Welcome to the Marine Lubricants Pocketbook from Shell Marine. Shell has, over many years, developed a comprehensive portfolio of exceptional lubricants, many of which have multiple functions or specialised applications for the marine industry. This pocketbook is designed as a useful and quick reference for personnel responsible for engineering operations and maintenance in the marine sector. The pocketbook provides only a summary of Shell’s main lubricant grades at the time of printing and contains typical physical characteristics along with brief product and application descriptions.

Further details on Shell Marine lubricants and their applications can be obtained from your Shell Marine representative or visit www.shell.com/marine.
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MARINE DIESEL ENGINES

OIL REQUIREMENTS

SLOW-SPEED CROSSHEAD (2-STROKE)

Cylinder oil
- Protection from all effects of oil stress
- Combustion acid neutralisation
- Scuffing prevention
- Good film strength
- Piston, ring and scavenge port cleanliness
- Anti-wear properties
- SAE 50 and SAE 60

System oil
- Good film strength
- Resistance to corrosion
- Excellent crankcase cleaning effect
- Able to separate from water and insolubles by centrifuging
- Extreme pressure properties
- Rust and oxidation prevention
- Resistant to microbial degradation
- SAE 30

TRUNK PISTON (4-STROKE)

Crankcase
- Protection from all effects of oil stress
- Controls piston land and ring deposits to prevent ring sticking
- Resistance to corrosion
- Neutralises combustion acids
- Scuffing prevention
- Extreme pressure properties
- TBN retention and consumption control
- Excellent detergency effect
- SAE 30 and SAE 40

Classification of marine diesel engines

<table>
<thead>
<tr>
<th>Type</th>
<th>Slow speed (rpm)</th>
<th>Medium speed (rpm)</th>
<th>Medium to high speed (rpm)</th>
<th>High speed (rpm)</th>
</tr>
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<tbody>
<tr>
<td>Speed (rpm)</td>
<td>65–150</td>
<td>230–750</td>
<td>600–1,200</td>
<td>1,200–2,250</td>
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<td>Bore (mm)</td>
<td>260–1,000</td>
<td>300–650</td>
<td>200–400</td>
<td>100–200</td>
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</table>

SAE 50 and SAE 60
## Cylinder Oils

### Shell Alexia

#### Shell Alexia 25

A cylinder oil for use in low-speed, 2-stroke diesel engines burning ultra-low-sulphur fuel (0.1% sulphur), distillate fuels and liquefied natural gas. Shell Alexia 25 has been engineered to offer excellent cleanliness and protection for all engine types. Approved by MAN ES, MHI and WinGD (Wärtsilä).

#### Shell Alexia 40

A cylinder oil for low speed, 2-stroke diesel engines using very-low-sulphur fuel (0.5% sulphur) and ultra-low-sulphur fuel (0.1% sulphur), as specified by the engine makers. Approved by MAN ES, MHI and WinGD (Wärtsilä).

#### Shell Alexia 70

A cylinder oil for low-speed, 2-stroke diesel engines burning heavy fuel oil with up to 3.5% sulphur. Formally known as Shell Alexia 50. Approved by MAN ES, MHI and WinGD (Wärtsilä).

### Shell Alexia 100

A cylinder oil designed to offer enhanced protection in the more demanding low-speed, 2-stroke diesel engines burning high-sulphur fuel oil, 0.5% sulphur fuel (if needed for cleanliness), or a vessel with a scrubber. A cylinder oil developed to protect from cold corrosion and to reduce the cost of maintaining demanding engines. Optimised deposit control. Approved by MAN ES, MHI and WinGD (Wärtsilä).

### Shell Alexia 140

A cylinder oil designed for use under conditions of extreme oil stress requiring high alkalinity and detergency. It has been engineered to offer excellent performance for the most demanding 2-stroke diesel engines under challenging operational conditions and with high-sulphur fuels. It is also ideal for use in onboard cylinder oil mixing systems in combination with lower BN Shell Alexia cylinder oils or Shell Melina system oil.
CYLINDER OILS

Outstanding qualities

- Operational simplicity
- Outstanding neutralisation of combustion products
- Excellent piston ring and cylinder wear rates
- Superior deposit control

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>Viscosity index</th>
<th>BN, mg KOH/g</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
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</table>

Note: For detailed application advice based on your specific engine type and operating conditions, please refer to manufacturers’ guidelines.
SHELL MELINA S 30
A premium-quality SAE 30 system oil for crosshead engines that can also be used in many different items of marine equipment, such as certain gears and ancillary equipment, to rationalise the number of grades of lubricant carried on board ship.

Outstanding qualities
- Wear protection
- Engine cleanliness
- Multifunctional: stern tubes, gears and general
- Excellent crankcase cleaning effect
- Able to separate from water and insolubles by centrifuging

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
<th>Flash point, °C</th>
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<td>–18</td>
<td>888</td>
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</table>
MEDIUM-SPEED ENGINE OILS

SHELL ARGINA S
Shell Argina S2 30 (SAE 30, BN20)
Shell Argina S2 40 (SAE 40, BN20)
A multifunctional crankcase lubricant for highly rated medium-speed diesel engines operating on residual, blended or distillate fuels with sulphur content up to 2.0%.

Shell Argina S3 30 (SAE 30, BN30)
Shell Argina S3 40 (SAE 40, BN30)
Multifunctional crankcase lubricants for highly rated medium-speed diesel engines operating on residual fuel with sulphur content up to 3.0%.

Shell Argina S4 40 (SAE 40, BN40)
A multifunctional crankcase lubricant for highly rated medium-speed diesel engines operating under high-stress conditions and on residual fuel with sulphur content up to 2.0%.

Shell Argina S5 40 (SAE 40, BN55)
A multifunctional crankcase lubricant for highly rated medium-speed diesel engines operating under high-stress conditions and on residual fuel with sulphur content above 3.0%. Designed for the latest high-output, low-oil-consumption engines.
MEDIUM-SPEED ENGINE OILS

SHELL ARGINA S

- Optimised to resist oxidation and maintain BN to reduce the amount of oil sweetening that is required
- Very effective level of detergency leading to exceptionally clean crankcase, valve deck and pistons
- The formulation has been further optimised to reduce deposits in critical areas, e.g., piston undercrown.

- Well-balanced high-detergency/low-dispersancy formulation to effectively release contaminants and water in centrifugal separators
- The oils have a comprehensive range of engine manufacturers’ approvals.

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
<th>Flash point, °C</th>
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</table>
MEDIUM-SPEED ENGINE OILS

SHELL GADINIA S3 30 (SAE 30)
SHELL GADINIA S3 40 (SAE 40)
High quality, multifunctional diesel engine lubricants designed for the most severe service main propulsion and auxiliary marine trunk piston engines burning distillate, hybrid and biofuels with a sulphur content up to 1%.

- Optimised for use in non-engine applications like gearboxes, clutches, deck machinery and stern tubes
- Very high load carrying capacity (FZG Gear Machine) – Failure Load Stage 12 (ISO 1435-1 A/8.3/90)

- Improved cleanliness performance and enhanced lube oil consumption control
- Excellent wear protection
- Shell Gadinia S3 is approved by leading trunk piston engine manufacturers.

Shell Gadinia S3 has a comprehensive set of non-engine approvals, including from Simplex B&V; Ortlingshaus; Stromag; Reintjes; Renk, Rheine; Renk, Augsburg; Siemens/Flender;MAN Alpha (meets requirements); CLP requirement specification (meets requirements widely); and VDL requirements specification (meets requirements widely).

