

Lubricants

Engineered for your machine



Lubricants Brochure Revision 8

BELL

Bell Machines

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Bell Lubricants Recommendations in accordance with Bell Equipment specifications

The recommendations provided herein are given in good faith and on the basis of the best information available at the time of issue. It is the responsibility of the user to ensure that the products are used in the applications for which they are intended, and no legal liability therefore is accepted by Bell Lubricants.

Bell Service Bulletin : Benefits of using a combination of low sulphur fuels with high quality lubricating oils

Use of Bell recommended oils ensures efficient performance and optimum protection of the engine. However, the use of low sulphur fuels with recommended oil provides maximum benefit. Sulphur in diesel forms sulphuric acid that play a major role in increasing engine wear. On the other hand, low sulphur diesel forms less sulphuric acid when combusted which leads to lower engine wear rates, reduced harmful exhaust emissions, improved combustion properties and longer engine life. Sulphur in diesel leads to the formation of sulphate particulates. In the engine oil, these cause depletion of additives and reduced oil life.



Articulated Dump Truck & Articulated Tractor



| | Recommendations | Part No.'s |
|--|--|----------------------------------|
| Engine C-series D-series & E-series | Mineral Engine Oil 15W-40 Semi Synthetic Engine Oil 10W-40 | BN005541 BN005545 |
| Coolant C-series, D-series & E-series (B18E-B30E, Stage 2 & 3B) E-series (B30E Stage 4 & all Large E) | Extended Life Coolant - Premix 50 Extended Life Coolant - Premix 50 Ultra | BN005611 BN033240 |
| Transmission C-series, D-series, E-series | Syn ATF Ultra | BN005548 |
| Transfer box C-series D-series, E-series B60D - B60E | Syn ATF Ultra Syn ATF Ultra Gear Oil Limited Slip 80W-90 | BN005548 BN005548 BN005574 |
| Axles C, D & E-series with Dry Disk Brakes (B18-B30) B60D & B35E - B60E with Wet Disk Brakes D-series (B35D-B50D) & E-series (B30E) with Wet Disk Brakes | Gear Oil Limited Slip 80W-90 Gear Oil Limited Slip 80W-90 Super Gear Oil | BN005574 BN005574 BN033629 |
| Wet disc brakes Cooling B40D Brake cooling reservoir B60D & E-series (B35-B60E) with Wet Disk Brakes | UTTO Ultra E# WDB Cooling Oil | BN005583 BN038209 |
| Dry disc brakes B40C & B35C | Brake Fluid | BN005559 |
| Hydraulics** C-series, D-series D-series, E-series | Hydraulic Oil VHHI Hydraulic Oil VG68 | BN005556 BN005597 |
| Grease General (Pin, Bushes, Auto greasing, etc.) Drivetrain (Bearings & Propshaft, etc.) Drivetrain (High Temperature PTO-where applicable, etc.) | Grease - Multi Purpose Grease - Wheel Bearing Grease - High Temperature | BN005567 BN005561 BN005771 |

* Refer to SIB 2011/1075

** Either oil may be used but do not mix. (Drain and refill only)

Wheeled Loader



Engine

D-series & E-series
C-series

Semi Synthetic Engine Oil 10W-40
Mineral Engine Oil 15W-40

BN005545
BN005541

Coolant

D-series & E-series
C-series

Extended Life Coolant - Premix 50 N
Extended Life Coolant - Premix 50

BN005608
BN005611

Transmission

C-series & D-series & E-series

UTTO Ultra

BN005583

Axles

C-series, L705 - L1004 D & E-series
D-series & E-series

Gear Oil Limited Slip 80W-90
HyGard TBC

BN005574
CJ18474

Wet brakes / Park brake

UTTO Ultra

BN005583

Dry disc brakes

B-series

Brake Fluid

BN005559

Hydraulics

C-series, 1706D MKII & L1806D - L2706D
L705D - L1004D & E-series

UTTO Ultra
Semi Synthetic Engine Oil 10W-40
or Mineral Engine Oil 15W-40

BN005583
BN005545
BN005541

Grease

General (Pin, Bushes, etc.)
Drivetrain (Bearings & Propshaft, etc.)

Grease - Multi Purpose
Grease - Wheel Bearing

BN005567
BN005561

Haulage Tractors



Engine

Series -I, II, III
Series -IV

Coolant

Transmission

Automatic (Series -I)
Automatic (Series -II & MKII)

Transfer Box

Axles

Hydraulics

Grease

Recommendations

Mineral Engine Oil 15W-40
Semi Synthetic Engine Oil 10W-40

Extended Life Coolant - Premix 50

Torque Fluid 434
Syn ATF Ultra

Gear Oil Limited Slip 80W-90

Gear Oil Limited Slip 80W-90

Hydraulic Oil VG 68

Grease - Multi Purpose

Part No.'s

BN005541
BN005545

BN005611

BN005589
BN005548

BN005574

BN005574

BN005597

BN005567

Tri-Wheeled Loader



Engine

Recommendations

Part No.'s

Mineral Engine Oil 15W-40

BN005541

Axles / Wheels

Gear Oil Limited Slip 80W-90

BN005574

Park Braking Housing

Mineral Engine Oil 15W-40

BN005541

Hydraulics

Hydraulic Oil VG 68

BN005597

Grease

Grease - Super Heavy Duty

BN005600

Excavator



Engine

Mk1/2/3 & R-series
E-series, C-series

Coolant

Mk1/2/3 & R-series, E-series, C-series

Final Drive & Slew Gear Box

Mk1/2/3 & R-series
E-series, C-series

Pump Distributor Gear

E-series, C-series

Hydraulics

Mk1/2/3 & R-series
E-series, C-series

Grease

Mk1/2/3 & R-series, E-series & C-series
Grease (Pin, Bushes, etc)
Swing Ring - All Excavators

Recommendations

Mineral Engine Oil 15W-40
Semi Synthetic Engine Oil 10W-40

Extended Life Coolant - Premix 50 N

Gear Oil Limited Slip 85W-140
Gear Oil Limited Slip 80W-90

Gear Oil Limited Slip 80W- 90

UTTO Ultra
Mineral Engine Oil 15W-40

Grease - Multi Purpose
Slew Ring Grease

Part No.'s

BN005541
BN005545

BN005608

BN005586
BN005574

BN005574

BN005583
BN005541

BN005567
BN031576

Tractor Loader Backhoe



| | Recommendations | Part No.'s |
|---------------------------------------|---|-------------------------|
| Engine G,J,K,L-series | Mineral Engine Oil 15W-40 | BN005541 |
| Coolant G,J,K,L-series | Extended Life Coolant - Premix 50 N or Extended Life Coolant - Premix 50 | BN005608 or BN005611 |
| Transmission G,J,K,L-series | UTTO Ultra | BN005583 |
| Axles G,J,K,L-series | UTTO Ultra | BN005583 |
| Hydraulics G,J,K,L-series | Mineral Engine Oil 15W-40 | BN005541 |
| Grease G,J,K,L-series | Grease - Super Heavy Duty | BN005600 |

Bell Dozer



| | Recommendations | Part No.'s |
|--|--|----------------------|
| Engine C-series, J-series | Mineral Engine Oil 15W-40 | BN005541 |
| Coolant C-series, J-series | Extended Life Coolant - Premix 50 N | BN005608 |
| Final Drives Rollers & Idlers C-series, J-series | Gear Oil Limited Slip 80W-90 | BN005574 |
| Hydrostatic Drive G-series, J-series & K-series | Mineral Engine Oil 15W-40 | BN005541 |
| Hydraulics G-series, J-series & K-series | Mineral Engine Oil 15W-40 | BN005541 |
| Grease Grease (Pin, Bushes, etc) Drive train (Bearings, Propshaft, etc) | Grease - Multi Purpose Grease - Wheel Bearing | BN005567 BN005561 |

Liebherr Dozer



| | Recommendations | Part No.'s |
|--|--|----------------------|
| Engine | Engine Oil 10W-40 | BN005545 |
| Coolant | Extended Life Coolant - Premix 50 N | BN005608 |
| Final Drives Distributor Gear | Gear Oil Limited Slip 80W-90 | BN005574 |
| Hydrostatic Drive, Axle Bearing & Dou Cone/Slip Ring Seal Travel Gear | Mineral Engine Oil 15W-40 | BN005541 |
| Hydraulics | Mineral Engine Oil 15W-40 | BN005541 |
| Grease Grease (Pin, Bushes, etc) Drive train (Bearings, Propshaft, etc) | Grease - Multi Purpose Grease - Wheel Bearing | BN005567 BN005561 |

Finlay



| | Recommendations | Part No.'s |
|---------------------------------|-----------------------------------|--------------|
| Engine | Mineral Engine Oil 15W-40 | BN005541 |
| Coolant | Extended Life Coolant - Premix 50 | BN005611 |
| Hydraulics | Hydraulic Oil VG 68 | BN005597 |
| Track Gear Boxes | Gear Oil limited Slip 80W-90 | BN005574 |
| Feeder Units (Vibrating) | Gear Oil limited Slip 85W-140 | BN005586 |
| Cone Lubrication Oil | Cone Lube | BN028424 |
| Wedge ring Grease (Cone) | Molybentone - 400g | FT31.12.0312 |
| Grease (All Bearings) | Grease Wheel Bearing | BN005561 |
| Feeder Gear Boxes | Gear Oil limited Slip 80W-90 | BN005574 |

Motor Grader



| | Recommendations | Part No.'s |
|--|--|----------------------|
| Engine D-series & and G-series | Mineral Engine Oil 15W-40 | BN005541 |
| Coolant D-series & and G-series | Extended Life Coolant - Premix 50 N | BN005608 |
| Transmission D-series & and G-series | UTTO Ultra | BN005583 |
| Axles Differentials, D-series & G-series Tandems, 6WD Hubs, D-series & G-series | UTTO Ultra UTTO Ultra | BN005583 BN005583 |
| Hydraulics D-series & and G-series | Mineral Engine Oil 15W-40 | BN005541 |
| Circle Driver Box D-series & and G-series | UTTO Ultra | BN005583 |
| Grease Grease (Pin, Bushes, etc) Drive train (Bearings, Propshaft, etc) | Grease - Multi Purpose Grease - Wheel Bearing | BN005567 BN005561 |

**Engine**

Single drum roller with air cooled engine
Single drum roller with water cooled engine
Refuse compactors with Cummins engine
Refuse compactors with Deuts water cooled engine
Heavy tandem roller with Deuts water cooled engine
Light tandem roller with Kutoba Engine
Walk behind roller with Hatz engine
Vibratory plates with Honda engine
Recyclers with Deutz water cooled engine

Vibration Bearing

Single drum roller with air cooled engine
Single drum roller with water cooled engine
Heavy tandem roller with Deuts water cooled engine
Light tandem roller with Kutoba engine
Walk behind roller with Hats engine
Vibratory plates with Honda engine
Vibration Bearing vario control

Axle Oil

Single drum roller with air cooled engine
Single drum roller with water cooled engine

Recommendations

Mineral Engine Oil 15W-40
Semi Synthetic Engine Oil 10W-40
Mineral Engine Oil 15W-40
Semi Synthetic Engine Oil 10W-40
Semi Synthetic Engine Oil 10W-40
Mineral Engine Oil 15W-40
Mineral Engine Oil 15W-40
Mineral Engine Oil 15W-40
Semi Synthetic Engine Oil 10W-40

Mineral Engine Oil 15W-40
Manual Transmission Oil 75W90

Gear Oil limited Slip 85W-140
Gear Oil limited Slip 85W-140

Part No.'s

BN005541
BN005545
BN005541
BN005545
BN005545
BN005541
BN005541
BN005541
BN005541
BN005545

BN005541
BN005541
BN005541
BN005541
BN005541
BN005541
BN005541
BN005593

Bomag

| | Recommendations | Part No.'s |
|---|--|--|
| Final Drive | Gear Oil Limited Slip 85W-140 Gear Oil Limited Slip 85W-140 Gear Oil Limited Slip 85W-140 | BN005586 BN005586 BN005586 |
| Hydraulic Oil | Hydraulic Oil VG46 Hydraulic Oil VG46 | BN005602 BN005602 BN005602 BN005602 BN005602 BN005602 BN005602 BN005602 |
| Coolant for all Deuts Water Cooled Engines | Extended Life Coolant - Premix 50 | BN005611 |
| Grease | Grease - Multi Purpose | BN005567 |

