12.5	2.9
40	—	—	12.5	< 16.3	2.9 (0W-40, 5W-50, and 10W-40 grades)
40	—	—	12.5	< 16.3	3.7 (15W-40, 20W-40, 25W-40, 40 grades)
50	—	—	16.3	< 21.9	3.7
60	—	—	21.9	< 26.1	3.7

1. mPa.s = 1cP; 1 mm²/s = 1 cSt. All values are critical specifications as defined by ASTM D 3244.

2. ASTM D 5293

3. ASTM D 4684 Note: The presence of any yield stress detectable by this method constitutes a failure regardless of viscosity.

4. ASTM D 445

5. ASTM D 4683, CEC L-36-A-90 (ASTM D 4741)

Table 2: Industrial lubricant viscosity classification

Viscosity system grade ISO standard 3448 ASTM D 2422	Mid-point viscosity, mm ² /s (cSt), at 40°C	Kinematic viscosity limits, mm ² /s (cSt), at 40°C	
		Min	Max
ISO VG 2	2.2	1.98	2.42
ISO VG 3	3.2	2.88	3.52
ISO VG 5	4.6	4.14	5.06
ISO VG 7	6.8	6.12	7.48
ISO VG 10	10	9.00	11.0
ISO VG 15	15	13.5	16.5
ISO VG 22	22	19.8	24.2
ISO VG 32	32	28.8	35.2
ISO VG 46	46	41.4	50.6
ISO VG 68	68	61.2	74.8
ISO VG 100	100	90.0	110
ISO VG 150	150	135	165
ISO VG 220	220	198	242
ISO VG 320	320	288	352
ISO VG 460	460	414	506
ISO VG 680	680	612	748
ISO VG 1000	1,000	900	1,100
ISO VG 1500	1,500	1,300	1,650



marine lubricants information bulletin 7

lubricant compatibility



Often when switching from one supplier to another, the question arises whether lubricants in use and in storage can safely be mixed with lubricants from the new supplier. Some oils are incompatible because of differences in additive chemistry. If these oils are mixed, insoluble material may form and be deposited in the oil system.

There have been cases where grease-like substances plugged lines and filters in circulating systems, resulting in equipment shutdown. Analysis of these substances showed that they were derived from oil additives. Incompatibility can exist between two different Chevron products or between a Chevron product and that of a competitor.

Cause of incompatibility

In rare cases, an adverse reaction may occur between two oils at certain working conditions in a system. Most often the cause of incompatibility is the neutralization of an acidic additive in one oil by an alkaline additive in the other oil.

During the reaction, a soap forms (usually a calcium soap) that can precipitate a grease-like gel that interferes with lubrication and oil flow. However, mixed oils may not always lead to incompatibility issues. They can exist without precipitation or reaction in an operating system for an indefinite period, provided no water is present.

Incompatibility reactions are not reversible. Removing water by drying the system and the oil does not remove the formed gel or eliminate the soap.

Chevron product compatibility

Chevron products containing acidic additives are classified in List A of Table 1 (see next page). Products shown in List B of the table contain alkaline additives. The products in both lists are compatible with other products in the same list; however, products in List A are not compatible with products in List B and visa versa.

Products shown in List C contain no acidic or alkaline additives and are compatible with the products shown in both Lists A and B.

Changing from alkaline to acidic

Small amounts of the alkaline-type compounding from the oils in List B mixed with the oils in List A can cause:

- Stable emulsions to form when water contamination occurs
- Grease-like, oil insoluble deposits that may block filters and small oil passages

For example, the last effect is a concern in a turbo charger system where Regal® R&O or Cetus® PAO replaces an engine oil. This incompatibility can be prevented by flushing the circulating system thoroughly with a straight mineral oil.

**Table 1: Compatibility lists**

LIST A	LIST B	LIST C
Oils containing acidic additives	Oils containing alkaline additives	Oils not containing either
Regal® R&O	Taro® DP/XL	Compressor Oil EP VDL
Regal EP	Taro Special HT 70	Capella® WF
Rando® HDZ	Taro Special HT LS 40	Capella HFC 55
Meropa®	Veritas® 800 Marine	Refrigeration Oil Low Temp
Pinnacle® Marine Gear 220	Delo® 1000 Marine	LPG Compressor Oil
Cetus® PAO	Ursa® Marine	Uncompounded (steam) cylinder oils
Cetus DE	Delo 6170 CFO	—
Compounded stern tube oils	Ursa Extra Duty 40	—
Texatherm® 46	Delo SHP	—

The flushing procedure will dilute the concentration of the alkaline compound to below 10 ppm of calcium in the final operating charge of oil. This requires at least one 100% volume flush with the straight mineral oil after the alkaline oil is drained from the system. Only one full system flush is required if the holdup of oil in the system after draining can be verified to be less than 3% of the system capacity.

Changing from acidic to alkaline

The amount of acidic material that reacts with alkaline compounds in change is so small that the volume of precipitate is negligible. Furthermore, the alkaline compounds are detergents, and therefore can keep a small amount of reaction material in suspension. Therefore, changing an oil system from oils in List A to oils in List B does not ordinarily require intermediate flushing. However, in all cases where the type of oil is changed, the system should be completely drained.

Chevron lubricants with competitive products

Chevron lubricants are fully compatible with equivalent competitive lubricants recommended for the same application.

For example, all Chevron two-stroke cylinder oils such as Taro Special HT 70 are fully compatible with the equivalent cylinder oils marketed by ExxonMobil, BPCastrol, etc. The same is applicable to medium-speed engine oils, hydraulic oils, turbine oils and gear oils from various companies.

This implies that the oils in use can safely be topped up with the recommended Chevron lubricants, provided that the normal top-up procedures are being followed (not more than 10% fresh oil added at a time). Unused equivalent lubricant from different suppliers, as shown in vessel lube charts, can normally be mixed in any ratio.

However, it is important to note that compatibility problems may occur when different types of oils from one or more suppliers are mixed. For example, if a hydraulic oil is mixed with a medium-speed engine oil from a different supplier, it can be expected that in the presence of some water, insoluble reaction products will form. These kinds of product mixtures should always be avoided.

Synthetics

In general, product mixtures of various synthetic lubricants should always be avoided, because various types of synthetics are not always compatible.

The compatibility of some common types of synthetic lubricants with mineral oil based lubricants is listed below.

Synthetic Lubricant Type	Compatibility with Mineral Oil
Alkylbenzenes	Excellent
Polyalphaolefins	Excellent
Diesters	Good
Polyglycols	Poor
Phosphate Esters	Fair
Polyolesters	Fair

Summary

- Equivalent products from various suppliers can be mixed without problem.
- Mixing different types of products from the same or different suppliers should be avoided.
- Product mixtures of various types of synthetic products should always be avoided. ■



marine lubricants information bulletin 8

synthetic oils



Mineral base oil and synthetic lubricants are widely available, especially those used in industrial lubrication applications, and they have many applications onboard ships. It is important to select the right lubricant for your hydraulic system.

Mineral base oils

These oils are mixtures of a wide range of hydrocarbons. They are derived from crude oils by distillation, solvent extraction, and hydro-finishing/cracking processes.

Mineral-oil based lubricants are blends of mineral base oils with additives to enhance or introduce specifically desired properties to the oil or suppress certain undesired characteristics.

Mineral-oil based lubricants, widely available at low to moderate prices throughout the world, provide satisfactory lubrication for most applications onboard ships. However, in specific conditions, such as some “filled-for-life” systems or under extremely demanding operating conditions, mineral-oil based lubricants can fail and synthetic-based lubricants should be considered.

Synthetic base oils

Historically, special purpose demands triggered the development of synthetic lubricants. For example, conventional mineral-oil based lubricants could not meet extreme low- (Arctic) or high-temperature operations and fire resistance requirements. Synthetic base oils, a complex mixture of hydrocarbons, are the result of a carefully controlled chemical reaction process that produces a “pure” chemical of pre-selected composition. This reaction process produces an unlimited variety of products.

Many synthetic-based lubricants are formulated with additives similar to those in mineral-oil based lubricants. However, some synthetics require newly developed additives. This is true of the fully formulated lubricants for internal combustion engines and heavy-duty gear cases. Various types of synthetic-based oils used to formulate synthetic lubricants have certain advantages over conventional mineral-oil based products. These advantages are:

- Low pour point
- Low volatility
- Low toxicity
- High viscosity index
- High oxidation stability
- High flash and fire points

Some pros and cons

Although synthetic lubricants are more expensive than mineral-oil based products, they offer operating or performance advantages that decrease operating costs. For example, synthetic lubricant is the preferred choice for lubricating cargo gas compressors that compress various gases. Mineral base oils can only be used with a limited number of these gases. However, synthetic oils, based on polyalkylene glycol, can be used with many of the gases shipped today.



Synthetic-based oils have a longer service life in addition to their extended overhaul periods. When used in air compressors, turbo chargers, and gear applications, synthetic-based oils may be more economical. For some systems, outside contamination (by water and/or dirt) and not lubricant breakdown may cause frequent oil changes. Using synthetic oils in these systems increases rather than decreases costs.

Synthetic lubricants are the best choice to use in extremely low- (Arctic) or high-operating temperatures. Some modern heavy fuel oil purifiers are located in special purifier rooms and work under extreme high-temperature conditions. Using synthetic gear oil for this application will extend the life of the equipment.

Not all synthetics and mineral oils are fully compatible; changing from synthetic base oil to mineral base oil can create potential problems. Systems must be drained and flushed when changing from one type of oil to another.

Seal compatibility issues can create another possible problem. Equipment seals selected for operation with mineral oils can show unexpected swelling or hardening with certain types of synthetic oils and visa versa. Your equipment manufacturer can help you avoid these problems.

Our conventional mineral-oil based lubricants, formulated with state-of-the-art additives, provide adequate lubrication for the majority of equipment installed onboard ships. However, for some specific applications, synthetic lubricants offer better performance that cannot be achieved by mineral oils.

Some synthetic lubricant products are already available in specific areas. These products are:

LPG Compressor Oil: A polyalkylene-glycol-based lubricant specifically developed for enclosed hydrocarbon and gas compressors, such as Sulzer-Burckhart “K” gas compressors.

Cetus® PAO 46 and 68: These polyalphaolefin compressor oils are used in rotary vane and screw-type air compressors and turbochargers.

Cetus® DE 100: A compressor oil, formulated with diesters, used in reciprocating (starting) air compressors.

Pinnacle® Marine Gear: A gear lubricant that is a mixture of polyalphaolefins and diesters. We recommend using this on enclosed gears operating at extreme temperatures or under severe conditions.

Ulti-Plex® Synthetic Grease EP: A high-temperature grease, composed of a lithium-complex thickener and synthetic-based oil, designed for the most extreme temperature environments and for applications that require extended re-lubrication intervals.

Capella® HFC 32, 55 and 100: Refrigerating compressor oils, formulated with polyolesters, intended for systems charged with chlorine-free refrigerants. ■

Synthetic lubricants: Advantages compared to mineral oils

Synthetic Base Type	Main Advantages	Applications
Alkylbenzenes	Low temperature performance	(Refrigeration) compressor oils mineral oil-like solvency
Polyalphaolefins	Wide temperature performance range, low volatility	Engine oils, gear oils, hydraulic oils, air compressor oils
Diesters	Wide temperature performance range, low volatility	Gas turbine oils, air compressor oils, hydraulic oils
Phosphate Esters	Fire resistance	Fire-resistant hydraulic fluids
Polyalkylene Glycols	Wide temperature performance range, hydrolytic stability, frictional properties	Gas compressor oil, gear oils
Polyolesters	Wide temperature performance range, low pour point	Jet engine oils, refrigeration compressor oils (chlorine-free refrigerants)



marine lubricants information bulletin 9

wire rope lubrication



Vessel lubrication charts often list products suitable for general lubrication onboard a ship. One product frequently listed is a lubricant used to protect steel wire ropes.

Steel wire rope construction

A steel wire rope is made of individual wires that are twisted together to form strands. The strands are wrapped around a core to create a final rope.

The core of a wire rope can be made of different types of material such as hemp, nylon, plastic, or another strand of wires. The selection of core material, number of wires per strand, number of strands, and the way the wires are twisted and strands are laid, depends on the rope's required strength, application, and cost.

Working environment

Wire ropes are usually used in less than ideal conditions. There are some applications, such as on an engine room crane or an elevator, which are not considered severe. However, most wire ropes are used on deck where they are exposed to corrosive seawater and varying ambient and working temperatures.

When in use, wire rope is subject to heavy loads, high pressures, and surface wear. The rope is also exposed to changing loads and pressures that cause the strands to move within the rope and result in internal wear. These unfavorable conditions can cause premature failure if the rope is not properly relubricated.

