MARINE LUBRICANTS POCKETBOOK

FOR SMOOTHER OPERATIONS

www.shell.com/marine

Shell Marine Products

SHELL MARINE PRODUCTS – LUBRICANTS FOR MARINE APPLICATIONS

Welcome to the Marine Lubricants Pocketbook from Shell Marine Products. 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 Products representative.

www.shell.com/marine

CONTENTS

CONTENTS

MARINE DIESEL ENGINES

OIL REQUIREMENTS

SLOW-SPEED CROSSHEAD (2-STROKE)

Cylinder oil

- Protection from all effects of oil stress
- Neutralises combustion acids
- Scuffing prevention
- Good film strength
- Piston, ring and scavenge port cleanliness
- Anti-wear properties
- Compatible with system oil
- SAE 40

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

Type	Slow speed	Medium speed	Medium to high speed	High speed
Speed (rpm)	**65–150**	**230–750**	**600–1,200**	**1,200–2,250**
Bore (mm)	**260–1,000**	**300–650**	**200–400**	**100–200**

CYLINDER OILS

SHELL ALEXIA S4 (SAE 40) BN60

A wide-range cylinder lubricant for use in all 2-stroke low-speed diesel engines burning residual fuel.
Shell Alexia S4 has been engineered to offer excellent performance under all operational conditions, including full power, slow and flexible steaming regimes, and to deal with all aspects of oil stress.

Outstanding qualities

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

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL ALEXIA S4	**165**	**15.5**	**60**	**>210**	**<–6**	**926**

SYSTEM OILS

SHELL MELINA S 30

Premium-quality SAE 30 system oils for crosshead engines that can also be used in many different items of marine equipment, such as certain gears and ancillary equipment. It can help to rationalise the number of grades of lubricant carried on board ship.

Outstanding qualities

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

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL MELINA S 30	**104**	**11.6**	**5**	**227**	**–18**	**897**

MEDIUM-SPEED ENGINE OILS

SHELL ARGINA

Shell Argina S 40 (SAE 40)
Low-alkaline engine oil for all turbocharged trunk piston and dual-fuel engines

Shell Argina T 30 (SAE 30)
Shell Argina T 40 (SAE 40)
Medium-alkaline engine oil for all turbocharged trunk piston engines burning residual fuels with sulphur content <3.0%

Shell Argina X 40 (SAE 40)
High-alkaline engine oil for all turbocharged trunk piston engines burning residual fuels with sulphur content >3.0%

Shell Argina XL 40 (SAE 40)
Trunk piston engine oil specifically designed for turbocharged engines with low oil consumption when burning high-sulphur residual fuels

MEDIUM-SPEED ENGINE OILS

SHELL ARGINA

Performance specification: API CF

- Effective detergency and dispersancy that prevent the build up of soot, black sludge and heavy fuel contaminants in critical parts of the engine and keep the engine exceptionally clean
- Neutralising ability for combustion acids; the engine is protected from acidic corrosion
- Good thermal and oxidation stability enables oil-drain intervals to be extended
- Excellent piston and liner wear control and good gear performance help reduce component costs
- The oils have a comprehensive range of engine manufacturers' approvals

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL ARGINA S 40	**135**	**14**	**20**	**234**	**–18**	**909**
SHELL ARGINA T 30	**110**	**12**	**30**	**212**	**–18**	**918**
SHELL ARGINA T 40	**135**	**14**	**30**	**225**	**–18**	**921**
SHELL ARGINA X 40	**135**	**14**	**40**	**205**	**–18**	**916**
SHELL ARGINA XL 40	**135**	**14**	**50**	**229**	**–18**	**921**

MEDIUM-SPEED ENGINE OILS

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

Premium-quality engine oil for highly rated turbocharged trunk piston engines running on distillate fuels with sulphur content <1%. Suitable for use in certain gears and ancillary equipment.

- World leader in its class
- Excellent wear protection
- Excellent engine cleanliness

Performance specifications

- API CF
- U.S Military MIL-L-2104C
- Shell Gadinia is approved by leading trunk piston engine manufacturers.