Special Products

| | Recommendations | Part No.'s |
|-----------------------------------|-------------------------|-------------------|
| Final Drive | Fuchs Renolin CLP220 | BMG00993009 |
| Change Over Weight Housing | Silicone Oil 47V100cSt | BMG00970008 |
| BVC Exciter Gears | Auto Top 2000 | BMG00996001 |
| Bitumen Heating System | Thermal Oil DIVINOL WTO | BMG00993007 |

Deere Forestry



Engine

Knuckle Boom Loaders

Skidders

Tracked Harvesters / Fellerbunchers

Forwarders

Wheeled Harvesters

Wheeled Fellerbunchers

Recommendations

Mineral Engine Oil 15W-40

Part No.'s

BN005541

BN005541

BN005541

BN005541

BN005541

BN005541

Transmission / Transfercase

Skidders

Forwarders

Wheeled Harvesters

Wheeled Fellerbunchers

HyGard

Gear Oil Limited Slip 80W-90

Gear Oil Limited Slip 80W-90

HyGard

CJ18474

BN005574

BN005574

CJ18474

Hydraulic System

Knuckle Boom Loaders

Skidders

Tracked Harvesters / Fellerbunchers

Forwarders

Wheeled Harvesters

Wheeled Fellerbunchers

Mineral Engine Oil 15W-40

Mineral Engine Oil 15W-40

Mineral Engine Oil 15W-40

Hydraulic Oil VG68

Hydraulic Oil VG68

Mineral Engine Oil 15W-40

BN005541

BN005541

BN005541

BN005597

BN005597

BN005541

Axles / Bogies / Final Drive / Track Drive Oil

Skidders - L-series CJ18474

Tracked Harvesters / Fellerbunchers

Forwarders

Wheeled Harvesters

Wheeled Fellerbunchers

HyGard

Gear Oil Limited Slip 80W-90

Gear Oil Limited Slip 80W-90

Gear Oil Limited Slip 80W-90

HyGard

CJ18474

BN005574

BN005574

BN005574

CJ18474

Deere Forestry

| | Recommendations | Part No.'s |
|-------------------------------------|---|-------------------|
| Brake / Park Brake | | |
| Skidders | Hy-Gard | CJ18474 |
| Forwarders | Bell UTTO Ultra | BN005583 |
| Wheeled Harvesters | Bell UTTO Ultra | BN005583 |
| Wheeled Fellerbunchers | Hy-Gard | CJ18474 |
| Crane Base / Swing Drive | | |
| Knuckle Boom Loaders | Gear Oil Limited Slip 80W-90 | BN005574 |
| Tracked Harvesters / Fellerbunchers | Gear Oil Limited Slip 80W-90 | BN005574 |
| Forwarders | Gear Oil Limited Slip 80W-90 | BN005574 |
| Wheeled Harvesters | Gear Oil Limited Slip 80W-90 | BN005574 |
| Pump Drive | | |
| Tracked Harvesters / Fellerbunchers | Bell UTTO Ultra | BN005583 |
| Wheeled Fellerbunchers | Bell UTTO Ultra | BN005583 |
| Cooling System | | |
| Knuckle Boom Loaders | Extended Life Coolant - Premix 50 N | BN005608 |
| Skidders - Models up to H-series | Extended Life Coolant - Premix 50 N | BN005608 |
| - Models from L-series | Extended Life Coolant - Premix 50 Ultra | BN033240 |
| Tracked Harvesters / Fellerbunchers | Extended Life Coolant - Premix 50 N | BN005608 |
| Forwarders | Extended Life Coolant - Premix 50 N | BN005608 |
| Wheeled Harvesters | Extended Life Coolant - Premix 50 N | BN005608 |
| Wheeled Fellerbunchers | Extended Life Coolant - Premix 50 N | BN005608 |
| Grease | | |
| Knuckle Boom Loaders | Grease - Super Heavy Duty | BN005600 |
| Skidders | Grease - Super Heavy Duty | BN005600 |
| Tracked Harvesters / Fellerbunchers | Grease - Super Heavy Duty | BN005600 |
| Forwarders | Grease - Super Heavy Duty | BN005600 |
| Wheeled Harvesters | Grease - Super Heavy Duty | BN005600 |
| Wheeled Fellerbunchers | Grease - Super Heavy Duty | BN005600 |
| Cablift / Engine Enclosure | | |
| Skidders | Bell UTTO Ultra | BN005583 |
| Tracked Harvesters / Fellerbunchers | Mineral Engine Oil 15W-40 | BN005541 |
| Forwarders | Bell UTTO Ultra | BN005583 |
| Wheeled Harvesters | Bell UTTO Ultra | BN005583 |
| Wheeled Fellerbunchers | Bell UTTO Ultra | BN005583 |
| Winches | Bell UTTO Ultra | BN005583 |

Mineral Engine Oil 15W-40

Bell Mineral Engine Oil 15W-40 is a super high performance multigrade diesel, and petrol engine oil with high quality mineral base stocks and specially developed additives.

Application

Bell Mineral Engine Oil 15W-40 is intended for all naturally aspirated and turbocharged petrol and diesel engines operating under the API service conditions described below.

The enhanced detergency and dispersancy of Bell Mineral Engine Oil 15W-40 enables it to remove pre-existing sludge and other deposits from engines that have operated on other oils. An early oil and filter change is therefore recommended for the initial fill when switching to this oil.

The superior lubricating properties of Mineral Engine Oil 15W-40 can retard the bedding-in of new components and it is not recommended for use during the running-in phase of new or rebuilt engines.

Features & Benefits

Bell Mineral Engine Oil 15W-40 has the following features and benefits:

- excellent oxidation stability
- enhanced high and low temperature dispersancy and detergency
- outstanding anti-sludging properties
- very good cold starting ability
- good fuel saving properties

Product Specifications

- MB 228.3
- API CI-4 plus, SL
- MAN M 271, M 3275
- Volvo VDS-3
- MTU type 2
- Cummins CES 20076/77/78
- Mack EO-N Premium Plus
- DDC93K215
- ACEA E4/E7-12
- Caterpillar ECF-1a
- Deutz QC-11-10
- Renault VI RLD-2, DHD-1

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents. Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Characteristics

| Property | Units | Typical |
|-----------------|-------------|---------|
| SAE No. | | 15W-40 |
| Viscosity | cST @ 40°C | 115 |
| Viscosity | cST @ 100°C | 15 |
| Viscosity Index | | 134 |
| Flash Point | °C | 222 |
| Pour Point | °C | -27 |
| Total Base No. | mgKOH/g | 10.8 |
| Sulphated Ash | % m/m | 1.4 |
| Density @ 20°C | kg/m³ | 883 |



Semi Synthetic Engine Oil 10W-40

Bell Semi Synthetic Engine Oil 10W-40 is a semi synthetic multigrade engine oil formulated to protect latest technology petrol and diesel engines including engines equipped with exhaust gas recirculation (EGR) systems. The oil is designed to enable advanced engine technology to meet strict exhaust emission standards.

Each component of the oil has been individually selected to provide superior engine protection and enable ultimate engine performance.

Application

Bell Semi Synthetic Engine Oil 15W-40 is designed to prolong the life of heavy-duty, high-speed diesel and petrol engines operating under severe service conditions.

The superior lubricating properties of Bell Semi Synthetic Engine Oil 10W-40 can retard the bedding-in of new components and it is not recommended for use during the running-in phase of new or rebuilt engines.

Features & Benefits

Semi Synthetic Engine Oil 10W-40 provides improved oxidation resistance, improved deposit protection and better wear protection while ensuring energy conservation.

Product Specifications

- MB 228.5
- MAN 3277
- API CI-4/CF/SL
- ACEA E7-04, E4-99
- Volvo VDS-3
- Renault RXD/RLD-2,
- MTU Type 3
- Scania LDF-2

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents. Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Characteristics

| Property | Units | Typical |
|-----------------|-------------|---------|
| SAE No. | | 10W-40 |
| Viscosity | cST @ 40°C | 96 |
| Viscosity | cST @ 100°C | 14.1 |
| Viscosity Index | | 152 |
| Flash Point | °C | 220 |
| Pour Point | °C | -33 |
| Total Base No. | mgKOH/g | 12.9 |
| Density @ 20°C | kg/m³ | 890 |



Syn ATF Ultra

Bell Syn ATF Ultra is a synthetic fluid designed to meet the demanding requirements of modern heavy duty automatic transmissions

Application

Bell Syn ATF Ultra is recommended for use in modern high performance trucks, buses, utility vehicles, haulers, vans and other equipment requiring Allison TES 295 performance level.

Features & Benefits

Bell Syn ATF Ultra has been formulated to exceed the original TES specification:

- Excellent seal compatibility
- Stringent cold
- Increased durability
- Protects against thermal breakdown at high temperatures while still providing outstanding performance at ambient temperatures as low as -54°C
- It offers outstanding gear shifting and power transfer performance.

Product Specifications

- Allison TES 295

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------------|---------|
| Property | Units | Typical |
| Density @ 20°C | kg/m ³ | 850 |
| Viscosity | cST @ 40°C | 39 |
| Viscosity | cST @ 100°C | 7 |
| Viscosity Index | | 168 |
| Flash Point | °C | 235 |
| Pour Point | °C | -54 |



Manual Transmission Oil

Bell Synthetic Manual Transmission Oil 75W-90 is a fully-synthetic, multi-grade gear oil designed for use in gearboxes and differentials operating under a wide range of ambient temperatures.

Application

Bell Synthetic Manual Transmission Oil 75W-90 is intended for most heavy duty and passenger cars differentials requiring API GL-5 or MT1 level of extreme pressure protection.

Features & Benefits

Bell Synthetic Manual Transmission Oil 75W-90 exceeds both API GL-5 gear oil requirements and enhanced features and benefits such as:

- Retention of full lubrication characteristics down to temperatures of -40°C
- Enhanced thermal stability with resultant longer drain interval capabilities and improved component cleanliness even under severe operating conditions
- Outstanding shear stability
- Excellent high temperature gear score performance with resultant longer differentials service life
- Better fuel consumption especially during low temperature operation

Product Specifications

- SAE 75W-90, SAE J2360
- API GL-5/MT1
- ARVIN MERITOR O76-N
- MAN 341 Type E3
- MAN 342 Typ M3
- MB-Approval 235.8
- MIL-PRF-2105E, SCANIA STO 1:0
- ZF TE-ML 02B, 05B, 12L, 12N, 16F, 17B, 19C, 21B
- DAF Performance
- MACK GO-J Performance
- Renault note technique B0032/2 annex 3 Performance

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents. Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| Density @ 15°C | kg/m³ | 870 |
| Viscosity | cST @ 40°C | 101 |
| Viscosity | cST @ 100°C | 15.1 |
| Viscosity Index | | 157 |
| Flash Point | °C | >200 |
| Pour Point | °C | -51 |



Torque Fluid 434

Bell Torque Fluid 434 is a multipurpose gear and transmission oil whose viscosity is equivalent to SAE 30 oil. It can be used in many drive train applications and is specially formulated for good chatter suppression, low temperature performance & anti-foam properties.

Application

Bell Torque Fluid 434 can be used for the following applications where the grade is specified:

- hydraulic systems
- heavy duty drive train and hydraulic systems
- torque converters
- gear units of certain commercial and construction vehicles

Features & Benefits

Bell Torque Fluid 434 is been specifically formulated to meet Caterpillar's TO-4 specification for transmissions/drive train oils (TDTO). Bell Torque Fluid 434 meets the API CF specification requirements.