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
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<td>230</td>
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</tbody>
</table>
MEDIUM-SPEED ENGINE OILS

SHELL GADINIA AL 30 (SAE 30)
SHELL GADINIA AL 40 (SAE 40)

- Reduce lacquer
- Lower lubricant consumption
- Increased engine reliability

SHELL MYSELLA S3 N 40
A high-performance natural gas engine oil for lean-burn, spark-ignition 4-stroke engines requiring low-ash oil.

SHELL MYSELLA S5 N 40
The highest performance natural gas engine oil for use in highly rated spark-ignition 4-stroke engines requiring low ash oil. It is specially developed to provide extended drain oil intervals.

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>SAE engine viscosity grade</th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
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</table>
HIGH-SPEED DIESEL ENGINE OILS

MULTIGRADE OILS

SHELL RIMULA R4 X 15W-40  (USA, Shell Rotella T Triple Protection 15W-40)
SHELL RIMULA R4 L 15W-40 (LOW-SAPS)  (USA, Shell Rotella T3 15W-40)
SHELL RIMULA R6 M 10W-40 (SYNTHETIC)  (USA, Shell Rotella T6 5W-40)

High-performance engine oil for highly rated high-speed diesel engines that meet the latest API and ACEA specifications.

- Suitable for engines burning distillate fuels with a sulphur content of up to 1.0 %wt.
- Outstanding engine cleanliness
- Superior wear control
- Excellent oxidation resistance
## HIGH-SPEED DIESEL ENGINE OILS

<table>
<thead>
<tr>
<th></th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
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<tr>
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</table>
HIGH-SPEED DIESEL ENGINE OILS

MONOGRAGE OILS

SHELL RIMULA R3+ 30 (USA, Shell Rotella T1 30)
SHELL ROTELLA DD+ 40
SHELL SIRIUS X 40

Monograde heavy duty diesel engine oils.

Performance specifications

Typical specifications are API CF; ACEA E3-96; MB 228.3; MAN Diesel & Turbo 3275; Ruston; Wärtsilä; NSD; Volvo VDS-2; MTU approved (Type II high-performance category); CWEC approved (Cummins Wärtsilä Engine Company); MWM Deutz approved (high output, high speed, e.g., TBD 620); meets the requirements of Caterpillar 3600 Series.

<table>
<thead>
<tr>
<th>SAE engine viscosity grade</th>
<th>Viscosity, mm²/s</th>
<th>BN, mg KOH/g</th>
<th>Flash point, ºC</th>
<th>Pour point, ºC</th>
<th>Density at 15°C, kg/m³</th>
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<td>7.5</td>
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</table>
**ENVIROMENTALLY ACCEPTABLE LUBRICANTS**

**SHELL NATURELLE S4 STERN TUBE FLUID 100**
A non-emulsifying fluid made from fully saturated esters. Approved by the major stern tube and seal manufacturers. Designed to offer superior lubrication and resistance to hydrolysis. EU Ecolabel registered for VGP 2013 compliance.

**SHELL NATURELLE S4 GEAR FLUID**
A fully saturated ester based gear fluid for use in thrusters and propulsion drives, and certain stern tube designs. Superior load-carrying performance while maintaining biodegradability. EU Ecolabel registered for VGP 2013 compliance for Shell Naturelle S4 Gear Fluid 150 and complies with the VGP 2013 requirements for Shell Naturelle S4 Gear Fluid 68 and 100.

**SHELL NATURELLE HF-E**
A synthetic ester based advanced hydraulic fluid for use in applications requiring VGP compliance. Approved for use in major manufacturers’ stabilisers and controllable-pitch propellers, and holding ISO 15380 (HEES) and DIN 51524 part 2 and 3. EU Ecolabel registered for VGP 2013 compliance.

**SHELL NATURELLE GREASE S5 V120P**
An advanced biodegradable extreme-pressure grease for use in plain and roller bearings, and for general vessel lubrication. Approved by major rudder carrier manufacturers. EU Ecolabel registered for VGP 2013 compliance.

**SHELL NATURELLE S2 WIRE ROPE LUBRICANT A**
A high-performance fully biodegradable lubricant for use on wire ropes, cables and open gears offering high resistance to water wash-off while maintaining outstanding adhesion properties. Complies with the VGP 2013 requirements.
## ENVIRONMENTALLY ACCEPTABLE LUBRICANTS

<table>
<thead>
<tr>
<th>Base</th>
<th>NLGI</th>
<th>Average dropping point, °C</th>
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<td>Calcium</td>
<td>120</td>
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<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
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HYDRAULIC OILS

SHELL TELLUS S2 VX
High-performance hydraulic fluids providing outstanding protection and performance across a wide range of temperatures. They resist breakdown under heat or mechanical stress and are ideally suited to most equipment subjected to a wider range of ambient or operating temperatures where ISO HV hydraulic fluids are recommended.

SHELL TELLUS S3 M 46
A premium zinc-free anti-wear formulation used where ISO HM hydraulic oils are recommended.

SHELL TELLUS S4 VX 32
Advanced technology to meet the requirements of extremely low ambient temperature conditions.

AEROSHELL FLUID 41
Excellent low-temperature properties and super-clean levels.
## HYDRAULIC OILS

<table>
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<tr>
<th></th>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
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<td>SHELL TELLUS S2 VX 68</td>
<td>68</td>
<td>10.5</td>
<td>230</td>
<td>–30</td>
</tr>
<tr>
<td>SHELL TELLUS S2 VX 100</td>
<td>100</td>
<td>14.0</td>
<td>230</td>
<td>–30</td>
</tr>
<tr>
<td>SHELL TELLUS S3 M 46</td>
<td>46</td>
<td>6.8</td>
<td>220</td>
<td>–33</td>
</tr>
<tr>
<td>SHELL TELLUS S4 VX 32</td>
<td>33.8</td>
<td>9.9</td>
<td>&gt;100</td>
<td>–60</td>
</tr>
<tr>
<td>AEROSHELL FLUID 41</td>
<td>14.1</td>
<td>5.3</td>
<td>105</td>
<td>–60</td>
</tr>
</tbody>
</table>
GEAR OILS

MINERAL
SHELL OMALA S2 GX
High-quality, extreme-pressure (EP) oils for the lubrication of heavy-duty marine gearboxes. Their high load carrying capacity, protection against micropitting and compatibility with seals and paints combine to offer excellent performance in enclosed gear applications. (Specific grades are approved by Siemens AG for use in Flender, helical, bevel, planetary and marine gear units.)

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, ºC</th>
<th>Pour point, ºC</th>
<th>Density at 15ºC, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40ºC</td>
<td>100ºC</td>
<td></td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 68</td>
<td>68</td>
<td>8.7</td>
<td>&gt;230</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 100</td>
<td>100</td>
<td>11.3</td>
<td>&gt;230</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 150</td>
<td>150</td>
<td>14.8</td>
<td>&gt;240</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 220</td>
<td>220</td>
<td>19.0</td>
<td>&gt;240</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 320</td>
<td>320</td>
<td>24.2</td>
<td>250</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 460</td>
<td>460</td>
<td>30.6</td>
<td>&gt;250</td>
</tr>
<tr>
<td>SHELL OMALA S2 GX 680</td>
<td>680</td>
<td>42.1</td>
<td>&gt;250</td>
</tr>
</tbody>
</table>
GEAR OILS

SYNTHETIC

SHELL OMALA S4 GXV
Advanced synthetic heavy-duty marine gear oil offering outstanding viscosity index and low-temperature fluidity, low foaming tendency and extended compatibility with seals and paints.