SHELL MELINA 30 (SAE 30)

Shell Melina is a premium-quality crankcase system oil for non-turbocharged trunk-piston engines.

SHELL MYSELLA S3 N 40

High-performance engine oil for lean-burn, spark-ignition 4-stroke engines requiring low-ash oil and fuelled by natural gas

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL GADINIA 30	**94.5**	**11.4**	**12**	**>200**	**–18**	**897**
SHELL GADINIA 40	**140**	**14.3**	**12**	**>225**	**–18**	**900**
SHELL MELINA 30	**104**	**11.8**	**8**	**227**	**–18**	**897**
SHELL MYSELLA S3 N 40	**139**	**14**	**5**	**230**	**–18**	**892**

MEDIUM-SPEED ENGINE OILS

ANTI-LACQUERING OILS

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

Advanced lubricants for medium-speed trunk-piston engines running on distillate fuel. Specially designed to control oil consumption in modern engines where liner lacquering is a potential problem.

- Reduce lacquer
- Lower lubricant consumption
- Increased engine reliability

Approvals: Rolls-Royce, Bergen, Deutz AG, MAN B&W Diesel AG, Wärtsilä NSD, MaK, Simplex.

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL GADINIA AL 30	**94.5**	**11.4**	**15**	**>200**	**–18**	**893**
SHELL GADINIA AL 40	**140**	**14.3**	**15**	**>200**	**–18**	**900**

HIGH-SPEED DIESEL ENGINES

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

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL RIMULA R4 X 15W-40	**109**	**14.7**	**10.5**	**230**	**–36**	**888**
SHELL RIMULA R4 L 15W-40	**118**	**15.5**	**10.6**	**227**	**–33**	**883**
SHELL RIMULA R6 M 10W-40	**90**	**13.6**	**15.9**	**240**	**–42**	**867**

HIGH-SPEED DIESEL ENGINES

MONOGRADE 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 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

	Viscosity at (mm^2/s)		BN-E (mg KOH/g)	Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C				
SHELL RIMULA R3+ 30	**93**	**11**	**9**	**242**	**–18**	**890**
SHELL ROTELLA DD+ 40	**138**	**14.4**	**8**	**250**	**–15**	**899**
SHELL SIRIUS X 40	**139**	**14**	**17**	**230**	**–18**	**890**

HYDRAULIC OILS

SHELL TELLUS S2 V

Premium performance anti-wear hydraulic oils that incorporate a special viscosity index improver giving very good viscosity–temperature performance and excellent thermal stability and filterability. Very good anti-foam, air release and demulsibility.

SHELL TELLUS S3 M 46

Advanced 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 41 FLUID

Excellent low-temperature properties and cleanliness levels

HYDRAULIC OILS

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL TELLUS S2 V 15	**15**	**3.8**	**160**	**–42**	**871**
SHELL TELLUS S2 V 22	**22**	**4.8**	**190**	**–39**	**872**
SHELL TELLUS S2 V 32	**32**	**6.4**	**170**	**–42**	**872**
SHELL TELLUS S2 V 46	**46**	**8.2**	**210**	**–39**	**872**
SHELL TELLUS S2 V 68	**68**	**10.9**	**230**	**–36**	**877**
SHELL TELLUS S2 V 100	**100**	**14.7**	**176**	**–30**	**889**
SHELL TELLUS S3 M 46	**46**	**6.8**	**220**	**–33**	**865**
SHELL TELLUS S4 VX 32	**33.8**	**9.93**	**>100**	**–60**	**866**
AEROSHELL FLUID 41	**14.1**	**5.3**	**105**	**<–60**	**870**

GEAR OILS

MINERAL

SHELL OMALA S2 G

Extreme-pressure gear oils with high load carrying capacity, high oxidation stability and good anti-corrosion and demulsibility properties