Product Specifications

- Caterpillar TO-4
- Allison C-4
- Sperry Vickers M2950-5
- ZF - TE - ML 03-04

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| SAE No. | | 30 |
| Viscosity | cST @ 40°C | 106 |
| Viscosity | cST @ 100°C | 11.6 |
| Viscosity Index | | 96 |
| Flash Point | °C | 228 |
| Pour Point | °C | -15 |
| Total Base No. | mgKOH/g | 10.5 |
| Density @ 20°C | kg/m³ | 892 |



Hydraulic Oil VHVI

Bell Hydraulic Oil VHVI is formulated from solvent refined base oils, viscosity index improvers, foam and oxidation-resistant fluid having frictional characteristics suitable for automatic transmissions designed to use Type G and Type F automatic transmission fluids and Ford specification ESW-M2C 33-G fluids.

Bell Hydraulic Oil VHVI is dyed red like any other ATF fluid.

Application

Bell Hydraulic Oil VHVI is intended for the following components of many commercial vehicles and off-highway equipment.

- heavy-duty transmissions
- power steering systems
- hydraulics and hydrostatic systems where Allison C-3 or C-4 fluid is recommended

Do NOT use in systems with silver-coated bearings

Features & Benefits

This product is used primarily for some commercial transmissions and certain manual gearboxes and power steering units. Bell Hydraulic oil VHVI is recommended for the automatic transmissions of Ford and other vehicles such as Leyland, Mazda, Volvo and older Toyota models.

Product Specifications

- Ford ESW-M2C 33-G
- Denison HF-0
- Allison C4
- General Motors Type F and G
- ZF TE-ML-09, 11 & 14
- Caterpillar T0-2
- Voith

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| Viscosity | cST @ 40°C | 39 |
| Viscosity | cST @ 100°C | 8.2 |
| Viscosity Index | | 190 |
| Flash Point | °C | 190 |
| Pour Point | °C | -40 |
| Colour | | Red |
| Density @ 20°C | kg/m³ | 864 |



Hydraulic Oil VG 32

Bell Hydraulic Oil VG 32 is a quality, rust and oxidation-inhibited oil having anti-foam properties. It contains an anti-wear additive that combines the functions of lubricating and hydraulic oils in a single product.

Application

Bell Hydraulic Oil VG 32 is intended for:

- heavy systems
- lightly to moderately loaded spur and bevel gears
- compressors (including certain rotary and other compressors)
- machine tool and other bearings
- industrial torque converters
- hydraulics couplings

Features & Benefits

Bell Hydraulics Oil VG 32 can be used in the hydraulic systems of automotive and earthmoving equipment wherever SAE 10W engine oils are normally specified or preferred due to local conditions.

Bell Hydraulic Oil can be used to good advantages in rotary sliding vane sticking is experienced with other lubricants.

Product Specifications

- Parker Denison HF0/HF1/HF2
- MAG IAS (Cincinnati Milacron) P-68/P-69/P-70
- AFNOR NFE 48-690/1 (Dry & Wet)
- AFNOR NFE 48-603
- ISO 11158 HM
- Eaton 03-401-2010
- DIN 51524 Part II
- Sauer Danfoss 520L0463
- US Steel 126, 127 and 136
- JCMAS HK
- SABS 1218-1984

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| ISO VG. | | 32 |
| Viscosity | cST @ 40°C | 30 |
| Viscosity | cST @ 100°C | 5.2 |
| Viscosity Index | | 100 |
| Pour Point | °C | -18 |
| Density @ 20°C | kg/m³ | 870 |



Hydraulic Oil VG 46

Bell Hydraulic Oil VG 46 is a high quality, rust and oxidation-inhibited oil having anti-foam properties. It contains an anti-wear additive that combines the functions of lubricating and hydraulic oils in a single product.

Application

Bell Hydraulic Oil VG 46 is intended for:

- heavy systems
- lightly to moderately loaded spur and bevel gears
- compressors (including certain rotary and other compressors)
- machine tool and other bearings
- industrial torque converters
- hydraulics couplings

Do NOT use in systems with silver-coated bearings

Features & Benefits

Bell Hydraulics Oil VG 46 can be used in the hydraulic systems of automotive and earthmoving equipment wherever SAE 15W engine oils are normally specified or preferred due to local conditions.

Bell Hydraulic Oil can be used to good advantages in rotary sliding vane sticking is experienced with other lubricants.

Product Specifications

- Parker Denison HF0/HF1/HF2
- MAG IAS (Cincinnati Milacron) P-68/P-69/P-70
- AFNOR NFE 48-690/1 (Dry & Wet)
- AFNOR NFE 48-603
- ISO 11158 HM
- Eaton 03-401-2010
- DIN 61524 Part II
- Sauer Danfoss 520L0463
- US Steel 126, 127 and 136
- JCMAS HK
- SABS 1218-1984

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| ISO VG. | | 46 |
| Viscosity | cST @ 40°C | 46 |
| Viscosity | cST @ 100°C | 6.9 |
| Viscosity Index | | 105 |
| Pour Point | °C | -15 |
| Density @ 20°C | kg/m³ | 870 |



Hydraulic Oil VG 68

Bell Hydraulic Oil VG 68 is a high quality, rust and oxidation-inhibited oil with very high viscosity index and excellent anti-rust, anti-oxidation and anti-foaming properties. it contains anti-wear additives and combines the functions of lubricating and hydraulic oils in a single product.

Application

Bell Hydraulic Oil VG 68 is intended for:

- hydraulic systems
- lightly to moderately loaded spur and bevel gears
- compressors (including certain rotary and other compressors)
- machine tool and other bearings
- industrial torque converters
- hydraulic couplings

Do NOT use in systems with silver-coated bearings

Features & Benefits

Bell Hydraulic Oil VG 68 can be used to good advantage in rotary sliding vane pumps where vane sticking is experienced with other lubricants.

Product Specifications

- Parker Denison HF0/HF1/HF2
- MAG IAS (Cincinnati Milacron) P-68/P-69/P-70
- AFNOR NFE 48-690/1 (Dry & Wet)
- AFNOR NFE 48-603
- ISO 11158 HM
- Eaton 03-401-2010
- DIN 51524 Part II
- Sauer Danfoss 520L0463
- US Steel 126, 127 and 136
- JCMAS HK
- SABS 1218-1984

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| ISO VG. | | 68 |
| Viscosity | cST @ 40°C | 64 |
| Viscosity | cST @ 100°C | 8.6 |
| Viscosity Index | | 105 |
| Pour Point | °C | -15 |
| Density @ 20°C | kg/m³ | 880 |



UTTO - Ultra

Bell UTTO Ultra is a multi-purpose gear and transmission oil with a viscosity equivalent to that of an SAE 20W engine oil.

Application

Bell UTTO Ultra is intended for:

- tractor transmissions for hydraulic systems
- differentials equipped with wet brakes
- drive train systems
- torque converters
- gear units of certain commercial and construction vehicles

Features & Benefits

Bell UTTO Ultra can serve as a replacement for all oils, other than engine oil, used for agricultural tractors. This type of oil is sometimes also referred to as Universal Tractor Oil or UTTO.

It can be used in wet brake and many drive train applications and is specially formulated for good:

- chatter suppression
- low temperature performance
- anti-foam properties

Product Specifications

- API GL-4
- Ford New Holland M2C 134-D, M2C 41B, M2C 48B & M2C 53A
- Massey Ferguson M1135, M1141, M1143
- John Deere JDM J20C
- Allison C-4
- Denison HF-0, HF-1, HF-2
- Sauer Sundstrand
- Sperry Vickers 1-280-S, m-2950-S,
- JIC 145/MS 1210
- JIC 185/MS 1204, MS 1205, MS 1206, MS 1207, B6
- Volvo transmission oil 97303
- Caterpillar T0-2

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Characteristics

| Property | Units | Typical |
|-----------------|-------------|---------|
| SAE No. | | 20W |
| Viscosity | cST @ 40°C | 55 |
| Viscosity | cST @ 100°C | 9.7 |
| Viscosity Index | | 158 |
| Pour Point | °C | 232 |
| Flash Point | °C | -30 |
| Density @ 20°C | kg/m³ | 884 |



Gear Oil 85W-140

Bell Gear Oil 85W-140 is a sulphur/phosphorous type, multipurpose, extreme pressure mineral gear oil with high load-carrying properties.

Application

Bell Gear Oil 85W-140 has been developed for:

- Spiral bevel and moderately offset hypoid axles operating under various combinations of high speed, low speed, high torque and shock load service conditions.
- Transmission of automotive equipment operating under the API service conditions quoted.

Features & Benefits

Bell Gear Oil 85W-140 is NOT recommended for automotive synchromesh gearboxes or final drives where GL-4 oils with milder extreme pressure properties are recommended.

Product Specifications

- API GL-5
- MIL-L-2105D
- ZF TE-ML 01, 05, 07

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| SAE No. | | 85W-140 |
| Viscosity | cST @ 40°C | 366 |
| Viscosity | cST @ 100°C | 26.6 |
| Viscosity Index | | 97 |
| Pour Point | °C | -12 |
| Flash Point (COC) | °C | 180 |
| Density @ 20°C | kg/m³ | 902 |



Gear Oil Limited Slip 80W-90

Bell Gear Oil Limited Slip 80W-90 is a premium quality, multipurpose gear lubricant containing sulphur-phosphorus EP additives developed to meet the rigorous demands of commercial-fleet manual transmissions, drive axles and final drives.

Application

This product is also suitable for similar components of farm and earth moving equipment and passenger cars. When properly applied at the intervals recommended by car manufacturers, this oil complies with new car warranty requirements.

Bell Gear Oil Limited Slip 80W-90 is recommended for smooth efficient operation of limited slip (LS) differentials.

Features & Benefits

Bell Gear Oil Limited Slip 80W-90 has the following features and benefits:

- Resistance to high temperature oxidation
- Multipurpose capability minimises misapplication
- Protection against wear and scoring under all operating conditions including high torque - shock loading
- Protection against rust and corrosion in wet operating conditions.

Bell Gear Oil Limited Slip 80W-90 is suitable for initial fill, top-up and refill of manual gearboxes, gear-cases of semi-automatic transmission where EP gear oils are recommended, as well as drive axles and final drives of passenger cars, bakkies trucks and earth moving, mine and farm equipment.

The exceptional chemical and thermal stability of this oil permit its use at intermittent bulk oil temperature up to 150° C with appropriate drain and refill schedules.

Product Specifications

- API GL-5
- MIL-L-2105B
- ZF TE-ML-05C, 12C, 16E and 21C
- VW TL-754
- GMC Spec No: 998035
- Ford ESW-M2C 119 A and 104 a plus
- Mack GO-F

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|-------------|---------|
| Property | Units | Typical |
| SAE No. | | 80W-90 |
| Viscosity | cST @ 40°C | 131 |
| Viscosity | cST @ 100°C | 14.4 |
| Viscosity Index | | 109 |
| Pour Point | °C | -27 |
| Flash Point (COC) | °C | 180 |
| Density @ 20°C | kg/m³ | 902 |



Gear Oil Limited Slip 85W-140

Bell Gear Oil Limited Slip 85W-140 is a premium quality, multipurpose gear lubricant containing sulphur-phosphorus EP additives developed to meet the rigorous demands of commercial-fleet manual transmissions, drive axles and final drives.

Application

This product is also suitable for similar components of farm and earth moving equipment and passenger cars. When properly applied at the intervals recommended by car manufacturers, this oil complies with new car warranty requirements.

Bell Gear Oil Limited Slip 85W-140 is recommended for smooth efficient operation of limited slip (LS) differentials.

Features & Benefits

Bell Gear Oil Limited Slip 80W-90 has the following features and benefits:

- Resistance to high temperature oxidation
- Multipurpose capability minimises misapplication
- Protection against wear and scoring under all operating conditions including high torque - shock loading
- protection against rust and corrosion in wet operating conditions.

Bell Gear Oil Limited Slip 85W-140 is suitable for initial fill, top-up and refill of manual gearboxes, gear-cases of semi-automatic transmission where EP gear oils are recommended, as well as drive axles and final drives of passenger cars, bakkies, trucks and earth moving, mine and farm equipment.

The exceptional chemical and thermal stability of this oil permit its use at intermittent bulk oil temperature up to 150° C with appropriate drain and refill schedules.