SHELL OMALA S4 WE 220
An excellent anti-oxidation synthetic polyalkylene glycol gear lubricant for operating temperatures up to 200°C or steel-on-bronze applications.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHELL OMALA S4 GXV 150</td>
<td>150</td>
<td>22.0</td>
<td>240</td>
</tr>
<tr>
<td>SHELL OMALA S4 GXV 220</td>
<td>220</td>
<td>30.0</td>
<td>240</td>
</tr>
<tr>
<td>SHELL OMALA S4 GXV 320</td>
<td>320</td>
<td>37.0</td>
<td>240</td>
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<td>SHELL OMALA S4 WE 220</td>
<td>222</td>
<td>34.4</td>
<td>278</td>
</tr>
</tbody>
</table>
MINERAL

SHELL CORENA S2 P

Premium-quality mineral oils with excellent oxidation stability for use in reciprocating air compressors with discharge temperatures up to 220°C.

SYNTHETIC

SHELL CORENA S4 P

A high-performance synthetic lubricant for use in reciprocating air compressors operating under the severest conditions.

SHELL CORENA S4 R

A fully synthetic lubricant for use in oil-flooded screw or rotary vane air compressors. Shell Corena S4 R 68 meets the requirements of ABB for the VTR.4 type turbocharger 5,000-hour oil-drain interval and is approved by GEA Westfalia separators.

<table>
<thead>
<tr>
<th></th>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHELL CORENA S2 P 100</td>
<td>100</td>
<td>9.2</td>
<td>240</td>
<td>–33</td>
</tr>
<tr>
<td>SHELL CORENA S2 P 150</td>
<td>155</td>
<td>12.1</td>
<td>240</td>
<td>–30</td>
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<tr>
<td>SHELL CORENA S4 P 100</td>
<td>100</td>
<td>10.2</td>
<td>260</td>
<td>–39</td>
</tr>
<tr>
<td>SHELL CORENA S4 R 46</td>
<td>46</td>
<td>7.7</td>
<td>230</td>
<td>–45</td>
</tr>
<tr>
<td>SHELL CORENA S4 R 68</td>
<td>68</td>
<td>10.2</td>
<td>248</td>
<td>–45</td>
</tr>
</tbody>
</table>
REFRIGERATION OILS

SHELL REFRIGERATION OIL S4 FR-F
A polyol ester refrigeration oil for use with environmentally friendly HFC refrigerant gases R23, R134a, R404a, R410 and R507.

SHELL REFRIGERATION OIL S4 FR-V
A high-performance universal alkylated benzene refrigeration oil suitable for reciprocating, centrifugal and rotary compressors using R22 or R717 down to evaporator temperatures of –60°C.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, ºC</th>
<th>Pour point, ºC</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C 100°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHELL REFRIGERATION OIL S4 FR-F 32</td>
<td>31</td>
<td>6.0</td>
<td>&gt;220</td>
</tr>
<tr>
<td>SHELL REFRIGERATION OIL S4 FR-F 68</td>
<td>66</td>
<td>8.8</td>
<td>&gt;230</td>
</tr>
<tr>
<td>SHELL REFRIGERATION OIL S4 FR-F 100</td>
<td>94</td>
<td>10.7</td>
<td>&gt;230</td>
</tr>
<tr>
<td>SHELL REFRIGERATION OIL S4 FR-V 32</td>
<td>29</td>
<td>4.1</td>
<td>180</td>
</tr>
<tr>
<td>SHELL REFRIGERATION OIL S4 FR-V 68</td>
<td>68</td>
<td>6.2</td>
<td>190</td>
</tr>
</tbody>
</table>
GAS COMPRESSOR OILS

SHELL GAS COMPRESSOR OIL S4 PV 190
A versatile polyalkylene glycol cylinder lubricant for reciprocating compressors handling hydrocarbon and other gases.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>190</td>
<td>36.0</td>
<td>262</td>
<td>–30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,056</td>
</tr>
</tbody>
</table>

SHELL GAS COMPRESSOR OIL S4 PV 190
**BEARING AND CIRCULATING OILS**

**MINERAL**

**SHELL MORLINA S2 B 150**
A mineral bearing oil giving excellent water shedding and corrosion protection.

**SYNTHETIC**

**SHELL MORLINA S4 B**
A fully synthetic anti-wear bearing oil approved for Alfa Laval separators (ISO 220).

<table>
<thead>
<tr>
<th></th>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SHELL MORLINA S2 B 150</strong></td>
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<td>15.0</td>
<td>262</td>
<td>-15</td>
</tr>
<tr>
<td><strong>SHELL MORLINA S4 B 220</strong></td>
<td>220</td>
<td>28.0</td>
<td>275</td>
<td>-45</td>
</tr>
<tr>
<td><strong>SHELL MORLINA S4 B 320</strong></td>
<td>320</td>
<td>37.0</td>
<td>275</td>
<td>-45</td>
</tr>
<tr>
<td><strong>SHELL MORLINA S4 B 460</strong></td>
<td>460</td>
<td>51.0</td>
<td>275</td>
<td>-33</td>
</tr>
</tbody>
</table>
TURBINE OILS

SHELL TURBO T

Specialist oils that meet the demands of high-output steam turbines. Meets ISO 8068 L-TSA, L-TGA type B and DIN 51515 L-TD. Shell Turbo T 68 meets the requirements of ABB for VTR.4 type turbocharger 1,000 hour oil-drain interval.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, ºC</th>
<th>Pour point, ºC</th>
<th>Density at 15ºC, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHELL TURBO T 32</td>
<td>32</td>
<td>5.45</td>
<td>&gt;215</td>
</tr>
<tr>
<td>SHELL TURBO T 46</td>
<td>46</td>
<td>6.9</td>
<td>&gt;220</td>
</tr>
<tr>
<td>SHELL TURBO T 68</td>
<td>68</td>
<td>8.95</td>
<td>&gt;240</td>
</tr>
<tr>
<td>SHELL TURBO T 100</td>
<td>100</td>
<td>11.7</td>
<td>&gt;250</td>
</tr>
</tbody>
</table>

Excellent
- thermal stability
- demulsibility
- air release
- resistance to foaming
- rust and corrosion protection.
TRANSMISSION OILS

SHELL SPIRAX S4 ATF HDX
A superior-quality automatic transmission fluid suitable for heavy duty transmissions.

SHELL SPIRAX S4 TXM
A premium “universal transmission oil” designed for use in transmissions, hydraulic systems, oil-immersed brakes and other ancillary systems.

SHELL SPIRAX S3 AX 80W-90
A high-performance API GL-5 gear and axle oil for moderate to heavily loaded gear applications requiring SAE 80W-90 oil.

<table>
<thead>
<tr>
<th></th>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHELL SPIRAX S4 ATF HDX</td>
<td>33</td>
<td>7.2</td>
<td>152</td>
<td>–48</td>
</tr>
<tr>
<td>SHELL SPIRAX S4 TXM</td>
<td>60</td>
<td>9.4</td>
<td>220</td>
<td>–42</td>
</tr>
<tr>
<td>SHELL SPIRAX S3 AX 80W-90</td>
<td>169</td>
<td>16.8</td>
<td>220</td>
<td>–30</td>
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</tbody>
</table>
HEAT TRANSFER FLUID

SHELL HEAT TRANSFER OIL S2
A heat transfer fluid for use in indirect closed fluid heat transfer systems with bulk temperatures up to 320°C.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>5.1</td>
<td>208</td>
<td>-12</td>
</tr>
</tbody>
</table>

SHELL HEAT TRANSFER OIL S2
SHELL NAUTILUS PREMIUM OUTBOARD
A high-performance lubricant for superior protection of all gasoline outboard 2-stroke motors.
Approved to NMMA TC-W3.

<table>
<thead>
<tr>
<th>Viscosity, mm²/s</th>
<th>Flash point, °C</th>
<th>Pour point, °C</th>
<th>Density at 15°C, kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>7.0</td>
<td>70</td>
<td>–35</td>
</tr>
</tbody>
</table>
GREASES

SHELL GADUS S2 V220 0
Extreme-pressure grease for highly loaded centralised systems.