Lubrication requirements

Lubrication protects the wires of the rope against corrosion and minimizes external and internal wear. To provide this protection, a lubricant must have some very specific characteristics.

The basic requirements for lubricants are listed in the ISO 4346 standard Steel Wire Ropes for General Purposes – Lubricants – Basic Requirements.

To meet these requirements, a lubricant must:

- Have good covering properties
- Be water-repellent, water-resistant, and not emulsifiable
- Not be subject to significant embrittlement
- Not have grit, abrasives, water, chlorine, or similar impurities
- Not contain additives or compounds, which can form corrosive products caused by water contamination or additive degradation

In addition, the lubricant must be able to penetrate into the core of the wire rope.

Relubrication practices

Wire ropes are initially lubricated during manufacturing. This lubrication protects the rope from corrosion during transportation and storage and reduces friction and wear during its initial use. However, the initial lubricant does not last. Relubrication is required because the lubricant works out of the rope or dries out after a certain period of use.

To obtain maximum service life, ropes should be relubricated at regular intervals. These intervals are dictated by various factors, such as the type of lubricant used, rope storage conditions, and method and frequency of use.



There are several techniques for relubrication; the most common are “painting” and “swabbing.” These techniques, however, rarely penetrate the lubricant down to the core of the rope. Using a high-pressure lubricator is preferred, because it provides good penetration of the lubricant into the rope. The degree of penetration achievable with any technique also depends on the type of lubricant used.

Lubricant types

Several types of lubricants, using various methods of application, are available on the market.

“Asphaltic” products, the most commonly used lubricants, are manufactured from very high-viscosity residual lubricants. These products often contain a nonflammable solvent for easy application and better penetration into the wire rope. They can be applied by brush, swabs, or spray guns, but cannot be used in high-pressure lubricators. Asphaltic-type products that do not contain a diluent solvent require heating. The resulting tacky coating sometimes shows “dripping” problems in hot areas or becomes brittle under low-temperature conditions.

Another group of available lubricants is based on paraffin wax, with or without a solvent. Products without solvents must be melted before application. These products are generally applied by brush or swab.

Additionally, there are many types of greases on the market. Some of them are excellent at lubricating wire ropes, depending on composition and method of application.

State-of-the-art relubrication

To sustain the life of wire rope, it is necessary to properly relubricate them at regular intervals. Rope tests show that the service life of a regularly relubricated wire rope is two to three times longer than that of a dry rope. Modern high-pressure lubricators, together with the latest technology lubricants, provide state-of-the-art relubrication and maintenance for wire ropes.

Before lubrication, a rope must be cleaned with wire brushes, a scraper, compressed air, or superheated steam. Old layers of lubricant and dirt may need to be removed from the rope by using a suitable solvent.

For wire rope relubrication, we recommend using **Ulti-Plex® Synthetic Grease EP** in high-pressure lubricators. This high-performance, multipurpose grease is manufactured from high-viscosity synthetic-based oils and a lithium-complex thickener with special rust and oxidation inhibitors and extreme pressure and tackiness additives.

The rust and corrosion inhibition and superior water wash-out resistance make this lubricant ideal for this application.

For application by brush or swab, **Rustproof Compound L** is recommended. This petrolatum-type product contains a nonflammable solvent for easy application. Detailed product information can be obtained from your Chevron marine sales representative. ■



marine lubricants information bulletin 10

cetus® DE 100 application guidelines



Cetus® DE 100 is a synthetic lubricant used to lubricate piston air compressors. It is formulated with diester-based fluid and exhibits a high degree of inherent detergency that keeps compressor parts clean and in service. The lubricant is miscible with nondetergent mineral or PAO-based compressor oils, such as Chevron's Compressor Oil EP VDL or Cetus PAO synthetic compressor oil.

Application guidelines

Cetus® DE 100's good solvency keeps components clean; however, its use requires these precautions:

- Make sure that all compressor components in contact with the lubricant are as clean as possible before changing lubricant products. Carbonaceous deposits from petroleum oils previously used may be loosened and dislodged by the detergent-cleaning action of Cetus DE 100.
- Change filter elements as required.
- Monitor oil pressure drop across the filters after changing to Cetus DE 100. It is important to follow the compressor manufacturer's recommended procedure when changing oils.

Changing oils

Reciprocating compressors (cylinder and crankcase lubrication change over)

1. Drain mineral oil from the compressor and inspect its internal condition.
2. Remove the cylinder heads and side covers from the compressor, and inspect the pistons, intake and discharge valves. If they are covered by carbon and/or heavy deposits, remove and clean them.
3. Remove deposits from the crankcase housing and/or any accessible air passageways when inspecting or cleaning the valves.

4. Blow out all accessible oil pipes. If possible, run Cetus DE 100 lubricant through the lube lines into a suitable container. Five to ten minutes of flow should flush old mineral oil deposits. The flushing oil can be used for further cleaning purposes if it is not too heavily contaminated.
5. Drain and clean the downstream filters and separators.
6. Start the compressor, using the same lubrication rate as used with the previous lubricant, after completing the inspection and cleanup. Because of the extremely low volatility of Cetus DE 100 synthetic lubricant and its good metal-wetting properties, the volume of oil required to maintain good lubrication is often less than that of other oils. To determine the optimum rate for these ester-based oils, inspect a cylinder wall after operation and adjust the rate so that the walls are wet.
7. Periodically inspect the downstream filters, separators, and air flow passages for sludge from portions of the compressor which were not cleaned. Cetus DE 100 synthetic lubricant removes deposits from inaccessible oil lines and passages, which may reduce filter efficiency.



Rotary compressors

1. Drain all mineral oil from the unit. For best results, drain the unit when it is warm.
2. Open the manual condensate drain valve and drain all liquid.
3. Remove the pipe plug from the bottom of the separator/receiver tank and drain all liquid.
4. Remove the pipe plug from the bottom of the oil cooler and drain completely.
5. Clean the oil filter completely or replace it.
6. Disconnect all oil piping that could trap oil and drain the pipes. If possible, run Cetus® DE 100 lubricant through lube lines into a suitable container. Five to ten minutes of flow should flush old mineral oil deposits. The flushing oil can be used for further cleaning purposes if it is not too heavily contaminated.
7. Start the compressor after completing the inspection and cleanup.
8. Periodically inspect the downstream filters, separators, and air flow passages for sludge from portions of the compressor which were not cleaned. Cetus DE 100 synthetic lubricant removes deposits from inaccessible oil lines and passages, which may reduce filter efficiency and require an earlier change.

To minimize the requirement for periodic inspections, follow the compressor manufacturer's recommended procedures for the thorough cleaning of all valves, air passages, intercoolers, and separators. Some compressor

manufacturers recommend using mineral solvents to clean compressors. Only use this type of solvent on severely lacquered or varnished machines where the deposits cannot be wiped or scraped off.

If using a mineral solvent, make sure that all loosened deposits and solvents are removed before filling the compressor with Cetus DE 100 lubricant. Any residual solvent can decrease the life of the synthetic lubricant.

Another, less preferred method for removing resistant deposits is to run the unit on the selected Cetus DE 100 lubricant for approximately 100 hours, drain the unit while it is hot, clean or replace the filter, and re-fill it with fresh Cetus DE 100 lubricant.

Materials compatibility

The guide below lists the types of materials generally acceptable for use with Cetus DE 100. This list is for guidance only. Before using the lubricant, consider any specific formulations, methods of manufacture and/or application, and the conditions and degree of exposure for all seals, paints, and plastics.

Polycarbonate bowls

A number of air line filters and separator manufacturers use polycarbonate plastic bowls in their units. Numerous tests demonstrated that compatibility problems can occur when using polycarbonate bowls with Cetus DE 100 lubricant. To avoid compatibility problems, we recommend either covering poly-carbonate bowls with metal bowl guards or replacing them with metal bowls. ■

Plastic compatibility

Acceptable	Marginal	Not Acceptable
✓ Nylon	~ Polyurethane	✗ Polyethylene
✓ Fluorocarbon (PTFE)	~ Polypropylene	✗ Lexan
✓ Polyacetal (Delrin)	~ Polysulfone	✗ PVC
		✗ Acrylic

Paints and coatings compatibility

Acceptable	Marginal	Not Acceptable
✓ Epoxy	~ Phenolic	✗ Acrylic
✓ Baked Phenolic	~ Industrial Latex	✗ Household Latex
✓ 2-Comp. Urethane	~ Single-Comp. Urethane	✗ Vinyl (PVC)
✓ Moisture-Cured Urethane	~ Alkyls (Baked-Finished preferred)	✗ Varnish and Lacquer

Seal material compatibility

Acceptable	Not Acceptable
✓ Fluorocarbon (Viton, PTFE, Fluorel)	✗ Ethylene-Propylene Terpolymer (EPDM)
✓ Fluorosilicone Rubber	✗ Polychloroprene (Neoprene)
✓ Silicone Rubber	✗ Butyl Rubber
✓ Epichlorohydrin	✗ Natural Rubber
✓ Medium Nitrile Rubber (Buna N, NBR 30–36% acrylonitrile)	✗ Low Nitrile Rubber (Buna N, NBR < 30% acrylonitrile)
✓ High Nitrile Rubber (Buna N, NBR 36% acrylonitrile)	✗ Styrene-Butadiene Rubber (Buna S, SBR)
✓ Polyacrylate Rubber	✗ Ethylene/Acrylic Rubber
✓ Chlorosulfonated Polyethylene (Hypalon)	✗ Ethylene-Propylene Copolymer Rubber (EPR)
✓ Polyurethane	✗ Polysulfide (Thiokol)



marine lubricants information bulletin 11

chevron brands, MPID and regional equivalents



Chevron Marine Lubricants provides products under three master brands: Chevron, Texaco and Caltex. Most of the products in the portfolio are globally available and supplied with the same product name, but may have different master brands, depending on which region or country the product is lifted.

Chevron brands, MPID and regional equivalents

Some of the products in the Marine Lubricants product portfolio — mainly ancillary grades — have been developed to match specific regional requirements, with heritage product names which are not globally available. Wherever possible, Chevron Marine Lubricants will supply the products listed on the vessels' Lubechart — products referred to as Parent Product. If the Parent Product is not available in the region or country of lifting, a Regional Equivalent will be supplied instead — if existing.

*The Parent Product and its Regional Equivalent are **direct equals**, of same or similar performance level for intended application and are fully miscible and compatible.*

Marine Product ID (MPID)

To simplify regional product equivalents, Chevron Marine Lubricants recently introduced the Marine Product ID (MPID). The MPID is a code assigned to identify products into a single product code for each Parent Product and its Regional Equivalent. The concept is also used for product or name changes to help manage transition from old to new products.

This means that only a parent product name or MPID is required; *should the Parent Product not be available in a specific region, Chevron Marine Lubricants will ensure that the correct Regional Equivalent is supplied instead.*

Only the Parent Product's name and MPID are listed on the Chevron Marine Lubricants website, World Port Directory, OnePort and vessel Lubechart. On the vessel Lubechart, any products with Regional Equivalents are listed in the footnotes for information. Regional Equivalents are provided in subscript on the Product Datasheets.

The Marine Lubricants Delivery Receipt (MLDR), which you receive with the supply, will state the name of the Parent Product ordered, and will list the Regional Equivalent supplied in case, to match the product name mentioned on the packaging.

Examples

As an example of this, Chevron Delo Gold Ultra 15W-40 (high speed engine oil with API CI-4/ACEA E7 performance) is the Parent Product and supplied under the Chevron brand in North America and the Caltex brand in Asia Pacific. However, Ursa Marine 15W-40 is supplied in Europe and Ursa Super TD 15W-40 in Latin America, respectively, as Regional Equivalents. These Regional Equivalents are of same performance level as the parent product.