Product Specifications

- API GL-5
- MIL-L-2105B
- ZF TE-ML-05C, 12C, 16E and 21C
- VW TL-754
- GMC Spec No: 998035
- Ford ESW-M2C 119 A and 104 a plus
- Mack G0-F

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Characteristics

| Property | Units | Typical |
|-----------------|-------------|---------|
| SAE No. | | 85W-140 |
| Viscosity | cST @ 40°C | 366 |
| Viscosity | cST @ 100°C | 26.6 |
| Viscosity Index | | 97 |
| Pour Point | °C | -12 |
| Flash Point | °C | 180 |
| Density @ 20°C | kg/m³ | 902 |



E# WDB Cooling Oil

Bell E# WDB Cooling Oil is a semi-synthetic, high performance, multipurpose automatic transmission fluid (ATF). It provides outstanding performance in automatic transmissions and power steering units where General Motors Dexron III-G and the older Dexron III-F, II-E or II-D fluids are specified. It is also suitable for use in applications calling for Allison TES 389 performance levels. Its properties make it suitable for use in specific wet disc brake applications as well.

Application

Bell E# WDB Cooling Oil is primarily used in Bell designed sealed Wet Disc Brake (WDB) systems of the Bell B35E to B60E articulated dump trucks. This oil is not suitable for use in axles which use a common brake and axle oil.

Features & Benefits

Bell E# WDB Cooling Oil has the following benefits:

- Good wear protection maximizes component life
- Compatibility with seal materials
- Increased oil life and protection against deposit formation
- Excellent frictional characteristics giving smooth operation

Product Specifications

- DEXRON III-G
- MERCON
- Allison C-4
- ZF TE-ML 02F, 03D, 14A, 17C
- Voith 55.6335
- MAN 339 Type F
- Mercedes 236.1

Storage & Handling

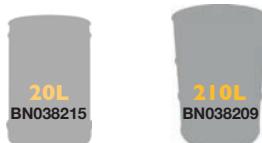
Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Characteristics | | |
|-------------------------|---------------|---------|
| Property | Units | Typical |
| Viscosity | mPa.s @ -40°C | 40 000 |
| Viscosity | cST @ 40°C | 38 |
| Viscosity | cST @ 100°C | 8.1 |
| Viscosity Index | | 194 |
| Pour Point | °C | -36 |
| Flash Point | °C | 190 |



Super Gear Oil

Bell Super Gear Oil is a multipurpose gear and transmission oil with borate-enhanced EP properties. the special borate-based additive provides additional protection of gears against wear (scoring, pitting, ridging, rippling), optimum friction coefficient as well as protection of the synchronizer ring against wear.

Application

Super Gear Oil is intended for:

- Tractor transmissions and hydraulic systems
- differentials equipped with wet brakes.
- drive train systems
- take-off clutches
- torque converters
- gear units of certain commercial and construction vehicles
- Final Drives

Features & Benefits

Bell Super Gear Oil can serve as a replacement for all oils, other than engine oil, used in agricultural tractors.

It can be used in wet brake and many drive train applications and is specially formulated for good:

- chatter suppression
- low temperature performance
- anti-foam properties

Product Specifications

- Allison C-3 & C-4
- MASSEY FERGUSON M1143
- Ford M2C134-A/B/C/D
- API GL-4 & GL-5
- Renault
- Caterpillar TO-2
- KUBOTA, DEUTZ, FIAT
- John Deere J20C
- JJ Case MS 1207, MS 1210 -B6

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Characteristics

| Property | Units | Typical |
|-------------------|--------------------|---------|
| Viscosity @ 100°C | mm ² /s | 14.2 |
| Viscosity @ 40°C | mm ² /s | 82.5 |
| Viscosity Index | | 160 |
| Pour Point | °C | -32 |
| Flash Point (COC) | °C | 230 |
| Density @ 20°C | kg/m ³ | 882 |



Cone Lube

Bell Cone Lube is synthetic high performance oil particularly suited to gear applications requiring micropitting resistance. The product is formulated with polyalphaolefins (PAO) base stocks in order to provide performance greatly superior to conventional petroleum oils. The molecular structure of PAO resembles that of high quality petroleum oils. Indeed, PAO fluids are fully compatible with petroleum base oils while offering significantly improved load carrying ability, excellent wear and rust protection, high viscosity index, high flash point, low pour point, outstanding oxidative stability, and cleaner running systems.

Application

Bell Cone Lube is particularly suited to gear applications operating under extreme service conditions. The products are recommended for all types of enclosed gear drives, bearings, including plain rolling elements and anti-friction types. In addition, applications requiring high micro-pitting resistance such as in Wind Turbine Gear Systems.

Features & Benefits

The specific formulation of Cone Lube oil ensures:

- Excellent oxidation and thermal stability
- High operating temperature range
- Lower maintenance costs
- Excellent load carrying ability
- Extended lubricant life
- Improved cleanliness

Product Specifications

- ANSI/AGMA 9005(table 3)
- Cincinnati Machine P-35 (ISO 460) % P-59 (320)
- David Brown S1.53.101
- DIN 51.517 Part 3
- Flenders GmbH as a High Micro Pitting Resistant Lubricant
- AISE 224

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|----------------------------------|-------------|---------|
| Property | Units | Typical |
| ISO VG. | | 220 |
| Viscosity | cST @ 40°C | 238 |
| Viscosity | cST @ 100°C | 28.1 |
| Viscosity Index | | 154 |
| Flash Point | °C | >250 |
| FZG Pass Load Stage | | 12 |



Brake Fluid

Bell Brake Fluid DOT 4 complies with the National Compulsory Standard Specification for Hydraulic Brake Fluids.

Application

- The DOT 4 product is intended for systems where operating temperatures can rise to above 260°C but will not exceed 270°C
- The grade number allocated to this product reflects the maximum permissible operating temperature
- This grade is a heavy duty product and is equally suitable for hydraulic clutch systems where operating temperatures are generally below those in brake systems

Features & Benefits

- Bell Brake Fluid DOT 4 is not a mineral oil, but somewhat toxic hydraulic fluids, blended from glycols and selected additives. Skin and eye contact should be avoided. If swallowed obtain medical assistance. Avoid spillage onto vehicle paintwork which can be damaged if left in contact with the product.
- The fluid is fully compatible with the natural rubber seals of automotive brake systems.
- The product is hygroscopic (absorb water) and should be replaced annually, especially in coastal areas, to prevent rusting of components and possible brake failure due to water vapour in the system. Containers must be kept tightly sealed.

Product Specifications

- U.S. Federal FMVSS No. 116 DOT 4
- S.A Government Mandatory requirement

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|--------------------------------------|-------------|---------|
| Property | Units | Typical |
| Dry Equilibrium Reflux Boiling Point | °C | 270 |
| Wet Equilibrium Reflux Boiling Point | °C | 170 |
| Viscosity | cST @ 100°C | 1.5 |
| Viscosity | cST @ -40°C | 1100 |
| Neutrality | pH | 8 |



Extended Life Coolant - Premix 50

Extended Life Coolant Premix 50 is a nitrite-, amine-, phosphate-, silicate-, and borate-free coolant based on ethylene glycol.

Application

Bell Extended Life Coolant - Premix 50 gives outstanding protection against frost, corrosion and overheating in all modern engines, but especially highly loaded aluminium engines. It effectively protects against corrosion and deposits in the cooling system with its vital parts, the coolant channels in the block and cylinder head, theradiator, the water pump and the heater core.

It is **Ready to Use** and no water must be added.

Features & Benefits

It is recommended that the antifreeze in a cooling system be replaced annually. Before a cooling system is filled with Bell Extended Life Coolant - Premix 50 it should be drained and thoroughly flushed with clean water. Do not top up with plain water but use the same product as used for the initial fill.

DO NOT MIX DIFFERENT BRANDS OF ANTIFREEZE.

Product Specifications

- MB 326.3 (325.3)
- MAN 324 SNF
- MTU MTL 5048
- ASTM D 1384, ASTM D 2570, ASTM D 2809 and ASTM D 4340
- VW / Audi / Seat / Skoda TL 774 - D/F
- Porsche

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Physical Characteristics

| Property | Units | Typical |
|----------------|-------------|-----------|
| Viscosity | cSt @ 20°C | 3,0 - 5,0 |
| Density | kg/l @ 20°C | 1,067 |
| Ash Content. | % m/m | 0,6 |
| Freezing Point | Min. °C | -37 |



Extended Life Coolant - Premix 50 Ultra

Bell Extended Life Coolant Premix 50 Ultra is a ready to use engine coolant based on ethylene glycol. It contains a corrosion inhibitor package based on salts of organic acids and silicates (Si-OAT coolant). It is free of nitrites, amines, phosphates and borates. is a premixed, ready to use coolant, that is a nitrite-, amine-, phosphate-, silicate-, and borate-free.

Application

Bell Extended Life Coolant Premix 50 Ultra gives outstanding protection against frost, corrosion and overheating in all modern engines, but especially highly loaded aluminium engines. It effectively protects against corrosion and deposits in the cooling system with its vital parts, the coolant channels in the block and cylinder head, the radiator, the water pump and the heater core. It is ready to use and no water must be added

Features & Benefits

It is recommended that the antifreeze in a cooling system be replaced annually. Before a cooling system is filled with Bell Extended Life Coolant Premix 50 Ultra it should be drained and thoroughly flushed with clean water. Do not top up with plain water but use the same product as used for the initial fill.

DO NOT MIX DIFFERENT BRANDS OF ANTIFREEZE.

Product Specifications

- MB 325.5
- MAN 324 type Si-OAT
- VW/Audi/Seat/Skoda TL 774-G
- Cummins 14603
- Porsche
- ASTM D 3306
- ASTM D 4985
- STM D 6210

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Physical Characteristics

| Property | Units | Typical |
|----------------|-------------|-----------|
| Viscosity | cSt @ 20°C | 3,0 - 5,0 |
| Density | kg/l @ 20°C | 1,075 |
| Ash Content. | % m/m | 0.6 |
| Freezing Point | Min. °C | -37 |



Extended Life Coolant - Premix 50 N

Bell Extended Life Coolant - Premix 50 N is a ready to use engine coolant based on ethylene glycol. It contains a hybrid corrosion inhibitor package with nitrates, salts of organic acids and silicates. Bell Extended Life Coolant Premix 50 N is free from amines and phosphates.

Application

Bell Extended Life Coolant Premix 50 N is designed to protect engines of both ferrous and aluminum construction against corrosion and frost damage. It contains a blend of inhibitors designed to give a high degree of corrosion protection to engine components such as radiators, cylinder blocks/heads and water pumps. Due to its nitrite content this product is especially recommended for use in heavy-duty engines.

It is **Ready to Use** and no water must be added.

Features & Benefits

It is recommended that the antifreeze in a cooling system be replaced annually. Before a cooling system is filled with Bell Extended Life Coolant Premix 50 N, it should be drained and thoroughly flushed with clean water. Do not top up with plain water but use the same product as used for the initial fill.

DO NOT MIX DIFFERENT BRANDS OF ANTIFREEZE.

Product Specifications

- MB 325.0
- MTU MTL 5048
- JDM H 24
- Ford WSS-97B51-A1
- Chrysler MS-9769
- ASTM D 3306
- ASTM D 6210

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Physical Characteristics

| Property | Units | Typical |
|----------------|-------------|-----------|
| Viscosity | cSt @ 20°C | 3,0 - 5,0 |
| Density | kg/l @ 20°C | 1,075 |
| Water Content | % | 50 |
| Freezing Point | Min. °C | -37 |



Grease - Multi Purpose

Bell Multi Purpose grease is a smooth textured, NLGI 2 Lithium 12 hydroxystearate based greases which contain an EP (extreme pressure) additive, oxidation, rust, and corrosion inhibitors. This grease provides exceptional wear protection, good water wash resistance, low temperature dispensing and long life in bearings operating at elevated temperatures.