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL OMALA S2 G 68	**68**	**8.7**	**193**	**–27**	**880**
SHELL OMALA S2 G 100	**100**	**11.4**	**195**	**–27**	**880**
SHELL OMALA S2 G 150	**150**	**15.0**	**198**	**–21**	**884**
SHELL OMALA S2 G 220	**220**	**19**	**204**	**–18**	**900**
SHELL OMALA S2 G 320	**320**	**25.0**	**210**	**–15**	**893**
SHELL OMALA S2 G 460	**460**	**31.8**	**216**	**–9**	**897**
SHELL OMALA S2 G 680	**680**	**38.0**	**272**	**–9**	**912**

GEAR OILS

SYNTHETIC

SHELL OMALA S4 GX

Premium, fully synthetic full extreme-pressure gear oils for enclosed gears and bearings

SHELL OMALA S4 WE 220

Excellent anti-oxidation synthetic polyalkylene glycol gear lubricant for operating temperatures up to 200°C or steel-on-bronze applications

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL OMALA S4 GX 150	**158**	**21.7**	**238**	**–45**	**877**
SHELL OMALA S4 GX 220	**230**	**30**	**250**	**–45**	**881**
SHELL OMALA S4 GX 320	**335**	**40**	**252**	**–42**	**883**
SHELL OMALA S4 WE 220	**222**	**34.4**	**278**	**–39**	**1,074**

AIR COMPRESSOR OILS

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

High-performance synthetic lubricant for use in reciprocating air compressors operating under the severest conditions

SHELL CORENA S4 R

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 VTR..4 type turbocharger 5,000-hour oil-drain interval

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL CORENA S2 P 100	**100**	**9.2**	**240**	**–33**	**899**
SHELL CORENA S2 P 150	**155**	**12.1**	**240**	**–30**	**902**
SHELL CORENA S4 P 100	**100**	**10.2**	**260**	**–39**	**988**
SHELL CORENA S4 R 46	**46**	**8**	**235**	**–33**	**854**
SHELL CORENA S4 R 68	**68**	**11**	**240**	**–33**	**859**

REFRIGERATION OILS

SHELL REFRIGERATION OIL S4 FR-V

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

SHELL REFRIGERATION OIL S4 FR-F

Polyol ester refrigeration oil for use with environmentally friendly HFC refrigerant gases R23, R134a, R404a, R410 and R507

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL REFRIGERATION OIL S4 FR-F 32	**32**	**6**	**255**	**–54**	**1,018**
SHELL REFRIGERATION OIL S4 FR-F 68	**64**	**8.6**	**250**	**–42**	**990**
SHELL REFRIGERATION OIL S4 FR-F 100	**93**	**10.9**	**280**	**–42**	**990**
SHELL REFRIGERATION OIL S4 FR-V 32	**30**	**4.2**	**180**	**–42**	**888**
SHELL REFRIGERATION OIL S4 FR-V 68	**68**	**6**	**190**	**–42**	**871**
SHELL REFRIGERATION OIL S4 FR-V 100	**107**	**7.2**	**200**	**–36**	**869**

GAS COMPRESSOR OILS

SHELL GAS COMPRESSOR OIL S4 PV 190

A versatile polyalkylene glycol cylinder lubricant for reciprocating compressors handling hydrocarbon and other gases

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL GAS COMPRESSOR OIL S4 PV 190	**190**	**36**	**262**	**–30**	**1,056**

STERN TUBE OILS

SHELL STROMBUS MP

Emulsifiable stern tube oil where excessive leakage past the outer seal is experienced. Designed specifically for oil-filled stern tubes, particularly in the event of leakage in systems incorporating lip seal stern tube glands, but also some face seals

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL STROMBUS MP	**273**	**–**	**200**	**–5**	**900**

BEARING AND CIRCULATING OILS

MINERAL

SHELL MORLINA S2 B 150

Mineral bearing oil giving excellent water shedding and corrosion protection

SYNTHETIC

SHELL MORLINA S4 B

Fully synthetic anti-wear bearing oil approved for Alfa Laval separators

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL MORLINA S2 B 150	**150**	**15**	**262**	**–15**	**887**
SHELL MORLINA S4 B 220	**220**	**25.9**	**240**	**–48**	**853**
SHELL MORLINA S4 B 320	**320**	**33.8**	**270**	**–45**	**854**
SHELL MORLINA S4 B 460	**460**	**45.5**	**274**	**–42**	**859**