The table on page 2 provides a comparison of Chevron Parent Products and the Regional Equivalents, depending on the port of supply. ■



Chevron Marine Lubricants Parent Products and Regional Equivalents

Parent Product	Regional Equivalents
Delo Gold Ultra 15W-40	Ursa Marine 15W-40 Delo 400 Multigrade SAE 15W-40 Ursa Super TD API CH 4 15W-40 Delo Gold Ultra E SAE 15W-40
Delo 400 MGX SAE 15W-40	Ursa Ultra LE 15W-40, Delo 400 LE 15W-40
Delo 100 Motor Oil SAE 40	Ursa Extra Duty SAE 40
Delo 400 SAE 40	Ursa HD SEA 40 Delo Silver SAE 40 Ursa LA 3 SAE 40
Delo 400 XSP SAE 5W-40	Delo 400 LE Synthetic SAE 5W-40 Ursa Ultra X SAE 10W-40
Delo 710 LE 20W-40	Delo 6170 CFO SAE 40
Havoline Outboard 2T	Motex 2T Outboard Havoline 2-Cycle Engine Oil TC-W3 Super Outboard 3
1000 THF	Textran TDH Premium
Havoline ATF III-H	Automatic Transmission Fluid MD-3 Texamatic 7045E Texamatic 1888
Delo Gear EP-5 SAE 80W-90	Multigear EP-5 80W-90 Geartex EP-C 80W-90 Geartex EP-5 SAE 80W-90 Thuban GL-5 EP 80W-90 Gear Oil GL-5 SAE 80W-90
Hydraulic Oil 5606	Hydraulic Oil 5606A
Meropa WG 460	Cylinder Oil W460
Delo Starplex EP 2	Starplex EP 2
Molytex EP 2	Moly Grease EP 2 Multifak Moly EP 2
Texatherm 46	Heat Transfer Oil 46
Capella Low Temp AB 68	Refrigeration Oil Low Temp 68
Cetus PAG	LPG Compressor Oil
Delo XLI Corrosion Inhibitor – concentrate	Havoline XLI
Delo XLC Antifreeze/Coolant – concentrate	Havoline Xtended Life Coolant – concentrate Havoline Xtended Life Antifreeze/Coolant – concentrate Havoline XLC – concentrate

Note: This table is subject to changes as the product portfolio is updated.

September 2020



marine lubricants information bulletin 12

marine industry greases



Grease lubricants have many applications onboard marine vessels; they provide sealing and retention on lubricated parts. Unlike oil lubricants, grease does not require frequent replenishment and, in open systems, it is used to coat surfaces where it is impractical to use oil.

Grease is a semi-solid product consisting of a thickener dispersed in a liquid lubricant. The thickener forms a network structure that holds the lubricant stationary, comparable to a sponge holding water. The two most distinguishing properties of grease are its consistency and dropping point.

Grease consistency

The consistency of grease is reflected by a penetration number. To determine the penetration number for a grease, a test amount is worked for 60 strokes to obtain a uniform sample. Then, a standard cone penetrates the sample under specified conditions of load, time, and temperature. Lastly, penetration depth is measured, and the depth is expressed in tenths of a millimeter.

Based on the penetration depth, the National Lubricating Grease Institute (NLGI) consistency grade is defined, as shown in Table 1. The NLGI in the United States defined a series of consistency grades ranging from 000 (very soft) to 6 (very hard). Each grade corresponds with a range of values for the penetration depth.

Dropping point

As temperature increases, grease gradually softens until it starts to become "liquid." The dropping point is the temperature at which liquid starts to form. It is measured by heating a sample in a test cup, with a small orifice at the bottom, until the first drop of material falls from the lower end of the cup. The dropping point for a grease is largely

Table 1: NLGI classification for greases

NLGI Grade	Worked Penetration Depth Range (mm/10)
000	445–475
00	400–430
0	355–385
1	310–340
2	265–295
3	220–250
4	175–205
5	130–160
6	85–115

determined by the thickener. Unlike calcium soaps, lithium soaps and, especially, lithium-complex soaps, result in high dropping points.

The dropping point determines the maximum usable temperature for a grease. In systems without frequent relubrication, we recommend staying at least 15°C to 30°C below the dropping point of the grease in service. However, with frequent or continuous relubrication, this service temperature limit can be raised.

Key properties

The key properties of a grease must match its intended application and required performance criteria. These properties relate to the composition of the grease.



Thickener and oil phase play important roles in grease composition. The thickener is usually present at a concentration level between 5% and 30%, depending on the desired consistency or “hardness” of the grease.

Metal soaps, such as calcium and lithium, are widely used as a thickener in marine greases today. While metal soaps are produced by the reaction of a single organic acid to the metal hydroxide, complex soaps are synthesized by the co-crystallization of two or more organic compounds with the metal hydroxide. This creates a more complex soap structure and provides higher thermal stability.

Additional non-soap chemicals, urea or inorganic materials (bentonite clays), can be applied in certain cases.

Table 2 (on the next page) shows the general characteristics and applications of the main grease families used by the marine and general industries. Lubricants provide the lubrication qualities of a grease and consist of mineral paraffinic or synthetic-based oil and a combination of various additives. These additives are:

- Anti-oxidants to prevent oil degradation as a result of heat or oxidation
- Rust and corrosion inhibitors to protect lubricated metal surfaces against rust from saltwater contamination
- Anti-wear additives to strengthen the lubricating film and reduce adhesive wear
- Tackifiers, such as fibrous molecules, to enable the grease to cling to the metal surface and prevent it from being thrown off when the equipment is rotating
- Solid friction modifiers, such as graphite powder or Molybdenum Disulphide (MoS_2), to allow the grease to tolerate very high loads or shock loads

Chevron marine grease products

As shown in Table 3 on the next page, our range of high-performing greases for specific marine applications meet the lubrication requirements of onboard marine vessels. These greases are formulated to meet the demands of extreme pressure, temperature, and corrosive environments — ideal properties for many marine applications.

Our marine grease product line includes:

Multifak® EP, an excellent multipurpose grease, is based on lithium soap. It has a smooth, buttery texture and is highly adhesive and water-resistant. This grease achieves high load-carrying capacity and low wear rates as a result of antiwear additives included in the formula. Multifak EP has two consistency grades, 0 and 2, that will satisfy the grease requirements for a majority of marine equipment. We especially recommend the 0 grade for use in central lubrication systems.

For protection against seizure under highly loaded service conditions, we recommend our **Molytex® EP 2** grease. This multipurpose, extreme-pressure lithium grease contains MoS_2 as a solid filler. This grease is specifically developed for use in constant-velocity joints.

Molytex EP 2 can also be used for all types of anti-friction bearing arrangements, from plain sleeve-type to rolling element bearings and bushings and other sliding surface or pivot points.

We also recommend Molytex EP 2 for the lubrication of (deck) cranes. Compared with other products in the market, this product increases the service life of rudder shafts by up to 30 percent.

The presence of MoS_2 in grease provides an extra measure of protection in shock-loading situations. During heavy shock-loading, the lubricant film between metal surfaces can temporarily squeeze out, which can result in equipment damage. The MoS_2 in the lubricant prevents metal-to-metal contact and protects the equipment.

We recommend **Texclad® 2** for applications on deck where exceptional water resistance is desired during continuous wet operation and where temperatures remain relatively low. This water-stabilized calcium grease contains selected graphite and molybdenum disulphide fillers. The presence of these solid lubricants guarantees reliable lubrication even under extreme heavy-duty operating conditions, such as open gear operations. The high adhesiveness to metals in Texclad 2 resists displacement or run-off and prevents the metal-to-metal contact of gear teeth, chains, and wire ropes. Additionally, the product is bitumen-free, which provides a more environmentally acceptable lubricant solution. Extended use of mineral grease at temperatures above 130°C causes rapid oxidation and degradation of the grease in service.

As an extension to the range of mineral greases, we offer **Ulti-Plex® Synthetic Grease EP**. This grease is formulated with a lithium-complex thickener and a synthetic base stock. It is designed for use in extreme temperature environments and for applications requiring extended re-lubrication intervals. Ulti-Plex Synthetic Grease EP provides outstanding thermal stability up to 140°C in continuous service and up to 230°C in central lubrication systems.

This grease retains its pumpability in temperatures as low as -30°C and provides proper bearing lubrication at temperatures as low as -50°C . Its anti-corrosion properties make it a superior multipurpose marine lubricant for use in deck equipment, offshore drilling equipment, and lubricated shaft bearings, cranes, and winches.



Table 2: Grease types — properties and applications

Thickener	Grease properties				Applications
	Appearance	Water resistance	Temperature resistance	Specific properties	
Soap thickened greases					
Sodium (Na)	Rough, fibrous	—	+/-	Good metal adhesion	Older equipment with frequent relubrication; roller-element bearings.
Calcium (Ca)	Smooth, buttery	++	—		Bearings in wet conditions; rail lubricant.
Lithium	Smooth, buttery to slightly stringy	+	+	Resistant to softening and leakage	Wheel bearings; multi-purpose grease.
Complex soap thickened greases					
Calcium complex	Smooth, buttery	++	++	Inherent load carrying capacity	High-temperature bearings.
Lithium complex	Smooth, buttery	+	++	Resistant to softening and leakage	Wheel bearings; high-temperature service including various roller-element applications.
Non-soap thickened greases					
Polyurea	Smooth, slightly opaque	++	++	Oxidation resistant less resistant to leakage	Roller-element bearings; Constant velocity joints.
Organo-clay	Smooth, buttery	++	++	Resistant to leakage	High temperature bearings with frequent relubrication; steel mill roll neck bearings.

Table 3: Chevron's range of marine greases

Product Name	Thickener	Base oil	Consistency (NLGI-class)	Dropping Point (°C)	Application Range (°C)
Multifak® EP 0	Li-soap	mineral	0	200	-30 to 120
Multifak EP 2	Li-soap	mineral	2	200	-30 to 120
Molytex® EP 2	Li-soap	mineral	2	210	-30 to 120
Texclad® 2	Ca-soap	mineral	2	106	-10 to 60
Ulti-Plex® Synthetic Grease EP	Li-complex soap	synthetic	1.5	285	-50 to 230



Grease compatibility

Before replacing your current grease, contact your Chevron marine representative for advice on the compatibility of using a new grease with the one in service. The compatibility diagram in Table 4 serves as a guideline and lists the main thickener systems used by the industry. Actual compatibility may, however, depend on the additive or base oil system of the specific products being mixed.

The Chevron Technology laboratory is one of the best-equipped grease testing facilities in the world. In addition to testing general physico-chemical characteristics, the lab conducts performance bench tests and continuously monitors the quality of grease batches produced and tests used greases arriving from the field. Our technical department personnel can always provide advice on grease compatibility issues. ■

Table 4: Compatibility between different grease types

	Aluminum Complex	Barium Complex	Calcium	Calcium Complex	Clay	Lithium	Lithium Complex	Polyurea	Sodium
Aluminum Complex									
Barium Complex									
Calcium									
Calcium Complex									
Clay									
Lithium									
Lithium Complex									
Polyurea									
Sodium									

- Compatible
- Borderline — sample should be checked
- Incompatible



marine lubricants information bulletin 13

bright stock



Solvent-extracted bright stock, with a viscosity in the range of 28.0 to 35.0 mm²/s (cSt) at 100°C, is often used in higher-viscosity grade lubricants such as slow-speed engine cylinder oils. The old “bright stock is bad” belief can no longer be confirmed.

Mineral base oils

Mineral base oils are complex mixtures of paraffins, naphthenes, and aromatics. These hydrocarbons have different molecular arrangements of hydrogen and carbon atoms. The hydrocarbon composition of base oils is related to the crude oil source and the type of refinery process used to manufacture them. For example:

- Paraffins are saturated straight and branched strings of hydrocarbons
- Naphthenes are saturated cyclic hydrocarbon structures
- Aromatics contain unsaturated alkyl rings

Saturated paraffins and naphthenes are suitable hydrocarbons for base oils. Unsaturated aromatics are prone to oxidation that produces sludge and lacquer formation and, therefore, are undesirable in base oils.

The properties of base oils are related to their predominating chemical structure, which includes:

- Boiling range
- Viscosity
- Density
- Pour point
- Solvency
- Oxidation resistance
- Thermal stability

For the majority of applications, the most important characteristics of base oils are viscosity and viscosity index. The viscosity index (VI) is the rate of change in viscosity with changes in temperature.

Mineral base oil enhancement

The properties of base oils can be enhanced by refining methods. Solvent refining is the most common method for high-viscosity oils.

Solvent-extracted base oils have a higher VI than non-refined base oils. This happens when solvent extraction removes aromatic components, which have lower VI. For example, paraffinic base oils have a higher VI than naphthenic base oils. Typical naphthenic base oils have a VI below 50; whereas typical paraffinic base oils have a VI above 80. Chevron exclusively uses solvent neutral oils with a minimum VI of 90, which are generally referred to as high-viscosity index (HVI) base oils.

Base oils cover a wide viscosity range from approximately 4 to 35 mm²/s (cSt) at 100°C. The viscosity level defines the grade of base oil into light, medium, and heavy neutral oils and bright stocks. The higher the molecular weight of the hydrocarbons, the more viscous the base oil.



Table 1 contains examples of typical HVI paraffinic base oils that are commonly used for lubricants blending.