Application

Bell Multi Purpose grease can be used wherever an extreme pressure grease of this type and grade is required or preferred and is recommended for the long term lubrication of equipment operating within a temperature range of:

- 12°C to 130°C. Some of its usages include:
 - general purpose automotive and chassis applications
 - machine tool applications
 - industrial antifriction and plain bearings
- Bell Multi Purpose grease should be used with caution in automotive wheel bearings where peak operating temperatures may exceed 130°C due to heat transfer from adjacent disc brakes.

Features & Benefits

Some of the benefits are:

- Excellent pumpability
- Shock Load capability
- Multipurpose convenience
- Superior wear protection
- Very good resistance to water wash.

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn. Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|----------------------------------|--------|---------|
| Property | Units | Typical |
| NLGI Grade | | 2 |
| Thickener Type | | Lithium |
| Colour | | Brown |
| Penetration, @ 25°C Worked | 0.1 mm | 280 |
| Dropping Point | °C | 192 |
| Viscosity of Base Oil @ 40°C | cSt | 190 |
| 4-Ball wear, Scar diameter | mm | 0.5 |
| 4-Ball EP Weld Load | N | 3000 |
| Timken OK Load | Lbs | 60 |



Grease - Super Heavy Duty

Bell Super Heavy Duty grease is a high performance multi-purpose grease containing solid lubricants. It is manufactured from solvent refined oils and it incorporates multi-functional extreme pressure additives as well as rust/corrosion inhibitors, anti-oxidation additives and molybdenum disulphide. Its service temperature range is between -15°C and 130°C.

Application

It is recommended for the long term lubrication of industrial and automotive equipment where heavy loading and/or shock loads are encountered and can be used for:

- General purpose automotive and chassis applications including fifth wheels, kingpins, steering and universal joints.
- Bulldozers, front-end loaders and other construction equipment.
- Mining equipment.
- Other applications include Constant velocity joints (CVJ), machine tools, geared couplings at normal speeds, vibrating shafts and sliding mechanisms.

Features & Benefits

Bell Super Heavy Duty Grease provides emergency run properties because of its molybdenum disulphide content, which plates out onto metal surfaces to form a solid lubricating film that reduces friction and wear between lengthy re-greasing intervals.

Product Specifications

- NLGI 2
- Lithium Moly Based EP

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|--|--------|-----------------|
| Property | Units | Typical |
| NLGI Grade | | 2 |
| Thickener Type | | Lithium Calcium |
| Colour | | Grey/Black |
| Penetration, @ 25°C Worked | 0.1 mm | 280 |
| Dropping Point | °C | 190 |
| Viscosity of Base Oil @ 40°C | cSt | 430 |
| 4-Ball wear, Scar diameter | mm | 0.46 |
| 4-Ball EP Weld Point | kg | 380 |
| Timken OK Load | Lbs | 55 |
| Proprietary Dual Solid Additives (Molybdenum Disulphide) | % | 5 |



Grease - Wheel Bearing

Bell Wheel Bearing is a multi-purpose lithium complex based grease developed for high temperature and long-term performance in industrial and automotive applications. The grease possesses good fretting corrosion protection, good water tolerance, resistance to water wash-out, and reliable corrosion protection combined with excellent mechanical stability and good load-carrying capabilities. It contains EP, Rust and Anti-oxidant additives.

Wheel Bearing grease has a wide operating temperature range, -30°C and +150°C.

Application

This product is suitable for grease-lubricated bearings at low and high speeds including electric motors, automotive bearings and various antifriction bearings in the mining, petrochemical, construction and steel industries. It has good pumpability properties and can be used in centralized lubrication systems

Features & Benefits

Some of the benefits are:

- Good high temperature stability
- Extreme pressure capability
- Resistance to water washout
- Excellent rust and corrosion protection
- Long service life

Product Specifications

- NLGI 2
- NLGI GC - LB

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

Typical Physical Characteristics

| Property | Units | Typical |
|------------------------------|--------|-----------------|
| NLGI Grade | | 2 |
| Thickener Type | | Lithium Complex |
| Colour | | Natural |
| Penetration, @ 25°C Worked | 0.1 mm | 280 |
| Dropping Point | °C | >260 |
| Viscosity of Base Oil @ 40°C | cSt | 170 |
| Water Resistance | | 1 - 90 |
| Corrosion Protection | | Degree 0/0 |
| Copper Strip Test | Lbs | Degree 1 |



Slew Ring Grease

Bell Slew Ring Grease is a smooth-textured, functional polymer based dual thickened lithium-calcium, resilient ultra heavy duty grease of NLGI 2 consistency, which combines the performance advantages of both lithium and calcium greases. It boasts exceptional Extreme Pressure (EP) additives, outstanding film thickness enhancement through advanced polymer technology to reinforce boundary lubrication scenarios built around a high viscosity base oil, oxidation, rust and corrosion inhibitors and is fortified with proprietary dual solid friction reduction additives. Ultimate wear protection, water washout and spray off resistance, along with enhanced rust inhibition. It has an operating temperature range of -15°C to 130°C.

Application

Bell Slew Ring Grease is recommended for use as chassis grease and it is dynamic for "off-road" applications in civil engineering (pin and bush) and agriculture. Further applications include lubrication of industrial plain and anti-friction bearings where severe or shock loads are experienced.

Exceptional in applications involving oscillating or limited relative motion, where fretting corrosion is likely to occur.

Features & Benefits

Some of the benefits are:

- Ultra high shock load capability.
- Superior resistance to water washout and spray off.
- Multi application convenience.
- Resilient wear, oxidation and rust protection.
- Dual solid lubricants for reduced friction and energy savings.

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|--|--------|-----------------|
| Property | Units | Typical |
| NLGI Grade | | 2 |
| Thickener Type | | Lithium Calcium |
| Colour | | Grey / Black |
| Penetration, @ 25°C Worked | 0.1 mm | 280 |
| Dropping Point | °C | 190 |
| Viscosity of Base Oil @ 40°C | cSt | 1000 |
| 4-Ball Wear, Scar diameter | mm | <0.3 |
| 4-Ball EP Weld Point | kg | 800 |
| Timken OK Load | Lbs | >60 |
| Proprietary Dual Solid Additives (Includes Molybdenum Disulphide) | % | 5 (min) |
| VKA - Welding Load | N | >6000 |



Grease - High Temperature

Bell High Temperature Grease is a premium industrial grease made from synthetic hydrocarbon fluid, a non-soap bentonite thickener and selected additives. It is characterised by low and high temperature lubricating ability, well beyond mineral oil-based greases. It exhibits outstanding low torque, long lubricant life, low bearing wear, high load carrying ability, corrosion protection and good water resistance.

Application

Bell High Temperature Grease is recommended for wide temperature range, multi-service applications in plain and anti-friction bearings, wheel bearings, gears, slides, cams and other services where friction reduction and low wear is required. It is particularly suitable for hot electric motors, fans and bearings in paper mill and plastics production equipment. In sub-zero temperature service it finds application in freezer plants and outdoor mobile equipment. High Temperature Grease application temperature range is nominally -40 °C to 180 °C.

Features & Benefits

Bell High Temperature Synthetic grease has the following features and benefits:

- Good oxidation and thermal stability
- Excellent rust and corrosion protection
- Extended lubrication intervals and equipment life
- It also offers excellent mechanical stability

Product Specifications

- PAO
- DIN 51825 KP 2 - R - 20
- NLGI 2

Storage & Handling

Avoid elevated temperatures (exceeding 100°C) and contact with water and other fluids. Do not store in open or unlabelled containers. Store away from strong oxidising agents or combustible material.

Typical Physical Characteristics

| Property | Units | Typical |
|-------------------------------|-------|------------------------|
| NLGI Grade | | 2 |
| Thickener Type | | Organophylic Bentonite |
| Colour | | Beige |
| Penetration, @ 25°C Worked | | 265 - 295 |
| Dropping Point | | Non-melt |
| Viscosity of Base Oil @ 40°C | | 100 |
| Viscosity of Base Oil @ 100°C | | 16 |
| Base Oil | | PAO |
| 4-Ball Weld Load | | 2600 |



Cutter Bar Oil

Bell Cutter Bar Oil is formulated to meet the special requirements of cutter bar lubrication.

Application

The combination of medium viscosity oil, tackiness, and anti-wear additives provide excellent performance and wear protection.

Features & Benefits

Bell Cutter Bar Oil adheres strongly to metal surfaces due to its tacky nature and resists being flung off from the cutter bar during operation.

Contains no PCB's

Product Specifications

- ISO VG 150

Storage & Handling

Use PVC, nitrile or other oil resistant gloves and protective clothing to prevent skin contact. Where eye contact is a potential hazard, goggles should be worn.

Avoid temperatures above 80°C and strong oxidizing agents.

Ambient temperatures and atmospheric pressures normally encountered within buildings or roofed-over outdoor storage areas are acceptable.

Avoid entering areas where mists or vapours have built up as a result of abnormal temperatures or pressures without the proper breathing equipment and protective clothing.

| Typical Physical Characteristics | | |
|----------------------------------|-------|---------|
| Property | Units | Typical |
| Viscosity @ 40°C | cSt | 148 |
| Flash Point (COC) | °C | 228 |
| Pour Point °C | °C | -6 |
| Viscosity @ 100°C | cSt | 14.4 |



Battery Terminal Protector

Battery Terminal Protector is an aerosol spray that protect battery terminals against corrosion. This is a clear spray and can be used on both terminals.

Application

Battery Terminal Protector should be sprayed over terminals after they have been cleaned.

Features & Benefits

- Protects terminals and all metal surfaces against corrosion.
- Suitable for home, car and industrial use.

200ml BN024669

Brake Cleaner

Bell Brake Cleaner is a heavy duty brake system cleaning spray for cleaning drum and disk brake systems without disassembly.

Application

Brake Cleaner is primarily used on drum and disk brakes, brake cables, rotors and disk pads / drum lining surfaces.

Features & Benefits

- Reduce brake squeal.
- Improve brake performance.
- Fast drying. No residue.
- Removes brake pad phenolic resins, dust and other degradation products.

500ml BN024671

Chrome Compound

"Bell Chrome Compound is an anti--seize compound for all threads."

Application

Chrome Compound should be applied to all threads and surfaces where a low break out torque is required.

Features & Benefits

- Effective as an anti-seize up to 1500°C.
- Low break out torque.

0.5kg
BN024672

Engine Cleaner & Degreaser

Bell Engine Cleaner and Degreaser is a highly concentrated degreasing agent.

Application

Bell Engine Cleaner and Degreaser is suitable for all workshop applications.

Features & Benefits

- Heavy duty emulsifiable solvent cleaner.
- Dissolves oils and greases and emulsifies it so that it can be rinsed off with water.



Water-based Cleaner

Bell Water-based Cleaner is a water based degreasing agent.

Application

Bell Water-based Cleaner is suitable for removing grease, oils and soils from engine components.

Features & Benefits

- Environmentally friendly.
- Rinse oil, grease and solvents off components with water.



Extreme Cleaner

Bell Extreme Cleaner is a powerful multi purpose detergent cleaner in a trigger pump spray bottle.

Application

Bell Extreme Cleaner is an environmentally friendly multi-purpose cleaner for the car, home, office and workshop.

Household

Removes stubborn stains, oil, grease, grit and grime from appliances, kitchens, floors, bathrooms, sinks, mirrors, windows, tiles and fabrics.

Outdoor

Cars, engines, workshops, tools.

Features & Benefits

- Contains no abrasives, ammonia or bleach.

750ml BN024677

Electrical Cleaner

Bell Electrical Cleaner a high dielectric strength cleaner especially developed for the electronics industry.

Application

Bell Electrical Cleaner can be used on a variety of applications like:

Electronics

Computers, PC boards, relays.

Electrical

Switches, electro-mechanical devices.

Telecommunications

Transceivers, connectors.

Avonics

Radar, navigational equipment.

Home

DVD and Blue Ray Players, audio equipment, TV sets.

Office

Telephone, switchboards, calculators, computer keyboards and electronic equipment.

Features & Benefits

- Leaves no residue.
- Fast drying.
- Non Flammable.

350ml BN024681

Rubber Grease

Bell Rubber Grease is an inorganically thickened vegetable--oil based grease fortified with extreme pressure and anti-corrosion additives.