SHELL GADUS S2 V220 1
Extreme-pressure grease for highly loaded centralised systems.

SHELL GADUS S2 V220 2
High-viscosity base oil multipurpose grease for high loads.

SHELL GADUS S2 A320 2
Extreme-pressure grease withstands water washout while retaining protection.

SHELL GADUS S2 V220AD 2
High-viscosity base oil and mixed lithium–calcium thickener with molybdenum disulphate.

SHELL GADUS S2 V220AC 2
High-viscosity base oil and mixed lithium–calcium thickener.

SHELL GADUS S2 V100 3
General-purpose grease for use in large electric motors.

SHELL GADUS S3 HIGH SPEED COUPLING GREASE
Special grease for flexible gear couplings.

SHELL GADUS S3 V220C 2
High-viscosity base oil multipurpose grease for high loads.

SHELL GADUS S3 T220 2
Top-performing, high-temperature, extreme-pressure multipurpose grease.

SHELL GADUS S5 V100 2
Synthetic, lithium complex extreme-pressure grease with a wide operating temperature range.

SHELL GADUS S2 OG 40
Superior performance open-gear grease.

SHELL GADUS S2 OG 50
Superior performance open-gear grease.
<table>
<thead>
<tr>
<th>Product Code</th>
<th>Base</th>
<th>NLGI grade</th>
<th>Average dropping point, °C</th>
<th>Operating temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHELL GADUS S2 V220 0</td>
<td>Lithium</td>
<td>0</td>
<td>–</td>
<td>–20 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S2 V220 1</td>
<td>Lithium</td>
<td>1</td>
<td>180</td>
<td>–20 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S2 V220 2</td>
<td>Lithium</td>
<td>2</td>
<td>180</td>
<td>–20 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S2 A320 2</td>
<td>Calcium</td>
<td>2</td>
<td>85</td>
<td>–10 to +60</td>
</tr>
<tr>
<td>SHELL GADUS S2 V220AD 2</td>
<td>Lithium–calcium</td>
<td>2</td>
<td>175</td>
<td>–10 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S2 V220AC 2</td>
<td>Lithium–calcium</td>
<td>2</td>
<td>180</td>
<td>–20 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S2 V100 3</td>
<td>Lithium</td>
<td>3</td>
<td>180</td>
<td>–20 to +130</td>
</tr>
<tr>
<td>SHELL GADUS S3 HIGH SPEED COUPLING GREASE</td>
<td>Lithium</td>
<td>1</td>
<td>&gt;150</td>
<td>–30 to +120</td>
</tr>
<tr>
<td>SHELL GADUS S3 V220C 2</td>
<td>Lithium complex</td>
<td>2</td>
<td>240</td>
<td>–25 to +140</td>
</tr>
<tr>
<td>SHELL GADUS S3 T220 2</td>
<td>Diurea</td>
<td>2</td>
<td>260</td>
<td>–20 to +160</td>
</tr>
<tr>
<td>SHELL GADUS S5 V100 2</td>
<td>Lithium complex</td>
<td>2</td>
<td>260</td>
<td>–50 to +150</td>
</tr>
<tr>
<td>SHELL GADUS S2 OG 40</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>SHELL GADUS S2 OG 50</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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</tbody>
</table>
## GREASE COMPATIBILITY CHART

<table>
<thead>
<tr>
<th></th>
<th>ALUMINIUM COMPLEX</th>
<th>CALCIUM</th>
<th>CALCIUM COMPLEX</th>
<th>CLAY</th>
<th>LITHIUM</th>
<th>LITHIUM COMPLEX</th>
<th>POLYUREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALUMINIUM COMPLEX</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>CALCIUM</td>
<td>●</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>CALCIUM COMPLEX</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
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<td>CLAY</td>
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<td>–</td>
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<tr>
<td>LITHIUM</td>
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<td>●</td>
</tr>
<tr>
<td>LITHIUM COMPLEX</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>POLYUREA</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
</tr>
</tbody>
</table>

- **Compatible**
- **Borderline**
- **Incompatible**

This chart is a guide and testing may be required to assess compatibility.
Shell RLA is the oil condition monitoring service that helps you to keep your vessels running smoothly by identifying potential oil or equipment failures before they become critical. It acts as an early-warning system that aims to give you peace of mind knowing that your equipment and lubricants are in optimum working order.

The Shell RLA service is available to all Shell Marine customers worldwide.

Shell RLA offers the simplified test suites shown in the table overleaf. This arrangement provides good flexibility and enables you to select best test suites for your machinery:

- **Test** provides cost-effective condition monitoring tests for all vessel equipment types.
- **Check** test suites are suitable for most equipment with a medium impact of failure.
- **Check Plus** test suites offer advanced diagnosis at equipment level and an enhanced test sequence suitable for equipment that is critical to the safe operation of a vessel.
### SHELL RLA TEST SUITES

<table>
<thead>
<tr>
<th></th>
<th>Viscosity</th>
<th>TBN</th>
<th>TAN</th>
<th>Clean ISO 4406</th>
<th>Water</th>
<th>Flash point, °C</th>
<th>ICP</th>
<th>IC/DP/MD</th>
<th>WPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40°C</td>
<td>100°C</td>
<td></td>
<td></td>
<td>%vol</td>
<td>ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engine test</strong></td>
<td>✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Shaft test (1)</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔ (2)</td>
<td>✔</td>
</tr>
<tr>
<td><strong>System test</strong></td>
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<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
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<td></td>
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<tr>
<td><strong>Engine check</strong></td>
<td>✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Shaft check (1)</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔ (2)</td>
<td>✔</td>
</tr>
<tr>
<td><strong>System check</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fridge check (3)</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas engine check (4)</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td><strong>Turbine check</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔ (5)</td>
<td>✔</td>
</tr>
<tr>
<td><strong>EMD engine check</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔ (6)</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Cylinder check</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔ (7)</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Hydraulic check</strong></td>
<td>✔ ✔ ✔ ✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

(1) Also includes heptane insolubles; (2) ICP with nickel; (3) includes degas; (4) includes oxidation and nitration; (5) Ca in ppm; (6) Zn in ppm; (7) Zn and P in ppm
### SHELL RLA TEST SUITES CONT.

<table>
<thead>
<tr>
<th>Viscosity</th>
<th>TBN</th>
<th>TAN</th>
<th>Clean ISO 4406</th>
<th>Water %vol</th>
<th>ppm</th>
<th>Flash point, °C</th>
<th>ICP</th>
<th>IC/DP/MD</th>
<th>WPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100°C</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Gear check ✔ ✔ ✔ ✔ ✔
- Thruster check ✔ ✔ ✔ ✔ ✔
- Thermal check ✔ ✔ ✔ ✔ ✔
- Grease check ✔ ✔
- Engine check plus ✔ ✔ ✔ ✔ ✔
- System check plus ✔ ✔ ✔ ✔
- Hydraulics check plus (1) ✔ ✔ ✔ ✔
- Gear check plus (1) ✔ ✔ ✔ ✔
- Thruster check plus ✔ ✔ ✔ ✔
- NK stern tube test (8) (9) ✔ ✔ ✔

(1) Also includes heptane insolubles; (2) ICP with nickel; (3) includes degas; (4) includes oxidation and nitration; (5) Ca in ppm; (6) Zn in ppm; (7) Zn and P in ppm; (8) includes oxidation; (9) includes direct reading ferrography
SAE VISCOSITY CLASSIFICATIONS

Engine oils

The most widely used system for engine oil viscosity classification is that established by the Society of Automotive Engineers (SAE) in the USA. In this system, two series of viscosity grades are defined: those containing the letter W and those without the letter W.