Table 1: Typical HVI paraffinic base oils

Approximate viscosity range	mm ² /s (cSt) at 100°C
100 neutral oil (light)	4.0 – 4.5
150 neutral oil (light)	5.0 – 5.5
300 neutral oil (medium)	7.0 – 8.0
500 neutral oil (heavy)	10.5 – 11.0
600 neutral oil (heavy)	11.5 – 12.0
150 bright stock (light)	28.0 – 35.0

Marine slow-speed engine cylinder oils

Paraffinic base oils are used for blending slow-speed engine cylinder oils because of their excellent properties, which include high VI, good oxidation resistance, good thermal stability, low volatility and good demulsibility. These base oils are usually a mixture of medium-viscosity neutral oil and high-viscosity bright stock. This combination is commonly available on a worldwide basis, thus ensuring uniformity of the finished cylinder oil.

The base oils used for blending cylinder oils, such as Taro® Special HT 70 and Taro Special HT LS 40, are thoroughly tested. The results must pass Chevron's stringent quality requirements before receiving approval.

Apart from the base oils, a critical component of slow-speed engine cylinder oils is the additive package used. The main purposes of these additive packages are:

- Neutralizing acidic combustion by-products
- Providing detergency or cleaning effect
- Preventing deposit formation by keeping deposit precursors soluble in the oil (dispersant)
- Reducing friction and wear

A carefully selected combination of base oils and additives results in a high-performance slow-speed engine cylinder oil.

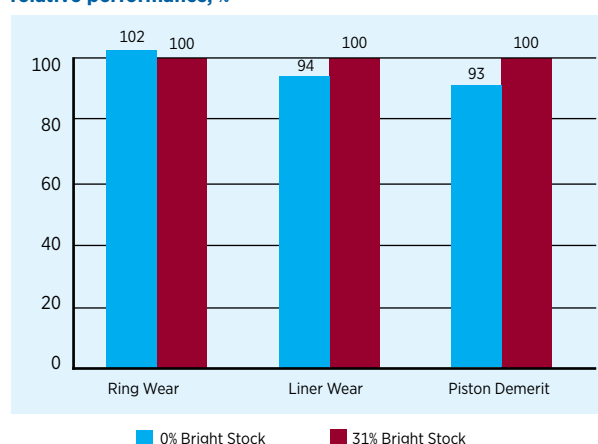
Solvent neutral oil versus bright stock

A laboratory engine test with slow-speed engine cylinder oils provided conclusive information on the effect of using different base oils. The corrosive wear test was conducted on two different cylinder oils containing 0% and 31% bright stock and exactly the same additive package. Three parameters were analyzed: ring wear, liner wear and piston cleanliness.

The results, displayed in Figure 1, show that when a good quality bright stock is selected, there are no performance differences between a fully formulated cylinder oil blended with solvent neutral oils plus bright stock, and the same cylinder oil with only solvent neutral oils. The differences shown are all within the tolerances of the engine test.

Conclusion

Figure 1: Corrosive wear test — Bolnes corrosive wear matrix, relative performance, %



Specially selected and tested highly refined, solvent-extracted bright stocks give at least equal performance in fully formulated slow-speed engine cylinder oils. ■



marine lubricants information bulletin 14

polyester-based synthetic refrigeration oils



Capella® HFC (polyolester) synthetic oil helps ship owners address environmental issues and regulations and minimize the number of different lubricating oils used onboard. Specifically developed for use with HFC (chlorine-free) refrigerants, such as R134a and R404a, Capella HFC exhibits excellent performance in HFC systems.

Application guidelines

Capella® HFC should only be used in systems designed to operate with chlorine-free refrigerants. When a ship's onboard refrigeration system is converted to an environmentally acceptable HFC refrigerant, the new system must use a synthetic polyolester-based compressor lubricant. Polyolesters are the best lubricant for HFC systems because they have low miscibility of the refrigerant, outstanding thermal stability, and excellent deposit control.

Do not use Capella HFC in compressors using conventional HFC and HCFC (chlorinated) refrigerants such as R12 and R22. Using the oil in these compressors can cause difficulties related to differences in the design of compressor systems.

Polyolester-based synthetic refrigeration oil can also be used in older compressors using conventional refrigerants. Using polyolester-based synthetic refrigeration oil in systems still using conventional

refrigerants, however, can increase the level of water in the lubricating oil. In time, this increase can lead to serious copper-plating problems and rapid oil degradation.

Additionally, compatibility with different sealing materials can be a problem because polyolester-type lubricants are hygroscopic and easily absorb moisture. To avoid moisture absorption, special filters/dryers are incorporated in systems designed for HFC refrigerant gases. For this reason, Capella HFC is supplied in small packages to avoid long storage time after the product is opened.

Refrigerating systems that convert HFC gases not only have to change to a polyolester-type lubricant, such as Capella HFC, but must also modify their filters/dryers, control devices and seals. Conversion of refrigerating systems to chlorine-free HFC refrigerants and systems should always be done in close cooperation with the system's manufacturer. ■



complete guide to delo® XLI corrosion inhibitor – concentrate



Section 1 provides instruction on using Delo® XLI Corrosion Inhibitor – Concentrate for the first time, or changing over the system from another cooling water treatment to Delo XLI Corrosion Inhibitor – Concentrate.

Section 2 provides guidelines for monitoring and recording important parameters of the cooling water treatment during service.

Section 1: Flushing and Changeover

Delo® XLI Corrosion Inhibitor – Concentrate (Delo XLI) is a high performance, readily biodegradable coolant based on Carboxylate technology which performs better than traditional coolants in terms of efficient heat transfer, increased corrosion protection, non-depletion and extended service life. Delo XLI offers protection for all commonly used materials in engine cooling water systems, including aluminium and copper.

Delo XLI is recommended for cooling water treatment operating below 100°C and is a concentrate that should be diluted in water. Before filling the engine with a 6–7.5% solution of Delo XLI in water, the existing fluid must be drained from the engine coolant system. Depending on the condition of the system, it may be necessary to thoroughly flush the system to remove loose deposits and precipitates.

Preferably, flushing is done with a 4.5–5% solution of Delo XLI in fresh water. Using Delo XLI for this process aids the removal of deposits and helps provide corrosion protection during and after the flushing operation. For new systems, a simple flush is usually sufficient to remove any cooling fluid and the few deposits present. In older systems, hard water scale, corrosion deposits, and precipitates from former water treatment chemicals are not removed by flushing only. **Depending on the nature and amount of the deposits, the engine must operate for some time to allow cleaning of the system by the standard 4.5–5% solution of Delo XLI.**

Delo XLI will gradually clean loose deposits and sludge from the system. These contaminants should be systematically removed by partial draining and skimming until the system is fully clean. Delo XLI has very low depletion rate in-service.

Supplemental additions of XLI should only be added to make up for losses from cooling water leakage.

The concentration levels of the coolant should be checked weekly using a refractometer. A hand held Delo XLI Refractometer can be ordered from your account manager.

The cooling water treatment must meet the requirements of the original engine manufacturer (OEM). Always check the guidelines.

Quality of fresh water*

We strongly recommend using distilled water or deionised water to dilute Delo XLI in engine cooling systems. If distilled water or deionised water is not available, use water that meets or exceeds the minimum acceptable water requirements listed below to minimize scale deposits:

PROPERTIES/CHARACTERISTIC	VALUE
Water type	Distillate or deionized freshwater
Prohibited	Sea water, river water, brines, industrial waste water, and rain water
Should not contain any	Chlorine, Sulphide, and Ammonia
Total hardness ($\text{CaCO}_3 + \text{MgCO}_3$), max, mg/kg	170
pH at 20°C	5.5–9.0
Chloride ion content (Cl^-), max, mg/kg	40
Sulphate content (SO_4^{2-}), max, mg/kg	100



General guidelines

1. Apply sufficient Delo® XLI in relation to your cooling system capacity.
2. Flushing and changeover operations must be completed in the presence of qualified ship staff.
3. If the vessel is equipped with an HT and LT circuit, it is advisable to change both systems one at a time.
4. When zinc anodes are installed in the fresh water system, it is advisable to remove them.
5. Check that the vessel is not using any biocide for jacket cooling water (JCW) treatment. If it is, please consult your Chevron representative.
6. The flushing operation should be conducted under safe conditions, such as using proper Personal Protection Equipment (PPE), testing correct functioning of expansion tank low level alarm and JCW circuit temperature sensors and gauges, making all affected ship staff aware of the operation, and any other steps which help ensure a safe flushing process.
7. It is preferable to perform draining at the lowest part of the cooling unit. This will remove deposits that might have originated anywhere in the system.
8. Take fluid samples before commencing the flushing operation (see page 3, "Taking Fluid Samples").
9. When changing from one coolant to another, first take a sample of the old existing coolant for analysis.

Flushing procedure for new engines

In new build engines, pipes and tanks may contain debris such as dust, rust and free moving particles and objects. It is vital to clean the cooling system of these before filling with Delo XLI.

1. Completely drain the cooling water system (hereafter referred to as "the system") and confirm that there is no cooling medium.
2. Preferably, fill the system with good quality fresh water* and add 4.5–5% solution of Delo XLI. (The percent of Delo XLI can be calculated using the formula in Figure 1 on page 3.)
3. Purge the system well.
- 4a. If the engine has a separate cooling water pump (e.g., 2-stroke slow speed engine), run the pump for 2–3 hours after the flushing solution has been heated to normal cooling water temperature.
- 4b. If the engine has an attached cooling water pump (generally the case with 4-stroke medium speed engines), run it at idle load or operate the engine in-service for sufficient time (generally one hour) after the flushing solution has been heated to the normal cooling water temperature.

5. Allow the system to cool down moderately to avoid thermal shocks and drain it completely.
6. Check the drain flushing fluid for deposits and precipitates.
7. Repeat steps 2 through 5 if the flushing fluid contains significant amounts of deposits or precipitates.
8. Check the cooling system filters (if present). Replace them when required.
9. Calculate the cooling water capacity, fill the system with good quality fresh water* and add chemical by 6–7.5% concentration. Maintain in-service levels for Delo XLI between 6–7.5%.

When using the expansion tank to dose the system, take care to circulate well and keep in mind that the changes in concentration will only be visible after a couple of days.

Flushing procedure for in-service engines while vessel is in dry-dock

1. Completely drain the system, if possible, and follow the steps listed under "Flushing procedure for new engines". **If it is not possible to completely drain the system, follow steps 2–10 below.**
2. Drain the system in a controlled manner by opening the bottom-most drain valve/cock, and concurrently filling the system with a solution of good quality fresh water*.
3. Continue step 2 until nitrite levels drop to 100 ppm (if nitrite-based treatment chemicals were in use) and drain as many contaminants as possible.
4. Add 4.5–5% solution of Delo XLI in fresh water. This will be flushing fluid. Purge the system.

During the last day of dry-dock, when main engines, auxiliary engines, boiler, etc. are running:

- 5a. If the engine has a separate cooling water pump (e.g., 2-stroke slow speed engine), run the pump for 2–3 hours after the flushing solution has been heated to normal cooling water temperature.
- 5b. If the engine has an attached cooling water pump (generally the case with 4-stroke medium speed engines), run it at idle speed or operate the engine in-service for sufficient time (generally one hour) after the flushing solution has been heated to the normal cooling water temperature.
6. Allow the system to cool down moderately to avoid thermal shocks. At this point it is preferable to drain the system completely, and if the flushing fluid contains significant amounts of deposits or precipitates, repeat Steps 2 through 6 until clear, then fill the system with good quality fresh water* and add Delo XLI to make Delo XLI concentration 6–7.5%. Maintain in-service levels for Delo XLI between 6–7.5%.

* Good quality fresh water: Water which is soft in nature, with low Chlorides (≤ 40 ppm) and pH+ (5.5–9.0). We generally advise using onboard generated water for this purpose; however, for new ships, please ask shipyard to provide good quality fresh water.



Figure 1: Calculating percent of Delo® XLI concentration

$$\% \text{ Delo XLI} = \frac{\text{Delo XLI (liters)}}{\text{Total fresh water in circuit (liters) + Delo XLI (liters)}} \times 100$$

Flushing procedure for in-service engines while vessel is en route

This procedure has been designed to changeover the system from another chemical treatment to Delo XLI while the vessel is en route. Ensure that the cooling water valves are in good working order prior to commencing this process, especially the fresh water filling valve(s) in the expansion tank and system drain valve.

In addition, it is advisable that all operations are executed under personal supervision of senior engineering staff.

Phase 1: Drain and fill in-service water to drop nitrite levels below 100 ppm

1. Because the changeover is taking place while equipment is in operation, it is advisable to drain the water slowly to avoid thermal shocks. If the Fresh Water Generator (FWG) is running, monitor the temperature closely to ensure there is no impact on the operation of the FWG.
2. Drain the system in a controlled manner by opening the bottom-most drain valve/cock, and concurrently filling the system with good quality fresh water to maintain system water level. Reduce the content of the nitrite treatment to 100 ppm (if nitrite-based treatment chemicals were in use) and drain as many contaminants as possible.
3. Always monitor the expansion tank level and continuously replenish the water at the same rate as it is drained.