Application

Bell Rubber Grease should be used when assembling rubber components such as hydraulic brake, clutch and suspension rubbers to prevent swelling or hardening. Lubricating plastic and rubber components such as o-rings, valves, diaphragms and cup and seals.

Features & Benefits

Compatible with natural and synthetic rubbers.



Multi-Purpose Lubricant

Bell Multi--Purpose Lubricant is a rust penetrant and moisture disperant that leaves an anti--corrosive film.

Application

Bell Multi-Purpose Lubricant has excellent cleaning properties on electrical switchgear.

Features & Benefits

- Non Flammable.
- Excellent cleaning properties on electrical switchgear.
- Meets MIL-C-16173D specification
- Safe for underground mine applications or environments where explosive conditions exist.



Petroleum Products - Common Terms

ABRASIVE WEAR

Wear between two surfaces in relative motion due to particles (three body) or surface roughness (two body).

ACID NUMBER

A measure of the amount of potassium hydroxide (KOH) needed to neutralise all or part of the acidity of a petroleum product.

ADDITIVE

Any material added to a base stock to change its properties, characteristics or performance.

ADHESIVE WEAR

Wear caused by metal-to-metal contact, characterised by local welding and tearing of the surface. Also known as "galling".

ANILINE POINT

The lowest temperature at which equal volumes of aniline and hydrocarbon fuel or lubricant base stock are completely miscible. A measure of the aromatic content of a hydrocarbon blend, used to predict the solvency of a base stock or the cetane number of a distillate fuel.

ANTIFOAM AGENT

An additive used to suppress the foaming tendency of petroleum products in service. May be a silicon oil to break up surface bubbles or a polymer to decrease the number of small entrained bubbles.

ANTISTATIC ADDITIVE

An additive that increases the conductivity of a hydrocarbon fuel to hasten the dissipation of electrostatic charges during high-speed dispensing, thereby reducing the fire/explosion hazard.

ANTIWEAR AGENT

An additive or its reaction products which form thin, tenacious films on highly loaded parts to prevent metal-to-metal contact.

APPARENT VISCOSITY

A measure of the viscosity of a non-Newtonian fluid under specified temperature and shear rate conditions.

BLACK OILS

Lubricants containing asphaltic materials, which impart extra adhesiveness, that are used for open gears and steel cables.

BLOW-BY

Passage of unburned fuel and combustion gases past the piston rings of internal combustion engines, resulting in fuel dilution and contamination of the crankcase oil.

BOUNDARY LUBRICATION

Lubrication between two rubbing surfaces without the development of a full-fluid lubricating film. Occurs under high loads and requires the use of antiwear and extreme-pressure (EP) additives to prevent metal-to-metal contact.

BRIGHT STOCK

A heavy residual lubricant stock with low pour point, used in finished blends to provide good bearing film strength, prevent scuffing and reduce oil consumption. Usually identified by its viscosity in SUS @ 210°F or cSt @ 100°C.

BRINELLING

Denting caused by impact of one bearing component against another while stationary.

BROMINE NUMBER (VALUE)

The percentage of bromine that will be absorbed by a chemically unsaturated substance (base oil, vegetable oil, rubber, etc.) in a given time under arbitrary conditions. A measure of unsaturation.

Petroleum Products - Common Terms

BROOKFIELD VISCOSITY

A measure of apparent viscosity as determined by the Brookfield viscometer at a controlled temperature and shear rate.

CAMS

Eccentric shafts used in most internal combustion engines to open and close valves.

CARBON RESIDUE

Coked material remaining after an oil has been exposed to high temperatures under controlled conditions.

CATALYTIC CONVERTER

An integral part of vehicle emission control systems since 1975. Oxidising converters remove hydrocarbons and carbon monoxide (CO) from exhaust gases, while reducing converters control nitrogen oxide (NO_x) emissions. Both use noble metal (platinum, palladium or rhodium) catalysts that can be "poisoned" by lead or phosphorous compounds in the fuel or lubricant.

CAVITATION

The formation and subsequent collapse of vaporous cavities within a liquid, caused by vigorous movement or vibration within the liquid.

CAVITATION DAMAGE

An erosion process in which metal is slowly removed by cavitation.

CENTIPOISE

Measurement unit of absolute (or dynamic) viscosity of a fluid. One centiPoise (cP) equals 0.01 Poise and is equivalent to one milliPascal-second (mPa·s) in SI units. See definition of Poise in this section.

CENTISTOKE

Measurement unit of kinematic viscosity of a fluid. One centiStoke equals 0.01 Stokes and is equivalent to one mm²/sec in SI units. See definition of Stoke in this section.

CETANE INDEX

A value calculated from the physical properties of a diesel fuel to predict its cetane number.

CETANE NUMBER

A measure of the ignition quality of a diesel fuel, as determined in a standard single cylinder test engine, which measures ignition delay compared to primary reference fuels. The higher the cetane number, the easier a high-speed, direct-injection engine will start and the less "white-smoking" and "diesel-knock" after startup.

CETANE NUMBER IMPROVER

An additive (usually an organic nitrate) that boosts the cetane number of a fuel.

CLOUD POINT

The temperature at which a cloud of wax crystals appears when a lubricant or distillate fuel is cooled under standard conditions. Indicates the tendency of the material to plug filters or small orifices under cold weather or operating conditions.

COLD CRANKING SIMULATOR (CCS)

An intermediate shear rate viscometer that predicts the ability of an oil to permit a satisfactory cranking speed to be developed in a cold engine.

COMPRESSION RATIO

In an internal combustion engine, the ratio of the volume of combustion space at bottom-dead-center to that of top-dead-centre.

COPPER STRIP CORROSION

A qualitative measure of the tendency of a petroleum product to corrode pure copper.

Petroleum Products - Common Terms

CORROSION INHIBITOR

Additive that protects lubricated metal surfaces from chemical attack by water or other corrosive contaminants.

CORROSIVE WEAR

Wear caused by chemical reaction.

CROWN

The top of the piston in an internal combustion engine above the fire ring, exposed to direct flame impingement.

DEMULSIBILITY

A measure of a fluid's ability to separate from water.

DENATURANTS

Toxic or noxious components used in fuel ethanol to make it unfit for use as a beverage.

DENSITY

Mass per unit volume.

DETERGENT

Substance added to fuels or lubricants to keep engine parts clean. In motor oil formulations commonly used detergents are metallic soaps with reserve basicity to neutralise acids formed during combustion.

DETERGENT/DISPERSANT

An additive package that combines a detergent with a dispersant.

DETONATION

Uncontrolled burning of the last portion (end gas) of an air/fuel mixture in the cylinder of a spark-ignition engine. Also known as "knock" or "ping".

DILUTION OF ENGINE OIL

Contamination of crankcase oil by unburned fuel, leading to reduced viscosity and flash point. May indicate component wear or fuel system maladjustment.

DISPERSANT

An additive that helps keep solid contaminants in a crankcase oil in colloidal suspension, preventing sludge and varnish deposits on engine parts. Usually non-metallic ("ashless") and used in combination with detergents.

DISTILLATION

The basic test used to characterise the volatility of a gasoline or distillate fuel.

ELASTOHYDRODYNAMIC LUBRICATION (EHL)

A lubrication regime characterised by high unit loads and high speeds in rolling elements where mating parts deform elastically due to the incompressibility of the lubricant film under very high pressure.

EMISSIONS (MOBILE SOURCES)

The combustion of fuel leads to the emission of exhaust gases that may be regarded as pollutants. Water and CO₂ are not included in this category but CO, NO_x and hydrocarbons are subject to legislative control. All three are emitted by gasoline engines. Diesel engines also emit particulates that are controlled.

EMISSIONS (STATIONARY SOURCES)

Fuel composition can influence emissions of sulphur oxides and particulates from power stations. Local authorities control the sulphur content of heavy fuel oils used in such applications.

Petroleum Products - Common Terms

EMULSIFIER

Additive that promotes the formation of a stable mixture, or emulsion, of oil and water.

END POINT

Highest vapour temperature recorded during a distillation test of a petroleum stock.

ENGINE DEPOSITS

Hard or persistent accumulation of sludge, varnish, lacquer and carbonaceous residues due to blow-by of unburned or partially burned fuel, or the partial breakdown of the crankcase lubricant. Water from the condensation of combustion products, carbon, residues from fuel or lubricating additives, dust and metal particles also contribute.

EP AGENT (EXTREME PRESSURE ADDITIVE)

Lubricant additive that prevents sliding metal surfaces from seizing under extreme pressure conditions.

EPA COMPLEX MODEL

More restrictive than the simple model and contains limits on RVP, oxygen, olefins, benzene, sulphur and T-90.

EPA SIMPLE MODEL

Used to define reformulated gasoline effective January 1, 1995. The model includes RVP and oxygen content requirements to reduce volatile organic compound emissions. It caps oxygen, benzene, sulphur, olefins and T-90 content at levels equal to or lower than a refiner's 1990 baseline.

EROSION

Wearing away of a surface by an impinging fluid or solid.

EXHAUST GAS RETICULATION (EGR)

System to reduce automotive emission of nitrogen oxides (NO_x). It routes exhaust gases into the carburetor or intake manifold where they dilute the air/fuel mixture and reduce peak combustion temperatures, thereby reducing the tendency for NO_x to form.

FAS

Free alongside. An import/export term.

FOS

Free on board. An import/export term.

FOT

Free on truck. An import/export term.

FALSE BRINELLING

Fretting of one bearing component against another. May appear as a dent but original surface is worn away.

FATIGUE

Cracking, flaking or spalling of a surface due to stresses beyond the endurance or elastic limit of the material.

FERROGRAPHY

Magnetic particle analysis.

FLASH POINT

Minimum temperature at which a fluid will support instantaneous combustion (a flash) but before it will burn continuously (fire point). Flash point is an important indicator of the fire and explosion hazards associated with a petroleum product.

Petroleum Products - Common Terms

FLUID FRICTION

Occurs between the molecules of a gas or liquid in motion and is expressed as shear stress. Unlike solid friction, fluid friction varies with speed and area.

FRETTING

Wear resulting from small-amplitude motion between two surfaces. May produce wear material in the form of red or black oxide.

FRiction

Resistance to motion of one object over another. Friction depends on the smoothness of contacting surfaces as well as the force with which they are pressed together.

FROST

Field of micropits. Form of microadhesive wear.

FUEL ETHANOL

Ethanol (ethyl alcohol – C₂H₅OH) with impurities, including water but excluding denaturants.

GALLING

See adhesive wear.

GASEOUS FUELS

Liquefied or compressed hydrocarbon gases (propane, butane or natural gas), which are finding increasing use in motor vehicles as replacements for gasoline and diesel fuels.

GASOLINE

A volatile mixture of liquid hydrocarbons containing small amounts of additives and suitable for use as a fuel in spark-ignition, internal combustion engines.

GASOLINE/ETHANOL BLEND

A spark-ignition automotive engine fuel containing denatured fuel ethanol in a base gasoline. It may be leaded or unleaded.

GRAvITY

In petroleum products, the mass/volume relationship expressed as:

GROSS ADDITIVE TREATMENT COST (GATC)

The cost of additive in one volume unit of finished product, not including base fluid credit or shipping costs.

GROSS DELIVERED TREATMENT COST (GDTC)

The cost of additive in one unit volume of finished product including shipping cost but not base fluid credit.

HIGH TEMPERATURE HIGH SHEAR RATE (HTHS) VISCOSITY

A measure of a fluid's resistance to flow under conditions resembling highly loaded journal bearings in fired internal combustion engines, typically 1 million s⁻¹ @ 150°C.

HYDROFINISHING

A process for treating raw extracted base stocks with hydrogen to saturate them for improved stability.

HYDROLYTIC STABILITY

Ability of additives and certain synthetic lubricants to resist chemical decomposition (hydrolysis) in the presence of water.

INDUCTION PERIOD

In an oxidation test, the time period during which oxidation proceeds at a constant and relatively low rate. It ends at the point where oxidation rate increases sharply.

Petroleum Products - Common Terms

INHIBITOR

Additive that improves the performance of a petroleum product by controlling undesirable chemical reactions, i.e. oxidation inhibitor, rust inhibitor, etc.