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

Excellent properties

- Thermal stability
- Demulsibility
- Air release
- Resistance to foaming
- Rust and corrosion protection

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL TURBO T 32	**32**	**5.2**	**>215**	**<–12**	**871**
SHELL TURBO T 46	**46**	**6.6**	**220**	**<–12**	**874**
SHELL TURBO T 68	**68**	**8.5**	**240**	**–9**	**876**
SHELL TURBO T 100	**100**	**11.4**	**250**	**–9**	**881**

TRANSMISSION OILS

SHELL SPIRAX S4 ATF HDX

A superior-quality automatic transmission fluid suitable for heavy duty transmissions

SHELL SPIRAX S4 TXM

Premium universal transmission oil designed for use in transmissions, hydraulic systems, oil-immersed brakes and other ancillary systems

SHELL SPIRAX S3 AX 80W-90

High-performance API GL-5 gear and axle oil for moderate to heavily loaded gear applications requiring SAE 80W-90 oil

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL SPIRAX S4 ATF HDX	**33.2**	**7.2**	**185**	**–48**	**847**
SHELL SPIRAX S4 TXM	**60**	**9.4**	**220**	**–42**	**882**
SHELL SPIRAX S3 AX 80W-90	**169**	**16.8**	**220**	**–30**	**900**

HEAT TRANSFER FLUIDS

SHELL HEAT TRANSFER FLUID S2

Heat transfer fluid for use in indirect closed fluid heat transfer systems with bulk temperatures up to 320°C

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL HEAT TRANSFER FLUID S2	**25**	**4.7**	**220**	**–12**	**866**

2-STROKE OUTBOARD ENGINE OILS

SHELL NAUTILUS PREMIUM OUTBOARD

High-performance lubricant for superior protection of all 2-stroke gasoline outboard motors.

Approved to NMMA TC-W3

	Viscosity at (mm^2/s)		Flash point, PMCC (°C)	Pour point (°C)	Density at 15°C (kg/m^3)
	40°C	100°C			
SHELL NAUTILUS PREMIUM OUTBOARD	**38**	**7.0**	**70**	**–35**	**871**

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 that withstands water washout to retain 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

GREASES

	Base	NLGI grade	Average dropping point (°C)	Operating temperature (°C)
SHELL GADUS S2 V220 0	Lithium	0	–	–20 to 120
SHELL GADUS S2 V220 1	Lithium	1	180	–20 to 120
SHELL GADUS S2 V220 2	Lithium	2	180	–20 to 120
SHELL GADUS S2 A320 2	Calcium	2	85	–10 to 60
SHELL GADUS S2 V220AD 2	Lithium–calcium	2	188	–10 to 120
SHELL GADUS S2 V220AC 2	Lithium–calcium	2	175	–20 to 120
SHELL GADUS S2 V100 3	Lithium	3	180	–20 to 130
SHELL GADUS S3 HIGH SPEED COUPLING GREASE	Lithium	0.5	>150	–30 to 120
SHELL GADUS S3 V220C 2	Lithium complex	2	260	–25 to 140
SHELL GADUS S3 T220 2	Diurea	2	260	–20 to 160
SHELL GADUS S5 V100 2	Lithium complex	2	260	–50 to 150
SHELL GADUS S2 OG 40	–	–	–	–
SHELL GADUS S2 OG 50	–	–	–	–