4. Maintain the JCW temperatures at engine outlet as per recommendation of OEM (may require JCW heater).
5. Check any filters in the fresh water cooling circuit frequently. Keep the standby filters ready for use.
6. Monitor the expansion tank(s) water for contamination and drain sediments regularly from the bottom.

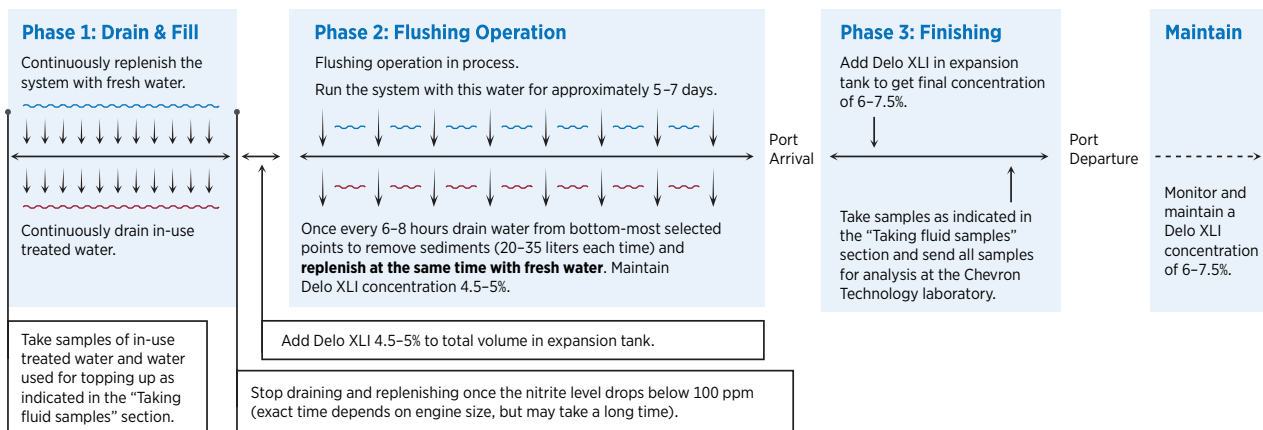
Phase 2: Flushing operation

7. Add Delo XLI to bring its concentration to 4.5–5%. The percent of Delo XLI can be calculated using the formula in Figure 1.
8. Every 6–8 hours drain 20–35 liters from the system to flush out any deposits.
9. Maintain Delo® XLI concentration of 4.5–5%.
10. Monitor the system for possible leaks. Delo XLI will clean any deposits and sludge from the system, hence it is possible to have minor leaks.
11. Pay extra attention to generator engine cooling, air compressor and other machinery cooling systems.
12. Continue this operation for 5–7 days or until the deposits have stopped coming out of the system.

Phase 3: Finishing

13. Increase the Delo XLI concentration to 6–7.5% and maintain at this level.

Figure 2: Changeover to Delo XLI for in-service engines while vessel is en route





Taking fluid samples

During the changeover process to Delo XLI, it is recommended the following samples are taken for analysis. Speak to your account manager about FAST™ trending and analysis services.

A. Before changeover procedure starts, take one sample (50–60 ml) each from:

- LT system at the circulation pump,
- LT system from central cooling water expansion tank,
- HT system at the circulation pump,
- HT system from jacket water expansion tank,
- Fresh water used for flushing and topping-up.

B. After changeover procedure is complete, take one sample (50–60 ml) each from:

- Fresh cooling water prepared and meant for filling the system,
- LT system at the circulation pump,
- LT system from central cooling water expansion tank,
- HT system at the circulation pump,
- HT system from jacket water expansion tank.

C. Send samples to the address indicated on the FAST sample kit.

Frequently asked questions

1. Does the whole system need to be drained and flushed before the filling water is treated with Delo XLI?

It would be good to take a sample and have it analyzed in the lab. That way we can determine the nitrite and it could be the reference sample for further trend analysis. Normally for a system treated by nitrite-based chemicals, drain the system as much as possible and confirm nitrite dropped below 100 ppm before introduction of Delo XLI.

2. What are the consequences of using Delo XLI as a top-up product for existing corrosion inhibitor system?

We do not advise adding Delo XLI to the existing product. This is due to the cleaning effect of Delo XLI and not because of compatibility issues or other factors, because flakes, sediment, and sludge might form. It is important to have detailed knowledge of the actual status of the cooling systems. Visual aspects and coolant analysis are very important in this respect.

3. What is the exact percentage of Delo XLI dosage in fresh water?

Depending on the quality of the top-up water, the Delo XLI concentration must be between 6–7.5%. Under no circumstances should it be lower than 5%.

4. Is flushing with water alone sufficient or must we use a Delo XLI solution in water?

In many cases, historical deposits and debris are present. It is recommended to have these efficiently removed. Therefore, it is better to flush with a 4.5–5% Delo XLI. The best result is obtained when Delo XLI is introduced in a running engine (hot flush).

5. What is the depletion rate of the product annually if the system has no leakage?

The product performs a minimum of 32,000 hours on condition that concentration was properly maintained, but more is possible depending on conditions. The corrosion inhibitors are long life, which means the depletion is limited. However, if the system is not clean, corrosion inhibitors from Delo XLI are partially consumed. This is why it is important to drain and flush the system.

6. How much Delo XLI dosage is required annually to maintain sufficient protection level if system has no leakages?

In good conditions without leakage, there is no need to add Delo XLI. After the system is flushed and filled with a 6–7.5% Delo XLI solution (minimum 5%), the protection level is sufficiently high. The concentration can be measured with a refractometer by the engine room crew.

7. Does Delo XLI react when it comes in contact with air in expansion tanks?

The product does not react with air. Nevertheless, it is important to exclude air from the cooling system to reduce/avoid corrosion.

8. Which tests are generally recommended to check and maintain the quality of treated water?

We recommend following tests:

- a. Delo XLI concentration — see Section 2, Part I.
- b. pH value — see Section 2, Part II.
- c. Chloride levels — see Section 2, Part III.

9. How do I maintain the test records?

Please refer to Section 2, Part IV for a monthly monitoring log. The comments provide a recommended range to maintain the parameters for each category.



Section 2: Monitoring and Recording

After a successful changeover to Delo® XLI, it is important to monitor and record the condition of the cooling water, and make maintenance adjustments as necessary.

Chevron recommended test frequency

Delo XLI concentration	Every week
pH and CI	Every two weeks
FAST™ analysis	Every system (HT/LT) every 6 months

Record the test results using the log sheet on page 11, or sign up for Chevron's FAST.XLI coolant monitoring program by emailing CMLtechservice@chevron.com.

Part I. Measuring Delo XLI Concentration with a Refractometer

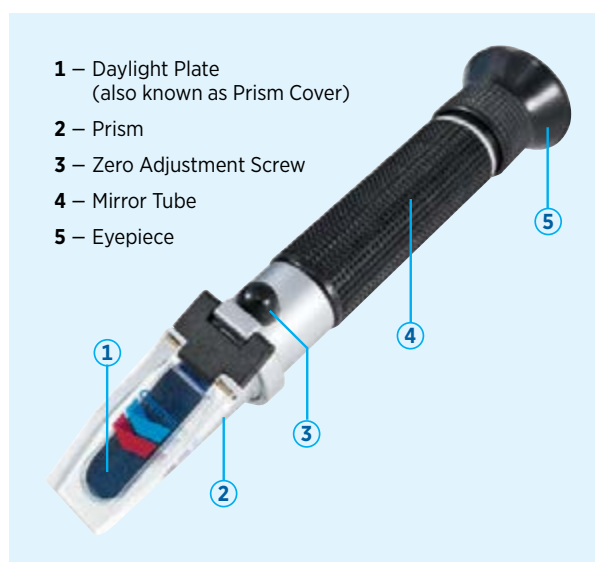
Read this user guide before using the refractometer, and keep it as a reference for future use. By following the guidelines highlighted here, you will extend the life of the refractometer and obtain the best measuring results, thereby enabling effective corrective actions to improve your operations. This user guide can also be used for refractometer models with minor differences (i.e., models with range of 0–5% Brix or with a self-correcting lens).

NOTE: Be sure that you are using a refractometer designed to measure % Brix. (Some types of refractometers are designed to measure concentration of ethylene glycol or battery fluid, with the scale in the prism surface showing either % by volume of antifreeze, freezing point in °C, or both. Using the wrong type of refractometer will yield invalid test results.)

The hand-held refractometer spot test is a quick method for determining the concentration of XLI in water. This method is easy to perform and does not require extensive sample handling or expensive equipment.

Summary

The refractive index of the solution (in % Brix) is measured by a hand-held refractometer. The reading is plotted on a calibration curve, from which the concentration of XLI is determined. Note that % Brix is NOT equal to % XLI — this is why the calibration curves must be used. Measure all solutions between 15–30°C.



Equipment

Refractometer: Brix 0–10% Item No. 2710

Procedure

1. Select the appropriate refractometer (Brix 0–10% Item No. 2710).
2. Ensure the prism surface and the plastic cover are clean. If not, clean them with distilled water and wipe dry with paper tissue. Do not immerse the refractometer in water.
3. Check the zero setting of the refractometer with water as described in Figure 3. Perform this operation prior to every set of measurements.



4. Check that the water sample temperature is between 15–30°C.
5. Hold the refractometer in a horizontal position.
6. With a clean pipette, place a few drops of the sample between the prism and daylight plate until the prism is completely covered with liquid. The liquid should not have bubbles.
7. Point the instrument toward a light source and look into the eyepiece. Keep the refractometer horizontal. Turn the eyepiece so that the scale is in sharp focus.
8. The Brix % reading is the dividing line where the boundary between light and dark (the edge of the shadow) crosses the scale.
9. If the edge of the shadow is not sharp, turn the eyepiece to bring the edge of the shadow into sharp focus. It is also possible that the edge of shadow is not sharp because the measuring surfaces were not sufficiently clean or dry, or an insufficient sample of coolant was used. Rinse the prism with distilled water, wipe dry and repeat the test.
10. The concentration of coolant can be derived from the conversion table shown in Figure 5.

Figure 3: Scale adjustment

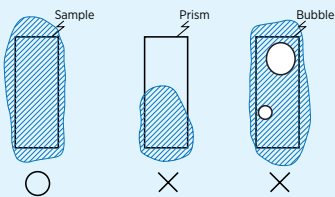
1. Open daylight plate and put a few drops of distilled water on the prism surface.



2. Close the daylight plate gently.



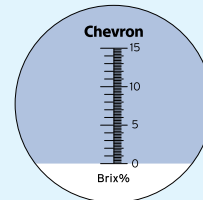
3. Water spreads all over the prism surface.



4. Look into eyepiece and turn it so that the scale is in sharp focus.



5. The boundary line must appear near the zero point.



6. Set boundary line at the zero point by turning Zero adjustment screw with a screwdriver.



7. After scale is adjusted, wipe water off the prism and daylight plate.



**Figure 4: Sample measurement**

1. Put a few drops of the sample on the prism.



2. Read the value of scale at the boundary line. Do not turn the Zero adjustment screw.



3. Wipe the sample off the prism and daylight plate with soft tissue paper, and clean them with water.

**Calculations**

In the absence of calibration curves, empirical calculation formulas can be used:

$$\% \text{ Delo XLI} = (\% \text{ Brix} - 0.0031) / 0.3695$$

(An estimation can be obtained using this formula:

$$\% \text{ XLI} = \% \text{ Brix} \times 2.7)$$

Precautions

1. The refractometer is a precision optical instrument. Handle it with care; avoid sudden impacts.
2. The prism is made of soft glass material. Take care not to scratch its surface.
3. After use, clean prism surface and daylight plate with a soft cloth soaked in water, and wipe off moisture with a dry cloth.
4. Best readings are obtained with a sample temperature of 15–30°C. Temperature correction is not required in this temperature range.