INSOLUBLES

Contaminants found in used oils due to dust, dirt, wear particles or oxidation products. Often measured as pentane or benzene insolubles to reflect insoluble character.

IODINE NUMBER (VALUE)

The percentage of iodine that will be absorbed by a chemically unsaturated substance (base oil, vegetable oil, rubber, etc.) in a given time under arbitrary conditions. A measure of unsaturation.

KINEMATIC VISCOSITY

Measure of a fluid's resistance to flow under gravity at a specific temperature (usually 40°C or 100°C).

LANDS

The circumferential areas between the grooves of a piston.

LEAD

Commonly-used name for tetraethyl or tetramethyl lead, an additive used in gasoline to improve octane ratings. Elemental lead is commonly used in sleeve bearing and bushing alloys.

LUBRICATION

Control of friction and wear by the introduction of a friction-reducing film between moving surfaces in contact. May be a fluid, solid or plastic substance.

MORPHOLOGY

Pertaining to structure or form.

MULTIGRADE OIL

Engine or gear oil that meets the requirements of more than one SAE viscosity grade classification and that can be used over a wider temperature range than a single grade oil.

NAPHTHENIC

A type of petroleum fluid derived from naphthenic crude oil containing a high proportion of closed-ring methylene groups.

NET ADDITIVE TREATING COST (NATC)

The cost of additive in one unit of finished product including base fluid credit but not shipping costs.

NET DELIVERED TREATING COST (NDTC)

The cost of additive in one unit of finished product including base fluid credit and shipping costs.

NEUTRALISATION NUMBER

A measure of the acidity or alkalinity of an oil. The number is the mass in milligrams of the amount of acid (HCl) or base (KOH) required to neutralise one gram of oil.

NEUTRAL OIL

The basis of most commonly used automotive and diesel lubricants, they are light overhead cuts from vacuum distillation.

NEWTONIAN FLOW

Rheological characteristic of a fluid where the rate of shear is directly proportional to the shearing force, as with straight grade oils that do not contain a polymeric viscosity modifier. When rate of shear is not directly proportional to the shearing force flow is non-Newtonian, as it is with oils containing viscosity modifiers or a soot-laden used engine oil.

Petroleum Products - Common Terms

NITRATION

The process whereby nitrogen oxides attack petroleum fluids at low temperatures, often resulting in viscosity increase and deposit formation.

OCTANE NUMBER

A measure of a fuel's ability to prevent detonation in a spark-ignition engine. Measured in a standard single-cylinder, variable compression ratio engine by comparison with primary reference fuels. Under mild conditions the engine measures Research Octane Number (RON), under severe conditions Motor Octane Number (MON). Where law requires posting of octane numbers on dispensing pumps the Antiknock Index (AKI) is used. This is the arithmetic average of RON and MON, $(R + M)/2$.

OCTANE REQUIREMENT (OR)

The lowest octane number reference fuel that will allow an engine to run Knock-free under standard conditions or service. OR is a characteristic of each individual engine.

OCTANE REQUIREMENT INCREASE (ORI)

As deposits accumulate in the combustion chamber the ORI of an engine increases, usually reaching an equilibrium value after 10,000 to 30,000 km. ORI is a measure of the increase, which may be in the region of three to ten numbers.

OXIDATION

Oxygen atoms attack and break bonds between other atoms in molecular chains. The process is accelerated by heat, light, metal catalysts and the presence of water, acids or solid contaminants. Leads to increased viscosity and deposit formation.

OXIDATION INHIBITOR

Substance added in small quantities to a petroleum product to increase its oxidation resistance, thereby lengthening its service or storage life. Also called antioxidant.

OXIDATION STABILITY

Resistance of a petroleum product to oxidation and, therefore, a measure of its potential service or storage life.

OXYGENATE

An oxygen-containing, ashless organic compound, such as alcohol or ether, that can be used as a fuel or fuel supplement.

OXYGENATED FUEL

Fuel for internal combustion engines that contains oxygen combined in the molecule, e.g. alcohols, ethers and esters. Term also applies to blends of gasoline with oxygenates, e.g. Gasohol, which contains 10% by volume anhydrous ethanol in unleaded gasoline.

OZONE AND CO-NONATTAINMENT AREAS

Any area of the continental U.S. that does not meet the 1990 Clean Air Act requirements for carbon monoxide or ground-level ozone pollutants.

PARAFFINIC

A type of petroleum fluid derived from paraffinic crude oil and containing a high proportion of straight-chain saturated hydrocarbons. Often susceptible to cold-flow problems.

PERCENTAGE PERMANENT VISCOSITY LOSS (PPVL)

Measure of the PVL related to the viscosity of fresh oil. Equals PVL divided by fresh oil viscosity, multiplied by 100.

PERCENTAGE TEMPORARY VISCOSITY LOSS (PTVL)

Difference between the viscosity of an oil measured at low and high shear rates, divided by viscosity measured at low shear rate, multiplied by 100. All viscosities must be measured at the same temperature and using the same units (cSt or cP).

Petroleum Products - Common Terms

PERMANENT VISCOSITY LOSS (PVL)

Irreversible reduction in lubricant viscosity due to mechanical shear in engines or laboratory test rigs. PVL equals the difference between the fresh oil viscosity and that of the degraded oil, both measured at the same temperature.

PITTING

Surface cavities in metal. May be related to fatigue, overload or corrosion.

PLASTIC FLOW

Surface deformation of metal as a result of yielding under heavy load.

POISE (P)

Measurement unit of a fluid's resistance to flow, i.e. viscosity, defined by the shear stress (in dynes/cm²) required to move one layer of fluid along another over a total layer thickness of one centimeter at a velocity of one centimeter per second. This viscosity is independent of fluid density and directly related to flow resistance.

POLISHING (BORE)

Excessive smoothing of the surface finish of a cylinder bore or liner in an engine to a mirror-like appearance, resulting in depreciation of ring sealing and oil consumption performance.

POSITIVE CRANKCASE VENTILATION (PCV)

System for removing blow-by gases from the crankcase and returning them through the carburetor intake manifold to the combustion chamber where the recirculated hydrocarbons are burned. A PCV valve controls the flow of gases from the crankcase to reduce hydrocarbon emissions.

POUR POINT

An indicator of the ability of an oil or distillate fuel to flow at cold operating temperatures. It is the lowest temperature at which the fluid will flow when cooled under prescribed conditions.

POUR POINT DEPRESSANT

Additive used to lower the pour point or low temperature, low shear rate fluidity of a petroleum product.

PRE-IGNITION

Ignition of the air/fuel mixture in a gasoline engine before the spark plug fires. Often caused by incandescent fuel or lubricant deposits in the combustion chamber, it wastes power and may damage the engine.

PUMPABILITY

The low temperature, low shear stress-shear rate viscosity characteristics of an oil that permit satisfactory flow to and from the engine oil pump and subsequent lubrication of moving components.

REFINING

A series of processes to convert crude oil and its fractions into finished petroleum products, including thermal cracking, catalytic cracking, polymerisation, alkylation, reforming, hydrocracking, hydroforming, hydrogenation, hydrogen treating, Hydrofining®, solvent extraction, dewaxing, de-oiling, acid treating, clay filtration and deasphalting.

REREFINING

A process of reclaiming used lubricant oils and restoring them to a condition similar to that of virgin stocks by filtration, clay absorption or more elaborate methods.

RIDGING

In gear teeth, a form of plastic flow characterised by a rippled appearance on the tooth surface.

RING STICKING

Freezing of a piston ring in its groove in a piston engine or reciprocating compressor due to heavy deposits in the piston ring zone.

Petroleum Products - Common Terms

RINGS

Circular metallic elements that ride in the grooves of a piston and provide compression-sealing during combustion. Also used to spread oil for lubrication.

ROLLING AND PEENING

In gear teeth, a form of plastic flow that gives the surface a hammered appearance. Metal may be rolled over the tooth tips.

RUST PREVENTATIVE

Compound for coating metal surfaces with a film that protects against rust. Commonly used to preserve equipment in storage.

SCRATCHING

Fine abrasive furrows in the direction of sliding.

SCUFFING

Abnormal engine wear due to localised welding and fracture. It can be prevented through the use of antiwear, extreme pressure and friction modifying additives.

SEM

Scanning electron microscope.

SHEAR STABILITY INDEX (SSI)

A measure of an oil's irreversible viscosity loss attributable to the viscosity modifier when the oil is subjected to engine operation or special test conditions. Also sometimes called Permanent Shear Stability Index (PSSI), SSI is defined by the equation:

$$\text{SSI} = 100(V_o - V_s)/(V_o - V_b)$$

where: V_o = viscosity of the unsheared oil

V_s = viscosity of the sheared oil

V_b = viscosity of the base oil.

SLUDGE

A thick, dark residue, normally of mayonnaise consistency, that accumulates on non-moving engine interior surfaces. Generally removable by wiping unless baked to a carbonaceous consistency, its formation is associated with insolubles overloading the lubricant.

SOLVENT EXTRACTION

Refining process used to separate reactive components (unsaturated hydrocarbons) from lubricant distillates in order to improve the oil's oxidation stability, viscosity index and additive response.

SOLVENT REFINING

A process of extracting lubricant base stocks from stripped heavy gas oil or other heavy, stripped crude streams using selective solvents such as furfural or phenol.

SPALLING

Severe damage characterised by large pits, cavities and related cracks. Related to overload and fatigue.

STOKE (St)

A unit of measure of kinematic viscosity defined by the ratio of the fluid's dynamic viscosity to its density. Usually expressed as centistokes (cSt), where 1 Stoke = 100 cSt and 1 cSt = 1 mm²/s.

SYNTHETIC LUBRICANT

Lubricating fluid made by chemically reacting materials of a specific chemical composition to produce a compound with planned and predictable properties.

Petroleum Products - Common Terms

TEMPORARY SHEAR STABILITY INDEX (TSSI)

The measure of the viscosity modifier's contribution to an oil's percentage viscosity loss under high shear conditions. Temporary shear loss results from the reversible lowering of viscosity in high shear areas of an engine, an effect that can positively influence fuel economy and cold cranking speed.

TEMPORARY VISCOSITY LOSS (TVL)

The difference between dynamic viscosity measured at high shear rate compared to that determined at low shear rate. Both viscosities are measured at the same temperature.

TRIBOLOGY

The science of the interactions between surfaces moving relative to each other, including the study of lubrication, friction and wear.

VALVE LIFTER

Sometimes called a "cam follower", a component in engine designs that use a linkage system between a cam and the valve it operates. The lifter typically translates the rotational motion of the cam to a reciprocating linear motion in the linkage system.

VAPOUR PRESSURE – REID (RVP)

A measure of the pressure of vapour accumulated above a sample of gasoline or other volatile fuel in a standard bomb at 100°F (37.8°C). Used to predict the vapour locking tendencies of a fuel in a vehicle's fuel system. Controlled by law in some areas to limit air pollution from hydrocarbon evaporation while dispensing.

VARNISH

A thin, insoluble, non-wipeable film occurring on interior engine parts. Can cause sticking and malfunction of close-clearance moving parts. Called lacquer in diesel engines.

VISCOSITY

A measure of a fluid's internal resistance to flow.

VISCOSITY INDEX (VI)

The relationship of viscosity to the temperature of a fluid. It is determined by measuring the kinematic viscosities of the oil at 40 and 100°C and using tables or formulae included in ASTM D 2270. High viscosity index fluids tend to display less change in viscosity with temperature than low viscosity index fluids.

VISCOSITY MODIFIER

Lubricant additive, usually a polymer, whose function is to provide beneficial rheological properties to lubricating oils, such as reducing the tendency of an oil's viscosity to change with temperature.

WHITE OIL

Highly refined lubricant stock used for special applications such as cosmetics and medicines.