Grades with the letter W are intended for use at lower temperatures and are based on a maximum low-temperature viscosity, a maximum borderline pumping temperature and a minimum viscosity at 100°C. Oils without the letter W, intended for use at higher temperatures, are based on their viscosity at 100°C only.

A “multigrade” oil satisfies the viscosity requirements of one of the W grades at low temperatures and one of the non-W grades at high temperatures.
# LUBRICANT VISCOSITY CLASSIFICATIONS

## SAE VISCOSITY GRADES FOR ENGINE OILS\(^{(1)}, (2)\) (J300–JAN2009)

<table>
<thead>
<tr>
<th>SAE viscosity grade</th>
<th>Low-temperature(^{(3)}) cranking viscosity (mPa·s)</th>
<th>Low temperature (°C) pumping viscosity(^{4}), mPa·s (^{4})</th>
<th>Low-shear-rate kinematic viscosity(^{5}), (mm(^{2})/s) at 100°C</th>
<th>High-shear-rate viscosity(^{6}), mPa·s at 150°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Max. with no yield stress</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>0W</td>
<td>6,200 at –35</td>
<td>60,000 at –40</td>
<td>3.8</td>
<td>–</td>
</tr>
<tr>
<td>5W</td>
<td>6,600 at –30</td>
<td>60,000 at –35</td>
<td>3.8</td>
<td>–</td>
</tr>
<tr>
<td>10W</td>
<td>7,000 at –25</td>
<td>60,000 at –30</td>
<td>4.1</td>
<td>–</td>
</tr>
<tr>
<td>15W</td>
<td>7,000 at –20</td>
<td>60,000 at –30</td>
<td>5.6</td>
<td>–</td>
</tr>
<tr>
<td>20W</td>
<td>9,500 at –15</td>
<td>60,000 at –20</td>
<td>5.6</td>
<td>–</td>
</tr>
<tr>
<td>25W</td>
<td>13,000 at –10</td>
<td>60,000 at –15</td>
<td>9.3</td>
<td>–</td>
</tr>
<tr>
<td>20</td>
<td>–</td>
<td>–</td>
<td>5.6</td>
<td>&lt;9.3</td>
</tr>
<tr>
<td>30</td>
<td>–</td>
<td>–</td>
<td>9.3</td>
<td>&lt;12.5</td>
</tr>
<tr>
<td>40</td>
<td>–</td>
<td>–</td>
<td>12.5</td>
<td>&lt;16.3</td>
</tr>
<tr>
<td>40</td>
<td>–</td>
<td>–</td>
<td>12.5</td>
<td>&lt;16.3</td>
</tr>
<tr>
<td>50</td>
<td>–</td>
<td>–</td>
<td>16.3</td>
<td>&lt;21.9</td>
</tr>
<tr>
<td>60</td>
<td>–</td>
<td>–</td>
<td>21.9</td>
<td>&lt;26.1</td>
</tr>
</tbody>
</table>

### Notes

1. 1 mPa·s = 1 cP; 1 mm\(^{2}\)/s = 1 cSt
2. All values, with the exception of the low-temperature cranking viscosity, are critical specifications, as defined by ASTM D3244\(^{(3)}\) [see text, Section 3]
3. ASTM D5293: Cranking viscosity – The non-critical specification protocol in ASTM D3244 shall be applied with a \(P\) value of 0.95.
4. ASTM D4684: Note the presence of any yield stress detectable by this method constitutes a failure regardless of viscosity.
5. ASTM D445
6. ASTM D4683, CEC L-36-A-90 (ASTM D4741) or ASTM D5481
LUBRICANT VISCOSITY CLASSIFICATIONS

AUTOMOTIVE GEAR LUBRICANTS

This classification is based on the lubricant viscosity measured at low and/or high temperatures. It should be noted that there is no relationship between the SAE engine oil and gear oil classifications. A gear lubricant and an engine oil having the same viscosity will have widely different SAE grade designations, as defined in the two classifications.

SAE J306 REVISED JUNE 2005 AUTOMOTIVE GEAR LUBRICANT VISCOSITY CLASSIFICATION

<table>
<thead>
<tr>
<th>SAE viscosity grade</th>
<th>Maximum temperature for viscosity of 150,000 cP, °C</th>
<th>Kinematic viscosity at 100°C, cSt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>70W</td>
<td>–55</td>
<td>4.1</td>
</tr>
<tr>
<td>75W</td>
<td>–40</td>
<td>4.1</td>
</tr>
<tr>
<td>80W</td>
<td>–26</td>
<td>7.0</td>
</tr>
<tr>
<td>85W</td>
<td>–12</td>
<td>11.0</td>
</tr>
<tr>
<td>80</td>
<td>–</td>
<td>7.0</td>
</tr>
<tr>
<td>85</td>
<td>–</td>
<td>11.0</td>
</tr>
<tr>
<td>90</td>
<td>–</td>
<td>13.5</td>
</tr>
<tr>
<td>110</td>
<td>–</td>
<td>18.5</td>
</tr>
<tr>
<td>140</td>
<td>–</td>
<td>24.0</td>
</tr>
<tr>
<td>190</td>
<td>–</td>
<td>32.5</td>
</tr>
<tr>
<td>250</td>
<td>–</td>
<td>41.0</td>
</tr>
</tbody>
</table>

Note: 1 cP = 1 mPa·s, 1 cSt = 1 mm²/s
ISO VISCOSITY CLASSIFICATION

The ISO viscosity classification uses centistoke (cSt) units and relates to the viscosity at 40°C. It consists of a series of 18 viscosity brackets between 1.98 and 1,650.0 cSt each of which is defined by a number. The numbers indicate, to the nearest whole number, the mid-points of their corresponding viscosity brackets.

<table>
<thead>
<tr>
<th>ISO viscosity grade</th>
<th>Mid-point viscosity at 40°C, cSt</th>
<th>Kinematic viscosity limits at 40°C, cSt</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO VG 2</td>
<td>2.2</td>
<td>1.98 - 2.42</td>
</tr>
<tr>
<td>ISO VG 3</td>
<td>3.2</td>
<td>2.88 - 3.52</td>
</tr>
<tr>
<td>ISO VG 5</td>
<td>4.6</td>
<td>4.14 - 5.06</td>
</tr>
<tr>
<td>ISO VG 7</td>
<td>6.8</td>
<td>6.12 - 7.48</td>
</tr>
<tr>
<td>ISO VG 10</td>
<td>10</td>
<td>9.00 - 11.00</td>
</tr>
<tr>
<td>ISO VG 15</td>
<td>15</td>
<td>13.50 - 16.50</td>
</tr>
<tr>
<td>ISO VG 22</td>
<td>22</td>
<td>19.80 - 24.20</td>
</tr>
<tr>
<td>ISO VG 32</td>
<td>32</td>
<td>28.80 - 35.20</td>
</tr>
<tr>
<td>ISO VG 46</td>
<td>46</td>
<td>41.40 - 50.60</td>
</tr>
<tr>
<td>ISO VG 68</td>
<td>68</td>
<td>61.20 - 74.80</td>
</tr>
<tr>
<td>ISO VG 100</td>
<td>100</td>
<td>90.00 - 110.00</td>
</tr>
<tr>
<td>ISO VG 150</td>
<td>150</td>
<td>135.00 - 165.00</td>
</tr>
<tr>
<td>ISO VG 220</td>
<td>220</td>
<td>198.00 - 242.00</td>
</tr>
<tr>
<td>ISO VG 320</td>
<td>320</td>
<td>288.00 - 352.00</td>
</tr>
<tr>
<td>ISO VG 460</td>
<td>460</td>
<td>414.00 - 506.00</td>
</tr>
<tr>
<td>ISO VG 680</td>
<td>680</td>
<td>612.00 - 748.00</td>
</tr>
<tr>
<td>ISO VG 1000</td>
<td>1,000</td>
<td>900.00 - 1,100.00</td>
</tr>
<tr>
<td>ISO VG 1500</td>
<td>1,500</td>
<td>1,350.00 - 1,650.00</td>
</tr>
</tbody>
</table>
LUBRICANT VISCOSITY CLASSIFICATIONS

NLGI GREASE CLASSIFICATION
The commonly used grease consistency classification is that established in the USA many years ago by the National Lubricating Grease Institute (NLGI). This classifies greases solely in terms of their hardness or softness; no other property or performance level is taken into consideration. The classification consists of a series of consistency ranges, each of which is defined by a number (or numbers) from 000 to 6. The consistency is defined by the distance in tenths of a millimetre that a standard cone penetrates a sample of the grease under standard conditions at 25°C.