Figure 5: Conversion table of % Brix into % Delo® XLI

Brix % at 20°C refractometer	Vol % Delo XLI	Brix % at 20°C refractometer	Vol % Delo XLI
0.0	0.00	4.6	12.44
0.1	0.26	4.7	12.71
0.2	0.53	4.8	12.98
0.3	0.80	4.9	13.25
0.4	1.07	5.0	13.52
0.5	1.34	5.1	13.79
0.6	1.62	5.2	14.06
0.7	1.89	5.3	14.34
0.8	2.16	5.4	14.61
0.9	2.43	5.5	14.88
1.0	2.70	5.6	15.15
1.1	2.97	5.7	15.42
1.2	3.24	5.8	15.69
1.3	3.51	5.9	15.96
1.4	3.78	6.0	16.23
1.5	4.05	6.1	16.50
1.6	4.32	6.2	16.77
1.7	4.59	6.3	17.04
1.8	4.86	6.4	17.31
1.9	5.13	6.5	17.58
2.0	5.40	6.6	17.85
2.1	5.67	6.7	18.12
2.2	5.95	6.8	18.39
2.3	6.22	6.9	18.67
2.4	6.49	7.0	18.94
2.5	6.76	7.1	19.21
2.6	7.03	7.2	19.48
2.7	7.30	7.3	19.75
2.8	7.57	7.4	20.02
2.9	7.84	7.5	20.29
3.0	8.11	7.6	20.56
3.1	8.38	7.7	20.83
3.2	8.65	7.8	21.10
3.3	8.92	7.9	21.37
3.4	9.19	8.0	21.64
3.5	9.46	8.1	21.91
3.6	9.73	8.2	22.18
3.7	10.01	8.3	22.45
3.8	10.28	8.4	22.73
3.9	10.55	8.5	23.00
4.0	10.82	8.6	23.27
4.1	11.09	8.7	23.54
4.2	11.36	8.8	23.81
4.3	11.63	8.9	24.08
4.4	11.90	9.0	24.35
4.5	12.17		



Part II. Measuring pH Value

Delo® XLI's unique corrosion inhibitor system is designed to protect aluminum and other system metals at lower pH levels than conventional coolants.

For general pH testing, Chevron recommends acid and base indicator strips measuring a pH range of 1–14. To determine specific values of the jacket cooling water, Chevron recommends narrow range strips measuring a pH range of 5.5–9.0, just above and below pH 7.0 (neutral).

Contact your customer service agent to order CI and pH test strips.



Part III. Measuring Chloride Levels

Measurement and maintenance of chloride levels is necessary for optimal performance of the cooling water system. High chloride levels can significantly increase the risk of corrosion, and can also indicate sea water contamination in the cooling water system.

Chevron evaluated several commercially available chloride test strips, and recommends Hach® Quantab® titrators to measure the chloride content in cooling water treated with Delo XLI.



Recommended test strips: Hach Quantab titrators for chloride, 30–600 ppm (low range).



Summary

The test strips are specifically designed for measurement of chloride content in pure water, with accurate results in the range from 30 to 600 ppm.

In cooling water samples treated with Delo XLI the results are typically slightly higher than the actual chloride content in the solution; the higher the actual chloride level the bigger the deviation.

The test strips are a good way to determine if the chloride content in the cooling water is excessive (>100 ppm) and if so, further action may be required.

Note: The reading of the test strip is to be taken as soon as the upper band of the scale (initially yellow) turns black, indicating that the strip is completely saturated. Taking the readings later can lead to less accurate results.

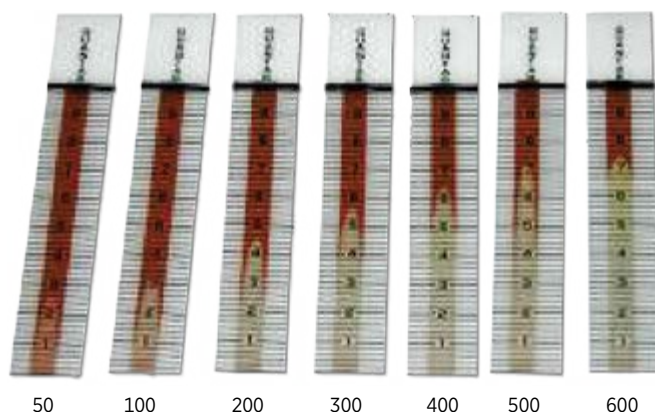
The test strips are not fit to measure the concentration of chloride in Delo XLI concentrate, since the liquid is too viscous to fully saturate the test strips. The amount of chloride in Delo XLI is low however, with minimal contribution to the total chloride content in the blended cooling water.

Note: The amount of chloride in Delo XLI is low, with minimal contribution to the total chloride content in the blended cooling water.

Other test methods

The Quantab test strips can be used to measure the chloride content in Delo XLI solutions. False results may occur if the test strips are exposed to other chemicals, leading to possible contamination. If further clarifications are required, a sample may be sent on shore for more accurate laboratory analysis, e.g., applying Ion Chromatography (IC).

Figure 6: Evaluation of Hach Quantab chloride test strips (7.5% Delo XLI in distilled water, tested with different chloride levels)



reference sample chloride content (ppm)	Quantab strip reading (units)	Quantab chloride content (ppm)
50	2.2	50
100	3.2	93
200	4.6	180
300	5.7	263
400	6.4	346
500	7.1	424
600	7.4	486



Part IV. Recording

Chevron recommends using the shipboard log sheet (on next page) two to three times a week to record the important parameters of your cooling water. A cloud-based system called the FAST.XLI Monitoring Program is also available; please contact your account manager for further details.

Figure 7 illustrates the limits and recommended corrective measures.

Figure 7: Cooling water treatment limits and comments

Appearance	Bright & Clear	Normal	Coolant is considered suitable for further service.
Appearance	Light Debris	Attention	Check system for rust and or water quality used for top up.
Appearance	Heavy Debris or Oil	Urgent	Drain and refill recommended.
pH	7.5–8.5	Normal	Coolant is considered suitable for further service.
pH	≥ 7.0 pH ≤ 7.4	Attention	Acidity is borderline. Follow up and use appropriate water at next top up.
pH	≥ 8.6 pH ≤ 9.0	Attention	Alkalinity is borderline. Follow up and use appropriate water at next top up.
pH	< 7.0	Urgent	Water is acidic. Drain and refill with correct dosage and adequate water to increase the pH as recommended to between 7.5–8.5.
pH	> 9.0	Urgent	Water is alkaline. Drain and refill with correct dosage and adequate water to reduce the pH as recommended to between 7.5–8.5. • Check: what was the last chemical used in the system and could this be interfering with the readings? • Check: what type of water was added to the system — shore (high in chlorides and/or pH) or technical water (distilled water, typically more acidic) produced onboard with the fresh water generator. • Check: what is the pH of the makeup water tank? For example: pH comes out at 9.7: 1. Repeat the test. 2. If the high value is confirmed, drain some water. 3. Add Delo® XLI with the new make up water and measure pH. 4. If ≤ 9.0: OK. 5. If higher than 9.0, repeat steps 2 and 3 until a pH of ≤ 9.0 is obtained pH comes out at 9.1: <i>Please check if the vessel just switched from competitive technology.</i> 1. If so, determine whether vessel had corrosion issues before switch. a. If not: closely monitor situation by sending samples to lab for analysis every 3 months. pH should drop after some time. b. If so: follow procedure above. 2. If not: drain and refill with the correct dosage of Delo XLI and adequate water.
Concentration Delo XLI	$> 6.0\%$ XLI $< 7.5\%$	Normal	Coolant is considered suitable for further service.
Concentration Delo XLI	$\geq 5.0\%$ XLI $\leq 6.0\%$	Attention	Delo XLI concentration required to be above 6%, please top-up the system with Delo XLI and bring the concentration above 6%.
Concentration Delo XLI	$\geq 7.5\%$	Attention	Our recommendation is to maintain Delo XLI concentration up to 7.5% for complete water care. Higher concentration will not harm the system.
Concentration Delo XLI	$< 5.0\%$	Urgent	Top-up the system with Delo XLI. Maintain Delo XLI concentration between $> 6.0\%$ and $< 7.5\%$. Monitor Delo XLI concentration whenever water replenishment is carried out.
Chloride	< 40 ppm	Normal	Coolant is considered suitable for further service.
Chloride	≥ 40 ppm Cl ≤ 100 ppm	Attention	Chloride content above normal levels. Drain the water from system and replenish with good quality water to reduce chloride level below 40 ppm. Look for causes of sea water ingress into the fresh water system and ensure no sea or desalinated water is used. Monitor chloride levels frequently.
Chloride	> 100 ppm	Urgent	Action is required. Too high chloride contamination in the system. Incorrect water is used. Drain the water from system and replenish with good quality water and Delo XLI to reduce chloride level below 40 ppm. Look for causes of sea water ingress into the fresh water system and ensure no sea or desalinated water is used. Monitor chloride levels frequently.



JACKET COOLING WATER TREATMENT PROGRAM

SHIPBOARD LOG SHEET

Ship's Name

Owner

Engine Make

Engine Model

Year Month

Type of ship

Makeup water

Shore

Distilled

Mixed

IMO No.

System Jacket HT

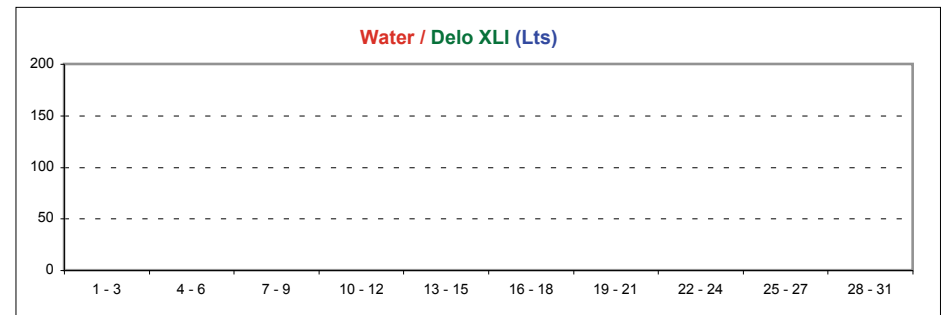
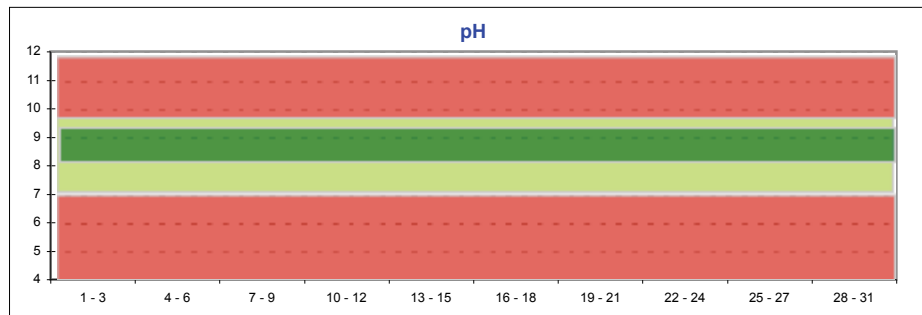
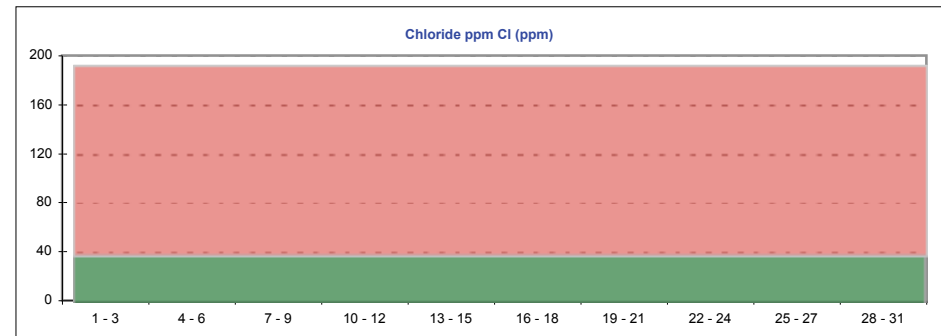
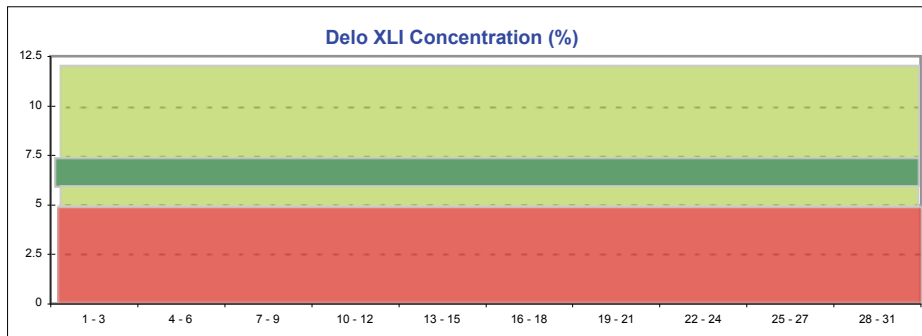
Jacket LT

Fuel Valves / Others

Others

Product –Delo® XLI

CAPACITY -	JACKET HT										
DATE	1 – 3	4 – 6	7 – 9	10 – 12	13 – 15	16 – 18	19 – 21	22 – 24	25 – 27	28 – 31	Summary
Delo XLI Concentration (%)											
Chloride ppm Cl (ppm)											
pH											
Delo added (ltr)											
Makeup water added (ltr)											



Comments :



Send fluid samples and direct technical enquiries to the below address:

Chevron Marine Lubricants – FAST Program
Contact: Warehouse Assistant

Chevron Technology Ghent
Marine Technology Team
Technologiepark – Zwijnaarde 88
B-9052 Ghent – Zwijnaarde, Belgium

Tel: +32 (9) 293 71 41

Email: cmltechservice@chevron.com



Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

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marine lubricants information bulletin 16

hydraulic fluid changeover procedure



When switching suppliers, the question often arises on how to best transition from one hydraulic fluid to another. Some hydraulic fluids are incompatible, and may cause foaming, filter plugging, poor water separability or other performance issues if mixed.