GREASE COMPATIBILTY CHART

■ Good compatibility ■ Borderline compatibility ■ Incompatible

	Al	Al-X	Ba	Ca	Ca-12	Ca-X	Clay	Li	Li/Ca	Li-X	Shell Polyurea
Aluminium (Al)	■	■	■	■	■	■	■	■	■	■	■
Aluminium complex (Al-X)	■	■	■	■	■	■	■	■	■	■	■
Barium (Ba)	■	■	■	■	■	■	■	■	■	■	■
Calcium (Ca)	■	■	■	■	■	■	■	■	■	■	■
Calcium 12-hydroxy (Ca-12)	■	■	■	■	■	■	■	■	■	■	■
Calcium complex (Ca-12)	■	■	■	■	■	■	■	■	■	■	■
Clay*	■	■	■	■	■	■	■	■	■	■	■
Lithium (Li)	■	■	■	■	■	■	■	■	■	■	■
Lithium–calcium (Li–Ca)	■	■	■	■	■	■	■	■	■	■	■
Lithium complex (Li-X)	■	■	■	■	■	■	■	■	■	■	■
Shell Polyurea Grease**	■	■	■	■	■	■	■	■	■	■	■

*Bentonite–hectorite microgel **Shell Polyurea Greases have been tested and found compatible with lithium, lithium–calcium, aluminium complex and Shell Gadus (clay).

LUBRICANT VISCOSITY CLASSIFICATIONS

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 and 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 JAN. 2009

SAE viscosity grade	Low-temperature(°C) cranking viscosity[3] (mPa·s)	Low temperature (°C) pumping viscosity[4], mPa·s [4]	Low-shear-rate kinematic viscosity[5], (mm^2/s) at 100°C		High-shear-rate viscosity[6], mPa·s at 150°C
	Max.	Max. with no yield stress	Min.	Max.	Min.
0W	6,200 at –35	60,000 at –40	3.8	–	–
5W	6,600 at –30	60,000 at –35	3.8	–	–
10W	7,000 at –25	60,000 at –30	4.1	–	–
15W	7,000 at –20	60,000 at –25	5.6	–	–
20W	9,500 at –15	60,000 at –20	5.6	–	–
25W	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	3.5 (0W-40, 5W-40, 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

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]

(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 consaitutes 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.

AXLE AND MANUAL TRANSMISSION LUBRICANT VISCOSITY CLASSIFICATION SAE J306 JUNE 2005

SAE viscosity grade	Maximum temperature for viscosity of 150,000 cP (°C)	Kinematic viscosity at 100°C (cSt)	
		Min.	Max.
70W	–55	4.1	–
75W	–40	4.1	–
80W	–26	7.0	–
85W	–12	11.0	–
80	–	7.0	<11.0
90	–	13.5	<24.0
140	–	24.0	<41.0
250	–	41.0	–

Note: 1 cP = 1 mPa·s, 1 cSt = 1 mm^2/s

LUBRICANT VISCOSITY CLASSIFICATIONS

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 1650.0 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.

		Kinematic viscosity limits at 40°C (cSt)	
ISO viscosity grade	Mid-point viscosity at 40°C (cSt)	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	11.00
ISO VG 15	15	13.50	16.50
ISO VG 22	22	19.80	24.20
ISO VG 32	32	28.80	35.20
ISO VG 46	46	41.40	50.60
ISO VG 68	68	61.20	74.80
ISO VG 100	100	90.00	110.00
ISO VG 150	150	135.00	165.00
ISO VG 220	220	198.00	242.00
ISO VG 320	320	288.00	352.00
ISO VG 460	460	414.00	506.00
ISO VG 680	680	612.00	748.00
ISO VG 1000	1,000	900.00	1,100.00
ISO VG 1500	1,500	1350.00	1,650.00

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 (NGLI). 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.

Grade No.	ASTM worked penetration at 25°C (dmm)
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

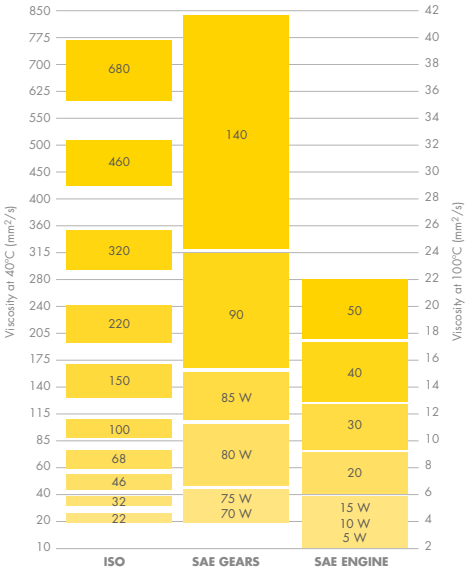
AMERICAN GEAR MANUFACTURERS ASSOCIATION CLASSIFICATION AGMA 250.04 (SUPERSEDED)