<table>
<thead>
<tr>
<th>Grade No.</th>
<th>ASTM worked penetration at 25°C, dmm</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>445–475</td>
</tr>
<tr>
<td>00</td>
<td>400–430</td>
</tr>
<tr>
<td>0</td>
<td>355–385</td>
</tr>
<tr>
<td>1</td>
<td>310–340</td>
</tr>
<tr>
<td>2</td>
<td>265–295</td>
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<tr>
<td>3</td>
<td>220–250</td>
</tr>
<tr>
<td>4</td>
<td>175–205</td>
</tr>
<tr>
<td>5</td>
<td>130–160</td>
</tr>
<tr>
<td>6</td>
<td>85–115</td>
</tr>
</tbody>
</table>

AMERICAN GEAR MANUFACTURERS ASSOCIATION CLASSIFICATION
AGMA 250.04
Industrial enclosed gear drives

<table>
<thead>
<tr>
<th>AGMA lubricant No.</th>
<th>ISO viscosity grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td>2</td>
<td>68</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td>5</td>
<td>220</td>
</tr>
<tr>
<td>6</td>
<td>320</td>
</tr>
</tbody>
</table>
VISCOSITY COMPARISON CHART

Kinematic viscosities

Kinematic viscosity table

Saybolt viscosities

SUS at 210°F

SUS at 100°F

cSt at 40°C cSt at 100°C

ISO VG AGMA grade SAE crankcase SAE gear
# GLOSSARY

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>CHEMICAL ELEMENT</th>
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</thead>
<tbody>
<tr>
<td>Ag</td>
<td>Silver</td>
</tr>
<tr>
<td>Al</td>
<td>Aluminium</td>
</tr>
<tr>
<td>B</td>
<td>Boron</td>
</tr>
<tr>
<td>Ba</td>
<td>Barium</td>
</tr>
<tr>
<td>Ca</td>
<td>Calcium</td>
</tr>
<tr>
<td>Cr</td>
<td>Chrome</td>
</tr>
<tr>
<td>Cu</td>
<td>Copper</td>
</tr>
<tr>
<td>Fe</td>
<td>Iron</td>
</tr>
<tr>
<td>Mg</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Mn</td>
<td>Manganese</td>
</tr>
<tr>
<td>Ma</td>
<td>Molybdenum</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
<tr>
<td>Ni</td>
<td>Nickel</td>
</tr>
<tr>
<td>P</td>
<td>Phosphorous</td>
</tr>
<tr>
<td>K</td>
<td>Potassium</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>S</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Sb</td>
<td>Antimony</td>
</tr>
<tr>
<td>Si</td>
<td>Silicon</td>
</tr>
<tr>
<td>Sn</td>
<td>Tin</td>
</tr>
<tr>
<td>Ti</td>
<td>Titanium</td>
</tr>
<tr>
<td>V</td>
<td>Vanadium</td>
</tr>
<tr>
<td>Zn</td>
<td>Zinc</td>
</tr>
</tbody>
</table>
ABRASION
In gears, a type of wear caused when hard particles are trapped between the gear teeth.

ACID
Any substance capable of producing hydrogen ions in solution. An acid will be neutralised by a base.

ACIDITY
In lubricants, the acidity denotes the presence of acidic constituents whose concentration is usually defined in terms of an acid number.

ADDITIVE
A substance added to a lubricant to improve its properties or impart new characteristics.

AIR RELEASE
The ability of a fluid to allow the escape of air entrained within it. Anti-foaming additives are included in some lubricant formulations to suppress foam formation.

ANTI-SCUFFING ADDITIVE
An additive included in some lubricant formulations that is absorbed on to metal surfaces to prevent direct metal-to-metal contact.

ANTI-WEAR ADDITIVE
An additive included in some lubricant formulations to reduce friction and wear.

APPARENT VISCOSITY (OF A GREASE)
The observed viscosity of a grease that varies with both temperature and flow rate.

AROMATIC
An organic chemical compound built mainly of carbon and hydrogen atoms, and containing one or more rings of carbon atoms in which there are some double bonds between adjacent carbon atoms.

ASPHALTENE
Large and complex chemical compounds in which sulphur, nitrogen, vanadium and nickel are built into aromatic structures. They occur predominantly in heavy residues such as residual fuel and bitumen.
ASH
Some additives, particularly metallic detergent additives, leave behind a powdery residue after combustion. This residue is known as ash and it can cause engine malfunction if allowed to build up in the combustion chamber.

ASH (SULPHATED)
The ash content of an oil, determined by charring the oil and breaking down the residue with sulphuric acid and evaporating to dryness. Expressed as percentage by mass.

B
BASE STOCK (BASE OIL)
Refined petroleum oil used in the production of lubricants and other products. The base stock may be used alone or blended with other base stocks and/or additives to manufacture a finished lubricant.

BIODEGRADABILITY
The capacity of a substance to be broken down by the biological action of living organisms.

BLEEDING
Separation of oil from grease. Some bleeding is desirable because it provides continuous oil lubrication to bearings.

BORE POLISHING
A condition that may occur in the cylinders of turbocharged engines when the cylinder walls appear highly polished. Bore polishing often leads to an increase in oil consumption and wear, and to a decrease in engine efficiency.

BOUNDARY LUBRICATION
A lubrication regime in which the film of lubricant is so thin that surface-to-surface contact takes place over a large area and the load is carried by a very thin film of lubricant.

C
CALCIUM BASE GREASE
A grease made from a lubrication fluid thickened with calcium soap. Calcium base grease is highly resistant to water but unstable at high temperatures.
CALCULATED CARBON AROMATICITY INDEX (CCAI)
The CCAI is a number calculated from an empirical formula indicating the ignition quality of a residual fuel. Only the fuel’s density and viscosity are required. The formula was derived by Shell Research. The higher the CCAI value, the worse the ignition quality.

CARBON RESIDUE
Coked materials remaining after an oil has been exposed to high temperatures under controlled conditions.

CAVITATION
The formation of pockets of air or vapour in a fluid when the pressure on the fluid is reduced.

CCAI
See calculated carbon aromaticity index.

CETANE INDEX
Cetane index is used as a substitute for the cetane number of diesel or distillate fuel. The cetane index is calculated based on the fuel’s density and distillation range and is a measurement of the combustion quality of diesel fuel during compression ignition.

COMPATIBILITY
The ability of substances to exist together without damaging each other.

CORROSION INHIBITOR
An additive included in some lubricant formulations to help the lubricant protect against corrosion.

DEMULSIFICATION
The separation of an emulsion into its component liquids.

DENSITY
Mass per unit volume. Standard units are kilogrammes per cubic metre (kg/m³) or grammes per cubic centimetre (g/cm³).

DETERGENT
An additive included in most engine oil formulations to inhibit deposit formation and protect the lubricated surfaces.
DEW POINT
The temperature at which water vapour starts to condense.

DISPENSABILITY
The property of a grease that governs the ease with which it may be transferred from its container to its point of application.