This Information Bulletin provides the following:

- Guidance on transitioning from one hydraulic fluid to another
- Brief descriptions of Chevron premium hydraulic fluids
 - Chevron Clarity® Synthetic (and non-synthetic) Hydraulic Oils AW
 - Chevron Rando® HD Premium Oil MV
 - Chevron Rando HDZ
- Recent Chevron compatibility testing

General guidelines for any fluid changeover to Chevron hydraulic oil products

- Always confirm the right product is used for the application.
- Follow OEM recommended lubricant flushing and change-out procedures, if available, including all relevant safety precautions.
- Properly dispose of used oil.
- With water-emulsifying hydraulic oils in a hydraulic system, we recommend following Procedure 1 as outlined below for both our Rando (HD and HDZ) and Clarity (Hydraulic and Synthetic Hydraulic Oils AW) product lines which are water-demulsifying oils and will not be compatible with these water-emulsifying hydraulic oils.

Guidelines for switching over to Chevron's ashless hydraulic oils

Clarity Hydraulic and Clarity Synthetic Hydraulic Oils AW are:

- Generally compatible with mineral oil/PAO based ashless hydraulic oils, but refer to the table below to confirm (if the product of interest is not listed, provide a sample of fresh and in-service fluid to be tested). Procedure 1 is the preferred recommendation for best performance results.
- Usually not compatible with water-demulsifying hydraulic oils containing calcium/zinc additives, but refer to the table below to confirm. Procedure 1 is the preferred recommendation for best performance results.
- Not compatible with water-emulsifying type products being used as hydraulic oils. Procedure 1 is the preferred recommendation for best performance results.

Our field experience has shown that in most cases, draining the hydraulic system of zinc/calcium containing hydraulic oil, and then charging the system with fresh Clarity Hydraulic or Synthetic Hydraulic Oil AW has resulted in no known performance issues (contamination at <5% level) (Procedure 2). However, in other cases, especially with old or contaminated in-service oil, foaming, filter plugging, or poor water



separability properties have been observed. Therefore, a thorough flushing and cleaning is recommended and Procedure 1 needs to be followed.

We do not recommend the practice of topping-off a system containing any zinc/calcium containing hydraulic oil with Clarity® Hydraulic AW or Clarity Synthetic Hydraulic Oil AW.

There may be a transition period needed to purge out the built-up sludge and deposits in the system. The length of this transition may depend on the amount of deposits formed previously. After the oil change-out, it is recommended to routinely monitor the hydraulic operation and filter life, closely monitor and evaluate the oil condition on a periodic basis to ensure proper performance, and take any corrective action that may be needed, including changing filters.

Procedure 1 — Drain and Flush

1. Operate the hydraulic system under normal operating temperature and conditions for minimum of 1 hour. Then shut the hydraulic system down. The lubricant in the system should be warm/hot when initiating the lubricant change.
2. Relieve all pressure in the system and disconnect all electrical power.
3. Drain the entire system as best as possible and try to include oil in all hoses and lines, hydraulic pump and motor, oil cooler, valves, reservoir, and filters. (Extreme caution should be exercised when draining hot lubricant to prevent possible injury.)
4. Thoroughly clean the hydraulic system if needed. Examine and replace all worn seals. Replace filters and strainers.
5. We then recommend the customer fill the system with Chevron Canopus® 13, or the replacement fluid, and run at minimum pressure with no-load condition for a determined length of time to clean, and flush the system. In some cases, a more viscous fluid, like Chevron Canopus 68 may be the preferred flushing oil.
6. Thoroughly drain the system as outlined in Step 3, rechecking filters for any contamination.
7. Refill the entire system to the correct level with fresh oil and operate system under normal operating conditions. An additional flush with the replacement fluid is recommended so that the new oil will be the lubricant being applied to the application when the operation re-starts to achieve the best performance results.

Procedure 2 – Drain and Fill

1. Operate the hydraulic system under normal operating temperature and conditions for minimum of 1 hour. Then shut the hydraulic system down. The lubricant in the system should be warm/hot when initiating the lubricant change.
2. Relieve all pressure in the system and disconnect all electrical power.
3. Drain the entire system (tank and reservoir) as best as possible and if desired for better performance include draining oil in the hoses, lines, hydraulic pump and motor, oil cooler, valves, reservoir, and filters. (Extreme caution should be exercised when draining hot lubricant to prevent possible injury.)
4. Thoroughly clean the hydraulic system if needed. Examine and replace all worn seals. Replace filters and strainers.
5. Refill the entire system to the correct level with fresh oil and operate system under normal operating conditions.

Chevron Clarity Synthetic Hydraulic Oils AW

Ashless, high viscosity index Clarity Synthetic Hydraulic Oils provide outstanding thermal, oxidation, and shear stability. Clarity provides hydraulic system energy efficiency. Clarity is also for systems operating in environmentally sensitive locations.

Chevron Rando® HD Premium Oil MV

Chevron Rando HD Premium Oil MV is an ISO 32 product with very high viscosity index (VI), beneficial for relatively extreme temperature swings and hydraulic system energy efficiency. Even after significant use, the VI of HD Premium Oil MV can remain higher than the starting (fresh oil) VI of other products. HD Premium Oil MV also contains a seal swell agent to help combat leakage. HD Premium Oil MV provides excellent thermal, oxidation, and shear stability as well. Rando HD Premium can be used where zinc anti-wear characteristics are preferred.

Chevron Rando HDZ Oils

Chevron Rando HDZ Oils also provide excellent thermal, oxidation, and shear stability, along with hydraulic system energy efficiency. Rando HDZ can be used where zinc anti-wear characteristics are preferred.

Do not use in high pressure systems in the vicinity of flames, sparks and hot surfaces.

For further information, please contact Chevron Technical Services at CMLtechservice@chevron.com ■

**Product Compatibility Table¹**

Chevron Replacement Product (all fresh oil unless noted)	Product to be replaced	Compatible? ¹
Chevron Clarity® Hydraulic Oil AW (fresh)	Citgo Dimension Hydraulic Fluid (fresh)	Yes
Chevron Clarity Hydraulic Oil AW 46 (fresh)	Castrol SHF 46 (fresh)	Yes
Chevron Clarity Hydraulic Oil AW 46 (fresh)	Citgo Dimension Hydraulic Fluid (fresh)	Yes
Chevron Clarity Synthetic Hydraulic Oil AW (fresh)	Chevron Rando HDZ (fresh)	No
Chevron Clarity Synthetic Hydraulic Oil AW (fresh)	Mobil DTE 10 Excel 32 (fresh)	No
Chevron Clarity Synthetic Hydraulic Oil AW 46 (fresh)	Shell Tellus EE 46 (fresh)	Yes
Chevron Clarity Synthetic Hydraulic Oil AW 46 (fresh)	Shell Tellus STX 46 (fresh)	Yes
Chevron Rando® HD Premium Oil MV (fresh)	Mobil SHC 524 (fresh)	Yes
Chevron Rando HDZ 15 (fresh)	Exxon Univis HVI 13 (fresh)	Yes
Chevron Rando HDZ 22 (fresh)	Mobilarma 522 (fresh)	Yes
Chevron Rando HDZ 32 (fresh)	Mobil DTE 10 Excel 32 (fresh)	Yes
Chevron Rando HDZ 32 (fresh)	Shell Tellus T 32 (fresh)	Yes
Chevron Rando HDZ 46 (fresh)	Chevron Hydraulic Oil 5606A (fresh)	Yes
Chevron Rando HDZ 46 (fresh)	Frontier Wear Guard AW 46 (fresh)	Yes
Chevron Rando HD 150 (fresh)	Chevron Regal R&O 150 (fresh)	No
Chevron Rando HD 22 (fresh)	Mobilarma 522 (fresh)	Yes ²
Chevron Rando HD 32 (fresh)	Shell Tellus T 32 (fresh)	No
Chevron Rando HD 32 (fresh)	Mobil DTE 10 Excel 32 (fresh)	Yes
Chevron Rando HD 46 (fresh)	Fuchs Renolin AF 46 (fresh)	No
Chevron Rando HD 46 (fresh)	Mobil DTE 25 (fresh)	Yes
Chevron Rando HD 68 (fresh)	76 Unax AW 68	Yes

1. Compatibility of fresh oils may be different than in-service oils. Contamination and aging of oils can make them incompatible. Reported results are based on ASTM D7155-06 "Standard Practice for Evaluating Compatibility of Mixtures of Turbine Lubricating Oils." The Tier 1 method compares the visual appearance of specific mixtures strictly for changes in physical appearance and the data are reported here. The Tier 2 method compares selected performance properties of specific mixtures and were not performed here. Please note that Chevron's compatibility testing is typically limited to appearance only (as described above for Tier 1 method) and that Chevron has not tested the performance properties of a mixture of the two products; Chevron has not utilized the Tier 2 testing method. Chevron has relied upon the information provided to make the recommendation set forth in this document. Chevron has not evaluated the particular operating environment or the specific application. The statement that two lubricants are compatible using the ASTM D 7155 Tier 1 method offers no information about the performance characteristics of either product or of mixtures of the products regarding wear prevention characteristics, load carrying capacity, sludge-formation tendency, the mechanical shear stability of lubricants mixtures while in service or any other measurable aspect of lubricant performance. When changing lubricants, it is essential that all equipment manufacturer recommended procedures be followed, including drain and flush requirements.

2. Although fresh Chevron product is visually compatible, we do not recommend using this product in place of Mobilarma 522.

The above table includes hydraulic oil compatibility testing since 2009. Even if products have been tested as compatible (by appearance), draining and flushing remains the preferred practice.



marine fuels information bulletin 1

ISO 8217: test methods — precision and interpretation



The International Organization for Standardization's (ISO's) 8217 standard lists the required specifications for marine fuel oils and the standard test methods used to assess them.

Most bunker fuel orders specify a fuel quality defined by ISO 8217 and many of Chevron's customers have their bunker fuel deliveries analyzed by an independent laboratory to comply with ISO 8217.

It is Chevron's policy to supply bunker fuels that comply with the specifications agreed upon when the order is accepted and confirmed. Our terms of sale state that only retain samples provided by/on behalf of Chevron at the time of bunkering are considered valid samples. However, a test analyzed by a customer's chosen lab on the customer's retain sample may fail a specification limit, while Chevron's retain sample analysis shows the product to meet specifications. How is this possible?

If the samples were properly taken and closely represent the quality of the fuel delivered, the answer is found in the ISO 8217 reference to the individual test methods to be used, and in the ISO 4259:2006 standard on the "determination and application of precision data in relation to methods of test." If the prescribed test method defined in ISO 8217 was not used by one of the two parties, that party should obtain the result using the prescribed test method before initiating any discussion.

The following question and answer format describes how to interpret a test method's precision and specification limit. Please see ISO 4259:2006 for additional information about the interpretation of test results.

Is every single test result the "true value?"

No, every single test result is only an approximation of the true value. The intrinsic limitations of the test result are determined by the precision of the test method. True value is the average of an infinite number of single test results obtained by an infinite number of laboratories and, therefore, cannot be exactly established.

What defines the precision of a test method?

For each test method "repeatability" and "reproducibility" values are defined and listed. Repeatability is the difference between consecutive test results obtained by the same operator using the same apparatus under constant operating conditions on identical test material. It is only relevant for the individual testing laboratory.

Reproducibility is the closeness of agreement between individual results obtained in the normal and correct operation of the same method on identical test material (different operator, different apparatus, and different laboratories).

How is test reproducibility used to judge the acceptability of two test results?

If the difference between two single test results (obtained with the same method in two different laboratories, for example, a supplier's test result and a customer's test result) is less than or equal to the reproducibility "R" of the test method, then both test results are considered acceptable. Their average value is considered the estimated value of the tested property.