Industrial enclosed gear drives

AGMA lubricant No.	ISO viscosity grade
1	46
2	68
3	100
4	150
5	220
6	320

VISCOSITY COMPARISON CHART

KINEMATIC VISCOSITY TABLE



GLOSSARY

SYMBOL	CHEMICAL ELEMENT
Ag	Silver
Al	Aluminium
B	Boron
Ba	Barium
Ca	Calcium
Cr	Chrome
Cu	Copper
Fe	Iron
Mg	Magnesium
Mn	Manganese
Ma	Molybdenum
Na	Sodium

SYMBOL	CHEMICAL ELEMENT
Ni	Nickel
P	Phosphorous
K	Potassium
Pb	Lead
S	Sulphur
Sb	Antimony
Si	Silicon
Sn	Tin
Ti	Titanium
V	Vanadium
Zn	Zinc

A

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 AGENT
An additive 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.

GLOSSARY

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, as it provides continuous oil lubrication to bearings.

BORE POLISHING
A condition that may occur in the cylinders of turbocharged engines when the cylinder walls become 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)
Calculated carbon aromaticity index 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

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

D

DEMULSIFICATION
The separation of an emulsion into its component liquids

DENSITY
Mass per unit volume. Standard units are kilogrammes per cubic metre (kg/m^3) or grammes per cubic centimetre (g/cm^3)

DETERGENT
An additive included in most engine oil formulations to inhibit deposit formation and protect the lubricated surfaces

GLOSSARY

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 lubricated 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)

E

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 formation 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

FRICTION
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

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

$$\text{API gravity} = \left(\frac{141.5}{\text{specific gravity at 60°F}} \right) - 131.5$$

GLOSSARY

GREASE
A lubricant with a semi-solid consistency produced by dispersing a thickening agent in a base oil

H

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

I

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 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

K

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

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.

P

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 oil.

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 that ensures satisfactory flow to and from the engine oil pump and subsequent lubrication of moving components

GLOSSARY

R

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 composed of the residues remaining after refining crude oil. Shell marine residual fuels oils are called Shell MFO.

RING STICKING
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

S

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

SPLASH 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

GLOSSARY

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
Manufactured 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 by 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

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

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

ZINC (ZDDP)
Commonly used name for zinc dithiophosphate, an anti-wear/oxidation inhibitor additive

TEST METHOD BODIES

ACEA	Association des Constructeurs Européens d'Automobiles
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials (ASTM International)
ATC	Technical Committee of Petroleum Additive Manufacturers in Europe
ATIEL	Association Technique de l'Industrie Européenne des Lubrifiants
BTCMPI	British Technical Council of the Motor and Petroleum Industries (replaced by BTC Testing Advisory Group)
CCMC	Comité des Constructeurs du Marché Commun (replaced by ACEA)
CEC	Conseil Européen de Co-ordination pour les Developments des Essais de Performance des Lubrifiants et des Combustibles pour Moteurs (coordinating European Council)
DIN	Deutsches Institut für Normung
EFTC	Engine Fuels Technical Committee (of CEC)
ELTC	Engine Lubricants Technical Committee (of CEC)
FZG	Forschungsstelle für Zahnräder und Getriebebau
IP	Institute of Petroleum (UK)
ISO	International Organization for Standardisation
MIL	US military specifications
NLGI	National Lubricating Grease Institute (USA)
CIMAC	Conseil International des Machines a Combustion
SAE	Society of Automotive Engineers
SPE	Society of Petroleum Engineers (USA)
STLE	Society of Tribologists and Lubrication Engineers

Shell Marine Products

Contact your Shell Marine Products account manager to find out more or email to smp-marketing@shell.com.
www.shell.com/marine

Issued October 2013