DISPERSANT
An additive included in some lubricant formulations to hold insoluble contaminants in suspension.

DISTILLATE
Any product obtained by condensing the vapours distilled from a refining process.

DROPPING POINT
Lowest temperature at which a grease is sufficiently fluid to drip, as determined by test method ASTM D566 or ASTM D2265. This test helps determine whether a grease will flow or not from a bearing at the operating temperature.

DYNAMIC VISCOSITY
The viscosity of a fluid defined as the shear stress (the force causing movement between adjacent layers of fluid) divided by the rate of shear (the difference in speed between adjacent layers of fluid).

ENGINE DEPOSITS
Accumulations of sludge, varnish and carbonaceous residues caused by blow-by of unburned and partially burned fuel, or from partial breakdown of the crankcase lubricant. Water from the condensation of combustion products, carbon, residues from fuel or lubricating oil additives, dust and metal particles also contribute.

EMULSIFICATION
The forming of an emulsion.

EXTREME PRESSURE (EP) ADDITIVE
An additive included in some lubricant formulations to provide extra protection against wear. Under heavy loads, EP additives form a protective chemical film on the surfaces in contact.
F

FILM STRENGTH
The ability of a film of oil or grease to resist rupture due to load, speed, temperature or shock loading.

FILTERABILITY
The ability of a liquid to pass freely through a filter without clogging it.

FLAMMABILITY
How easily something can be ignited and burned.

FLASH POINT
The lowest temperature of a liquid at which the vapour above the liquid can be ignited by an open flame.

FRICION
The force that resists relative movement between two surfaces in contact.

FUEL INJECTION
The introduction of fuel under pressure directly into the cylinders of an internal combustion engine.

FZG GEAR TEST RIG
A method for determining the load carrying capacity of lubricants. Calibrated spur gears are operated at fixed speeds and controlled initial oil temperatures for 15-min stages. The load on the gear teeth is increased at each stage. Lubricant performance is judged by the number of stages run up to a defined weight loss of the test gears or visual assessment of damage to the tooth flanks. The maximum number of stages is 12.

G

GRAVITY
For petroleum products only, the mass/volume relationship expressed as

Specific gravity = \frac{\text{mass/unit volume product at } 60^\circ\text{F}}{\text{mass/unit volume water at } 60^\circ\text{F}}

API gravity = \left( \frac{141.5}{\text{specific gravity at } 60^\circ\text{F}} \right)^{-131.5}
GREASE
A lubricant with a semi-solid consistency produced by dispersing a thickening agent in a base oil.

HIGH VISCOSITY INDEX (HVI)
An HVI oil is one having a viscosity index of between about 85 and 115.

HYDROCARBONS
Chemical compounds that consist entirely of carbon and hydrogen. They form the basic components of all fuels and lubricants derived from petroleum.

HYDRODYNAMIC LUBRICATION
The lubrication regime that provides the best lubricating conditions and exists when two moving surfaces are completely separated by a relatively thick film of lubricant.

IMMISCIBLE
Incapable of being mixed to form a homogeneous fluid (or mixture), e.g., oil plus water.

INCOMPATIBILITY
Incompatibility occurs when a mixture of two lubricants results in physical properties or performance being markedly inferior to those of both individual products. Performance or properties inferior to one of the products but superior to the other may be due to simple mixing and is not considered evidence of incompatibility.

INHIBITOR
A substance that is added in a small proportion to a lubricant to prevent or retard undesirable changes in the quality of the lubricant or in the condition of the equipment in which the lubricant is used.

INSOLUBLES
Contaminants found in used oils such as dust, dirt, wear particles and/or oxidation products, which are often measured as pentane or benzene insolubles to distinguish the different types of insoluble matter.
ISO 8217
The international standard Petroleum products – Fuels (Class F) – Specification for marine fuels defines a range of fuel grades that meet the requirements for marine fuels supplied on a worldwide basis for consumption on board ships. The standard sets out the required properties of the fuels at the time and place of custody transfer. The current version of the standard was published in 2012.

ISO VISCOSITY GRADE (ISO 3104)
A measure of the viscosity of a lubricant at 40°C, as specified in the viscosity grading system laid down by International Standards Organization.

KINEMATIC VISCOSITY
A definition of viscosity commonly used by lubricant manufacturers. It is equal to the dynamic viscosity of a liquid divided by its density.

L
LACQUER
A hard, shiny, transparent surface coating usually found in engines and derived from the breakdown products of fuel and lubricant.

LITHIUM BASE GREASE
A product prepared from a lubricating fluid thickened with lithium soap. Lithium base grease resists both heat and moisture.

LOW VISCOSITY INDEX (LVI)
Low viscosity index oils have a viscosity index of less than about 30.

M
MECHANICAL STABILITY
The ability of a grease to resist structural breakdown when mechanically worked.

MINERAL OIL
Oil derived from fractionating and purifying crude oil.
Glossary

**MISCIBLE**
Descriptive of substances, usually liquids, that mix together to form a homogeneous fluid.

**MIXED BASE GREASE (MIXED SOAP GREASE)**
A grease made by co-crystallisation of two or more metallic soaps, usually lithium and calcium.

**MONOGRADE**
An oil with a viscosity that satisfies the requirements of only one grade of the SAE grading system.

**MULTIGRADE**
A term used to describe an oil for which the viscosity/temperature characteristics are such that its low- and high-temperature viscosities fall within the limits of two different SAE grades.

**N**

**NAPHTHENIC BASE STOCK**
A type of base stock prepared from naphthenic crudes containing a high percentage of ring-type asphaltic hydrocarbons. They are characterised by high specific gravity and a low viscosity index.

**NITRATION**
The process whereby nitrogen oxides attack petroleum fluids at high temperature, often resulting in viscosity increases and deposit formation.

**NLGI NUMBER**
A numerical scale for classifying the consistency or stiffness range of lubricating greases.

**NON-SOAP THICKENER**
A substance such as clay, silica gel, carbon black or any of several specially treated or synthetic materials that can be either thermally or mechanically dispersed in liquid lubricants to form lubricating grease. Also called synthetic thickener. Certain types are called inorganic thickeners.

**O**

**OIL-IMMERSED BRAKES**
An automotive braking system installed in the vehicle gearbox or rear axle rather than at the wheels.
Glossary

OIL MIST LUBRICATION
A system of lubrication used in some gearboxes in which the lubricant is atomised and sprayed into the gearbox in a stream of dry compressed air.

OIL SEPARATION
In greases, the separation of the base oil from the thickener.

OXIDATION STABILITY
The ability of a chemical to resist chemical breakdown by the action of oxygen.

PENETRATION
A measure of the consistency (hardness) of a grease. All penetration measurements are on an inverse scale to consistency, i.e., the softer the consistency, the higher the penetration number.

PITTING
In gears, a type of wear in which cracks develop in gear teeth because of metal fatigue caused by overloading.

POLYALPHAOLEFIN (PAO)
A synthetic hydrocarbon with a defined molecular structure. Their low- and high-temperature and viscosity-temperature characteristics are better than for mineral oils.

POLYMER
A chemical compound of large molecular size that is built up from numerous smaller molecules linked together.

POUR POINT
The lowest temperature at which an oil will just flow.

POUR POINT DEPRESSANT
An additive included in some lubricant formulations to minimise the tendency of an oil to congeal when it is cooled.

PUMPABILITY
The characteristic of an oil or grease that ensures satisfactory flow to and from the engine oil pump and subsequent lubrication of moving components.
REFINING
A series of processes for converting crude oil to finished petroleum products, including thermal cracking, catalytic cracking, polymerisation, alkylation, reforming hydrocracking, hydroforming, hydrogenation, hydrogen treating, solvent extraction, dewaxing, deoiling, acid treating, clay filtration and deasphalting.