Example 1: RMG 380 test — density determination

Lab 1: Density at 15°C, ISO 12185:1996: 991.4 kg/m³
 Lab 2: Density at 15°C, ISO 12185:1996: 990.2 kg/m³
 Listed reproducibility “R” of method ISO 12185:1996:
 R = 1.5 kg/m³

The difference between the two single test results, 991.4 kg/m³ – 990.2 kg/m³ = 1.2 kg/m³, is less than R. Hence, the average value of the two test results is considered the estimated value of the density: (991.4 kg/m³ + 990.2 kg/m³)/2 = 990.8 kg/m³

If the two results differ by more than R, both results are considered to be suspect and, in theory, each lab will then apply the procedures outlined in ISO 4259:2006. In practice, both parties will generally agree to accept the result obtained by a mutually selected third laboratory on a valid retain sample. In this case, it is important to ascertain that the third laboratory is using the prescribed test method and has accepted quality certificates.

Is it possible to estimate the product’s compliance to a specification limit when only one single test result is available?

Yes. ISO 4259:2006 includes supplier and customer guidelines to evaluate a product against a specification limit, using the customer’s single test result. It is assumed that:

- The sample used for the analysis is a valid retain sample.
- The laboratory has performed the test under the conditions fully prescribed by the test method.

How can a supplier make an evaluation of maximum specification limit when there is only a single test result which is smaller than the specification limit?

The supplier can consider, with 95% confidence, that his or her product meets a maximum specification limit (A1) if the test result $X \leq A1 - 0.59R$, where R is the reproducibility of the test method (see Example 2). If the supplier’s single test result X’ is such that $A1 - 0.59R < X' \leq A1$, then there is a calculated risk that the product would fail the specification limit during multiple testing.

Example 2: Supplier with a single test result for density

Case 1

Density specification limit (A1): 991.0 kg/m³ @ 15°C

R (test method ISO 12185:1996): 1.5 kg/m³

Single test result X available on a representative sample for delivery: 990.0 kg/m³ @ 15°C

It is 95% likely that this product will meet the specification limit upon multiple testing, because the condition $X \leq A1 - 0.59R$ is fulfilled.

(990.0 < 991.0 – 0.59 × 1.50 or 990.0 < 991.0 – 0.9 or 990.0 < 990.1)

Case 2

Density specification limit (A1): 991.0 kg/m³ @ 15°C

R (test method ISO 12185:1996): 1.5 kg/m³

Single test result X’ available on a representative sample for delivery: 990.5 kg/m³ @ 15°C

It is likely that this product would fail the specification limit during multiple testing because the condition $X' \leq A1 - 0.59R$ is not fulfilled.

(990.5 exceeds $A1 - 0.59R$ or 990.5 > 991.0 – 0.9 or 990.5 > 990)

How can a customer make an evaluation about a maximum specification limit when there is only one single test result which exceeds the specification limit?

The customer can consider, with 95% confidence, that a product will fail the maximum specification limit requirement upon multiple testing if the single test result $X > A1 + 0.59R$ (where A1 is the maximum limit and R is the reproducibility of the test method). If a customer’s single test result X’ meets the condition $A1 < X' \leq A1 + 0.59R$, there is a statistical chance that multiple testing would still show the product to be on spec.

Example 3: Customer with a single test result for density

Case 1

Density specification limit (A1): 991.0 kg/m³ @ 15°C.

R (test method ISO 12185:1996): 1.5 kg/m³

Single test result X available: 992.2 kg/m³ @ 15°C

It is 95% likely that the product will fail the specification limit upon multiple testing, because $X > A1 + 0.59R$.

(992.2 > 991.0 + 0.59 × 1.5 or 992.2 > 991.0 + 0.9 or 992.2 > 991.9)



Case 2

Density specification limit (A1): 991.0 kg/m³ @ 15°C.

R (test method ISO 12185:1996): 1.5 kg/m³

Single test result X' available: 991.4 kg/m³ @ 15°C.

The single test result exceeds the specification limit A1; however, because it is lower than A1 + 0.59R, multiple testing may still result in finding the density on spec ($A1 + 0.59R \geq X' > A1$).

($991.0 + 0.59 \times 1.5 > 991.4 > 991.0$ or $991.0 + 0.9 > 991.4 > 991.0$ or $991.9 > 991.4 > 991.0$)

For the evaluation of one single test result X with a minimum specification A2, the conditions applied by the supplier and customer are, respectively, $X \geq A2 + 0.59R$ and $X < A2 - 0.59R$.

Summary:

Test results deviate from the “true value”; this is inherent to all test methods. The precision statements are an integral part of every official test method and listed in the method. For more information, please see Appendix: Reproducibility of ISO 8217 or Equivalent IP/ASTM Test Methods. ■

Appendix: Reproducibility of ISO 8217 or Equivalent IP/ASTM Test Methods*

Acid number, mg KOH/g

ASTM D664

R (fresh oils) = 0.141 (x+1)

Where x is the average of the results being compared

Ash, %

ISO 6245

For ash content between 0.001 and 0.079 wt %:

R = 0.005

For ash content between 0.080 and 0.180 wt %:

R = 0.024

Ca, Zn, P, mg/kg

1. Ca

IP 501 (ICP) R = $0.6440x^{0.65}$

IP 470 (AAS) R = $1.139x^{0.8}$

2. Zn

IP 501 (ICP) R = $0.5082x^{0.7}$

IP 470 (AAS) R = $0.580x^{0.75}$

3. P

IP 501 (ICP) R = $1.2765x^{0.55}$

IP 500 (UV) R = $1.2103x^{0.4}$

Where x is the average of the results (mg/kg) being compared

Cat fines Al+Si, mg/kg

1. ISO 10478, IP 501

ICP detection:

Al: R = 0.337x

Si: R = 0.332x

Where x is the average of the results (mg/kg) being compared

2. IP 470

AAS detection:

Al: R = $0.789x^{0.67}$

Si: R = $1.388x^{0.67}$

Where x is the average of the results (mg/kg) being compared

CCAI (Calculated Carbon Aromaticity Index)

Precision (R) depends on the precision (R) of the density and viscosity of the residual fuel oil that enter into the calculation

Cetane index (4 variable equation)

ISO 4264

Precision depends on the precision of the original density and distillation recovery temperature calculations.

Cloud Point, °C

ISO 3015

For distillate fractions: R = 4°C

Density at 15°C, kg/m³

1. ISO 3675

For transparent, non viscous products:

R = 1.2 kg/m³ or 0.0012 kg/l

For opaque products: R = 1.5 kg/m³ or 0.0015 kg/l

2. ISO 12185

For transparent middle distillates:

R = 0.5 kg/m³ or 0.0005 kg/l

For crude oils and other petroleum products:

R = 1.5 kg/m³ or 0.0015 kg/l

FAME, volume %

IP 579

Procedure A: 0.05–3.00 volume %:

R = $0.0499x + 0.0231$

Procedure B: 3.0–20.0 volume %:

R = $0.0793x - 0.0413$

Where x is the average of the results being compared

Flash point, P.M., closed tester

ISO 2719

Procedure A (distillate fuels): R = 0.071x

Where x is the average of the results (°C) being compared

Procedure B (residual fuel oils): 6°C

* Edition of test methods as cited in ISO 8217:2017 paragraph 2. Normative references

**H₂S, mg/kg**

IP 570

Procedure A

Distillate and residual fuels: $R = 0.4459x^{0.55}$

Procedure B

Residual fuels: $R = 0.5232x^{0.6}$ Distillate fuels: $R = 0.2389x^{0.7}$

Where x is the average of the results being compared

Kinematic viscosity, mm²/s

ISO 3104

Heavy fuels: at 50°C: $R = 0.074x$ Distillate fuels: at 40°C: $R = 0.0082(x + 1)$

Where x is the average of the results being compared

Lubricity, µm

ISO 12156-1

 $R = 102$ **Micro carbon residue, mass %**

ISO 10370

 $R = x^{2/3} \times 0.2451$

Where x is the average of the results being compared

Micro carbon residue, on 10% volume distillation residue, mass %

ISO 10370

 $R = x^{0.5} \times 0.2125$

Where x is the average of the results being compared

Oxidation stability, g/m³

ISO 12205

 $R = 10.6(x/10)^{0.25}$

Where x is the average of the results being compared

Pour Point, °C

ISO 3016

 $R = 6.59^\circ\text{C}$ **Sodium, mg/kg**

1. IP 501 (ICP)

 $R = 1.0667x^{0.55}$

2. IP 470 (AAS)

 $R = 1.303x^{0.6}$

Where x is the average of the results being compared

Sulphur, mass %

1. ISO 8754

For values > 0.05 m/m % and ≤ 5.00 m/m %: $R = 0.0812(x + 0.15)$ for values ≥ 0.03 m/m % and ≤ 0.05 m/m %: $R = 0.1781(x + 0.05)$

Where x is the mean sulphur content

2. ISO 14596

For sulphur content in the range 0.03–0.0499 m/m %:

 $R = 0.005$

For sulphur content in the range 0.05–0.0099 m/m %:

 $R = 0.02$

For sulphur content in the range 0.10–0.99 m/m %:

 $R = 0.02$

For sulphur content in the range 1.00–2.50 m/m %:

 $R = 0.04$ **Total sediment aged, mass %**

ISO 10307-2

Heavy fuels: $R = 0.294\sqrt{x}$

Distillate fuels containing heavy components:

 $R = 0.174\sqrt{x}$

Where x is the average of the test results in % (m/m)

Total sediment by hot filtration, mass %

ISO 10307-1

Heavy fuels: $R = 0.294\sqrt{x}$

Distillate fuels containing heavy components:

 $R = 0.174\sqrt{x}$

Where x is the average of the test results in % (m/m)

Vanadium, mg/kg

1. ISO 14597

The method is applicable to products having V content in the range of 5 to 1000 mg/kg, although reproducibility data have only been determined up to 100 mg/kg for V

For V content between 5–30 mg/kg: $R = 5$ mg/kg

For V content between 31–100 mg/kg:

 $R = 10$ mg/kg

2. IP 501

 $R = 1.6799x^{0.6}$

Where x is the average of the results (mg/kg) being compared

3. IP 470

 $R = 3.26x^{0.5}$

Where x is the average of the results (mg/kg) being compared

Water, volume %

1. ISO 3733

Water collected between 0.0 and 1.0 ml:

 $R = 0.2$ ml

Water collected between 1.1 and 25 ml:

 $R = 0.2$ ml or 10% of mean, whichever is greater

2. IP 12937

 $R = x^{0.06877}$

Where x is the average of the results being compared



marine lubricants

global contact list





chevron marine lubricants

global contact list

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chevron marine lubricants

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Samples for FAST™ lubricant analysis services are to be sent to the following addresses

Inform the courier company that the receiver is 'Warehouse Assistant'.

Chevron Marine Lubricants — FAST Program

Chevron Technology Ghent
Technologiepark — Zwijnaarde 88
B-9052 Ghent/Zwijnaarde
Belgium
Tel: +32 9 2937141

Samples landed in **mainland China only** should be sent to our Shanghai laboratory:

Chevron Marine Lubricants — FAST Program

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Learning Resources

Scan this QR code to search our YouTube channel for Chevron Marine Lubricants videos on how to conduct safe and reliable lubricant tests, how to order marine lubricants online using the OnePort customer portal, and useful tips and resources.



Online Ordering

OnePort™
customer portal

Chevron's online portal makes lubricant procurement more efficient:

www.chevronmarineproducts.com

Visit our website chevronmarineproducts.com for more information.





one place for your lubrication needs

OnePort™
customer portal

Keep your business running smoothly with around-the-clock access to your orders and account information.

The OnePort™ customer portal has been designed with you in mind — its easy online access allows for a quick and simple process when ordering lubricants.

OnePort promotes efficiency and reduces order management time by eliminating unnecessary work from the lubricant procurement process. This in turn releases your valuable resources so you can focus on your core business activities. By improving product availability and visibility, the digital tool makes it easier for you to get what you need — anywhere in the world — whenever you need it.

OnePort is designed to make lubricant procurement more efficient — but rest assured, Chevron Marine Lubricants' world-class customer service representatives are always available globally to help you.

OnePort Benefits

- Multiple port and price enquiry
- Easy-to-use product selection
- Orders are linked to your recommended products
- Up to 5-port price comparison
- Quick order placement
- Local customer service representatives
- Improved communications with your Chevron customer service representative, reducing emails
- Summary of all orders in progress and status



everything you need at your fingertips

Digital order management

The launch of OnePort™ is a key part of Chevron Marine Lubricants' multi-year digitization investment program, delivering our customers peace of mind, wherever they are in the world. Using OnePort helps to lead your business to a brighter future by using a digital platform to keep your business running smoothly — we work hard, so you don't have to.

Quality

Here at Chevron, we pride ourselves on being an organization that provides quality and ease to our customers. That's why the OnePort system is easy to use — just contact your local Chevron representative for more information and get started today.

For more info, scan here to view our OnePort YouTube video:



Or visit chevronmarineproducts.com