RESIDUAL FUEL OIL
Very heavy fuel oils produced from the residue of the fractional distillation process rather than from the distilled fractions. This is a term for fuel oil mainly comprising the residues remaining after refining crude oil. Shell marine residual fuels oils are called Shell MFO.

RING STICKING
The situation when the piston grooves become sufficiently full of deposits to prevent the piston rings from moving freely.

RUST INHIBITOR
An additive in some lubricant formulations to restrict rust formation on lubricated surfaces.

SAE SYSTEM
A system devised by the Society of Automotive Engineers for classifying engine and automotive gear lubricants according primarily to their viscosity.

SAPONIFICATION
The chemical conversion of a fatty acid and base or alkali into a soap. A common process in grease manufacture.

SCUFFING
In gears, a type of wear which develops when direct metal-to-metal contact takes place between gear teeth.

SHEAR STABILITY
The ability of a liquid to resist being degraded by mechanical shearing forces. Also refers to the ability of a grease to resist changes in consistency.

SILICONE
A complex synthetic polymer composed of repeated silicon containing units and often used where a chemically inert lubricant is required.
SLUDGE
A black sooty deposit that usually forms in engines as a result of oil oxidation and ineffective dispersancy.

SOAP
A compound formed by the reaction between a metal hydroxide (such as lime) and a fatty acid (an organic acid derived from natural fats), e.g., lithium, calcium soaps in grease.

SODIUM BASE GREASE (SODA GREASE)
A grease prepared from a lubricating fluid thickened with sodium soap, stable at high temperatures but washing out in moist conditions.

SOLID LUBRICANT
Any class of lubricants in which the reduction of friction and wear during sliding is caused by making the shearing take place within the crystal structure of a material with low shear strength in one particular plane. Examples include graphite, molybdenum disulphide and certain soaps. Lubricating grease is not a solid lubricant, but may contain solid lubricants as additives.

SOLVENT EXTRACTION
Refining process used to separate reactive components (unsaturated hydrocarbons) from lubricant distillates to improve the oxidation stability, viscosity index and response to additives.

SPARK IGNITION
The system of ignition used in a petrol engine whereby a fuel–air mixture is ignited by an electric spark.

SPECTROGRAPHIC OIL ANALYSIS
A sophisticated analytical technique for determining the types and quantities of elements in an oil sample.

SPASH LUBRICATION
A system of lubrication in which a machine part travels through an oil bath and, in so doing, splashes lubricant onto nearby surfaces requiring lubrication.

SPRAY LUBRICATION
A system of lubrication in which the lubricant is sprayed directly on to the surfaces to be lubricated.
STABILISER
An additive that may be included in some grease formulations to ensure that the base oil and the thickener form a stable mixture with uniform composition.

STATIC FRICTION
The force that tends to prevent one body sliding over another.

SYNTHETIC
Produced artificially rather than occurring naturally.

T

TACKINESS ADDITIVE
An additive that may be included in the formulation of lubricants for slideways and open gears to help the lubricant adhere more effectively.

THERMAL CONDUCTIVITY
The ability of a material to conduct heat.

THERMAL STABILITY
The ability of a substance to resist degradation owing to the effects of heat.

THICK FILM LUBRICATION
The same as hydrodynamic lubrication.

THICKENING AGENT
A substance used in making greases that is mixed with base oil to produce a stable semi-solid product.

TOTAL ACID NUMBER (TAN)
TAN is a measure of the acidity of a lubricant, usually expressed in terms of the amount of alkali needed to neutralise it. A measurement of TAN can give an indication of the deterioration of an oil in service due to oxidation.

TOTAL BASE NUMBER (TBN)
TBN is a measure of the reverse of basicity of a lubricant. A measurement of TBN can often give important information about the depletion of basic additives.

TOXICITY
The capacity of a substance to harm living organisms.
GLOSSARY

V

VARNISH
A hard, shiny, transparent surface coating sometimes found in engines and derived from the breakdown products of fuel and lubricant.

VISCOSITY
Resistance to flow relating to the thickness of the fluid.

VISCOSITY INDEX (VI)
An arbitrary number that indicates how the viscosity of a fluid varies with changes in temperature. A fluid with a viscosity that is relatively sensitive to changes in temperature has a low viscosity index.

VISCOSITY INDEX IMPROVER (VII)
An additive that may be added to some lubricating oils to make their viscosity less sensitive to changes in temperature.

VOLATILITY
The tendency of an oil to evaporate on heating.

W

WATER RESISTANCE
The ability of a lubricant to withstand the addition of water to the lubricant system without adverse effects.

WATER SEPARABILITY
The ability of a lubricating oil to shed any water with which it has become intimately mixed.

X

XHVI
A registered trademark used to describe Shell manufactured synthetic base oils with an exceptionally high viscosity index.

Y

YIELD POINT
The point at which a grease just begins to flow when pressure is applied to it.

Z

ZDDP
Commonly used name for zinc dithiophosphate, an anti-wear/oxidation inhibitor additive.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEA</td>
<td>Association des Constructeurs Européens d’Automobiles</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>APE</td>
<td>Association of Petroleum Engineers (USA)</td>
</tr>
<tr>
<td>API</td>
<td>American Petroleum Institute</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials (now ASTM International)</td>
</tr>
<tr>
<td>ATC</td>
<td>Technical Committee of Petroleum Additive Manufacturers in Europe</td>
</tr>
<tr>
<td>ATIEL</td>
<td>Association Technique de l’Industrie Européenne des Lubrifiants</td>
</tr>
<tr>
<td>BTC</td>
<td>British Technical Council of the Motor and Petroleum Industries (member CEC)</td>
</tr>
<tr>
<td>CCMC</td>
<td>Comité des Constructeurs d’Automobiles du Marche Commun (replaced by ACEA)</td>
</tr>
<tr>
<td>CEC</td>
<td>Coordinating European Council for the Development of Performance Tests for Fuels, Lubricants and Other Fluids</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsches Institut für Normung eV (German Institute for Standardization)</td>
</tr>
<tr>
<td>EFTC</td>
<td>Engine Fuels Technical Committee (of CEC)</td>
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<tr>
<td>ELTC</td>
<td>Engine Lubricants Technical Committee (of CEC)</td>
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<tr>
<td>FZG</td>
<td>Forschungsstelle für Zahnräder und Getriebebau</td>
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<tr>
<td>IP</td>
<td>Institute of Petroleum (UK)</td>
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<td>ISO</td>
<td>International Organization for Standardisation</td>
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<td>MIL</td>
<td>US military specifications</td>
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<td>NLGI</td>
<td>National Lubricating Grease Institute (USA)</td>
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<tr>
<td>CIMAC</td>
<td>Conseil International des Machines a Combustion</td>
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<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
</tr>
<tr>
<td>STLE</td>
<td>Society of Tribologists and Lubrication Engineers</td>
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## FUEL OIL DEFINITIONS

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>SULPHUR LEVEL, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquefied natural gas (LNG)</td>
<td>Below 0.1</td>
</tr>
<tr>
<td>Ultra-low-sulphur fuel oil (ULSFO)</td>
<td>Maximum 0.1</td>
</tr>
<tr>
<td>Very-low-sulphur fuel oil (VLSFO)</td>
<td>Maximum 0.5</td>
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<tr>
<td>Low-sulphur fuel oil (LSFO)</td>
<td>Maximum 1.0</td>
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<tr>
<td>High-sulphur fuel oil (HSFO)/high-sulphur heavy fuel oil (HSHFO)</td>
<td>Above 1.0</td>
</tr>
<tr>
<td>Marine gas oil (MGO)</td>
<td>As specified</td>
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Shell Marine

Contact your Shell Marine account manager to find out more.

www.shell.com/marine