ZINC (ZDP or ZDDP)

Commonly used name for zinc dithiophosphate a chemical antiwear agent and oxidation inhibitor

Abbreviations of Organisation Names

| | |
|--------------------|--|
| AAM | Alliance of Automotive Manufacturers |
| ACC | American Chemistry Council |
| ACEA | Association des Constructeurs Européens de l'Automobile |
| ACS | American Chemical Society |
| AFNOR | Association Française de Normalisation |
| AGMA | American Gear Manufacturer's Association |
| AHEM | Association of Hydraulic Equipment Manufacturers |
| ANFAVEA | Automotive Manufacturer's Association (Brazil) |
| ANSI | American National Standards Institute |
| APE | Association of Petroleum Engineers (USA) |
| API | American Petroleum Institute |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society of Testing and Materials |
| ATC | Technical Committee of Petroleum Additive Manufacturers |
| ATIEL | Association Technique de l'Industrie Européenne des Lubrifiants |
| BHRA | British Hydromechanics Research Association |
| BLF | British Lubricants Federation |
| BNP | Bureau de Normalisation des Pétroles |
| BSI | British Standards Institution |
| BTC | British Council of the Motor and Petroleum Industries (CEC member) |
| CARB | California Air Resources Board |
| CEC | Conseil Européen de Coordination les Développements des Essais de Performance des Lubrifiants et des Combustibles pour Moteurs (Coordinating European Council) |
| CEC Finland | Finnish Petroleum Federation (CEC member) |
| CEC / SB | Conseil Européen de Coordination / Société Belge (CEC member) |
| CEFIC | European Chemical Industry Council |
| CEN | Conseil Européen de Normalisation |
| CIMAC | International Council on Combustion Engines |
| CLR | Cooperative Lubrication Research |
| CMA | Chemical Manufacturer's Association (renamed ACC) |
| CONCAWE | Conservation of Clean Air and Water (Europe) |
| CRC | Coordinating Research Council (USA) |
| CUNA | Commissione Tecnica di Unificazione nel l'Autoveicolo (CEC member) |
| DIN | Deutsches Institut für Normung |
| DKA | Deutscher Koordinierungsausschuss für die Entwicklung von Prüfverfahren für Kraft- und Schmierstoffe (CEC member) |
| ECE | Economic Commission for Europe |
| EEB | European Environmental Bureau |
| EEC (CEE) | European Economic Community (Conseil Européen Economique) |
| EFTC | Engine Fuels Technical Committee (of CEC) |
| ELTC | Engine Lubricants Technical Committee (of CEC) |
| EMA | Engine Manufacturer's Association |
| EPA | Environmental Protection Agency |
| ETLP | Engine Tests of Lubricants Panel (of IP) |
| FZG | Forschungstelle für Zahnrad und Getriebau |
| GFC | Groupement Française de Coordination (CEC member) |
| GRPE | Groupe des Rapporteurs pour la Pollution et l'Énergie |

Abbreviations of Organisation Names

| | |
|---------------|--|
| IchemE | Institute of Chemical Engineers (UK) |
| ICOMIA | International Council for Marine Industry Associations |
| IFP | Institut Française du Pétrole |
| IGL | Investigation Group – Lubricants (of CEC) |
| ILMA | International Lubricant Manufacturer's Association |
| ILSAC | International Lubricant Specification Advisory Committee |
| IP | Institute of Petroleum (UK) |
| ISO | International Organisation for Standardisation |
| JAMA | Japanese Automobile Manufacturer's Association |
| JARI | Japanese Automobile Research Institute |
| JASO | Japanese Automobile Standards Organisation |
| JAST | Japanese Society of Tribologists |
| JIS | Japanese Industrial Standards |
| JSAE | Japanese Society of Automotive Engineers |
| LRI | Lubricants Review Institute (USA) |
| MITI | Ministry of International Trade and Industry |
| NCM | National Comite Motorproeven (Netherlands) (CEC member) |
| NLGI | National Lubricating Grease Institute (USA) |
| NMMA | National Marine Manufacturer's Association |
| NPRA | National Petroleum Refiner's Association |
| PAJ | Petroleum Association of Japan |
| SAE | Society of Automotive Engineers |
| SMR | Svenska Mekanisters Riksforening (CEC member) |
| SNV | Schweizerische Normenvereiniung (CEC member) |
| STLE | Society of Tribologists and Lubrication Engineers |
| TUV | Technischer Überwachungs Verien (Germany) |

Lubricant Basics - Viscosity

ABSOLUTE AND KINEMATIC VISCOSITY

When a fluid is subjected to external forces it resists flow due to internal friction. Viscosity is the measure of this internal friction.

Kinematic viscosity is a measure of the resistive flow of a fluid under the influence of gravity. When two fluids of equal volume are placed in identical capillary viscometers and allowed to flow by gravity, a viscous fluid takes longer than a less viscous fluid to flow through the capillary. If one fluid takes 200 seconds to complete its flow and another fluid takes 400 seconds, the second fluid is twice as viscous as the first on a kinematic viscosity scale.

Absolute viscosity, sometimes called dynamic or simple viscosity, is the product of kinematic viscosity and fluid density.

$$\text{Absolute Viscosity} = \text{Kinematic Viscosity} \times \text{Density}$$

The dimension of kinematic viscosity is L^2/T , where L is a length and T is a time. Commonly, the centistoke (cSt) is used. The SI unit of kinematic viscosity is mm^2/s , which is 1 cSt. Absolute viscosity is expressed in units of centipoise (cP). The SI unit of absolute viscosity is the millipascal-second (mPa·s), where $1 \text{ cP} = 1 \text{ mPa}\cdot\text{s}$.

Other common but obsolete units of kinematic viscosity are Saybolt Universal Seconds (SUS) and Saybolt Furol Seconds (SFS). These units can be converted to centistokes by following the instructions in ASTM D 2161.

NEWTONIAN AND NON-NEWTONIAN FLUIDS

The relationship in which viscosity is a constant regardless of shear stress or rate of shear is called Newton's Viscosity Law. Many common solvents, mineral base oils, synthetic base fluids and fully formulated single-grade oils obey Newton's Viscosity Law and are called Newtonian fluids.

Non-Newtonian fluids can be defined as those for which viscosity is not a constant but varies based upon the rate of shear or the shear stress at which it is measured. The majority of modern motor oils are multi-viscosity-grade oils that are formulated with high molecular weight polymers called viscosity modifiers. The viscosities of such oils decrease with an increase in shear rate. These are called "shear-thinning" fluids. Other examples of non-Newtonian fluids are ceiling paint, quicksand and rubber cement.

VISCOSITY MEASUREMENT TECHNIQUES

Viscometers can be classified into three major types:

1. **Capillary Viscometers** measure the flow rate of a fixed volume of fluid through a small orifice at a controlled temperature. The rate of shear can be varied from near zero to 10^6 s^{-1} by changing capillary diameter and applied pressure. Types of capillary viscometers and their modes of operation are:
 - **Glass Capillary Viscometer** (ASTM D 445) – Fluid passes through a fixed-diameter orifice under the influence of gravity. The rate of shear is less than 10 s^{-1} . All kinematic viscosities of automotive fluids are measured by capillary viscometers.
 - **High Pressure Capillary Viscometer** (ASTM D 4624 & D 5481) – Applied gas pressure forces a fixed volume of fluid through a small-diameter glass capillary. The rate of shear can be varied up to 10^6 s^{-1} . This technique is commonly used to simulate the viscosity of motor oils in operating crank shaft bearings. This viscosity is called high-temperature high-shear (HTHS) viscosity and is measured at 150°C and 10^6 s^{-1} . HTHS viscosity is also measured by the Tapered Bearing Simulator (ASTM D 4683) and the Ravenfield Tapered Plug viscometer (ASTM D 4741) (see below).
2. **Rotary Viscometers** use the torque of a rotating shaft (at constant rotational speed) or the flow, rotational speed of the rotating shaft (at constant shear stress) to measure a fluid's resistance to The Cold Cranking Simulator (CCS), Mini-Rotary Viscometer (MRV), Brookfield Viscometer,

Lubricant Basics - Viscosity

Tapered Bearing Simulator (TBS) and Ravenfield Tapered Plug Viscometer are all rotary viscometers. Rate of shear can be changed by changing rotor dimensions, the gap between rotor and stator wall and the speed of rotation.

- **Cold Cranking Simulator** (ASTM D 5293) – The CCS measures an apparent viscosity in the range of 500 to 200,000 cP. Shear rate ranges between 104 and 105 s⁻¹. Normal operating temperature range is 0 to -40°C. The CCS has demonstrated excellent correlation with engine cranking data at low temperatures. The SAE J300 viscosity classification specifies the low-temperature viscometric performance of motor oils by CCS limits and MRV requirements.
- **Mini-Rotary Viscometer** (ASTM D 4684) – The MRV test, which is related to the mechanism of pumpability, is a low shear rate measurement. Slow sample cooling rate is the method's key feature. A sample is pretreated to have a specified thermal history which includes warming, slow cooling and soaking cycles. The MRV measures an apparent yield stress, which, if greater than a threshold value, indicates a potential air-binding pumping failure problem. Above a certain viscosity (currently defined as 60,000 cP @ -30°C by SAE J300), the oil may be subject to pumpability failure by a mechanism called "flow limited" behaviour. An SAE 10W oil, for example, is required to have a maximum viscosity of 60,000 cP @ -30°C with no yield stress. This method also measures apparent viscosity under shear rates of 1 to 50 s⁻¹.
- **Brookfield Viscometer** - Determines a wide range of viscosities (1 to 105 P) under low rate of shear (up to 102 s⁻¹). ASTM D 2983 is used primarily to determine the low temperature viscosity of automotive gear oils, automatic transmission fluids, torque and tractor fluids and industrial and automotive hydraulic fluids. Test temperature is held constant in the range -5 to -40°C. ASTM D 5133, the Scanning Brookfield technique, measures the Brookfield viscosity of a sample as it is cooled at a constant rate of 1°C/hour. Like the MRV, ASTM D 5133 is intended to relate to an oil's pumpability at low temperatures. The test reports the gelation point, defined as the temperature at which the sample reaches 30,000 cP. The gelation index is also reported and is defined as the largest rate of change of viscosity increase from -5°C to the lowest test temperature. This method is finding application in engine oils and is required by ILSAC GF-2.
- **Tapered Bearing Simulator** (ASTM D 4683) and **Ravenfield Tapered Plug Viscometer** (ASTM D 4741) - These techniques also measure high-temperature high-shear-rate viscosity of motor oils (see High Pressure Capillary Viscometer). Very high shear rates are obtained by using an extremely small gap between the rotor and stator wall.

3.

Miscellaneous Instruments operate by a number of principles, for example, the falling time of a steel ball or needle in a fluid, the vibration resistance of a probe and the pressure applied to a probe by a flowing fluid.

Viscosity Index

Viscosity Index (VI) is an empirical number indicating the degree of change in viscosity of an oil within a given temperature range. It is determined by measuring the kinematic viscosities of the oil at 40 and 100°C and using the tables or formulae included in ASTM D 2270. A high VI signifies a relatively small change in viscosity with temperature, whereas a low VI reflects a large viscosity change with temperature. Most mineral base oils have a VI between 0 and 110 but the VI of synthetic fluids often exceeds 120. The incorporation of polymers often increases the VI of the base oils to over 110.

SAE has not used VI to classify motor oils since 1967 because the term is technically obsolete. However, API 1509 describes a base oil classification system using VI as one of several parameters to provide guidelines for base oil interchange and viscosity grade read-across.

MAJOR TYPES OF VISCOSITY MODIFIERS

Chemical structure and molecular size are the most important elements of the molecular architecture of viscosity modifiers. Many types of viscosity modifiers are available and choice depends on the particular circumstances.

Viscosity modifiers available today all consist of aliphatic carbon-to-carbon backbones. The major structural differences lie in the side groups, which differ both chemically and in size. These variations in chemical structure are responsible for various properties of viscosity modifiers such as oil thickening ability, viscosity-temperature dependency, oxidation stability and fuel economy characteristics.

Polyisobutylene (PIB or Polybutene) – The predominant viscosity modifiers at the end of the 1950s, PIB types have since been replaced by other viscosity modifier types because they generally do not provide satisfactory low temperature and diesel performance. However, low molecular weight PIBs are still widely used in automotive gear oils.

Polymethacrylate (PMA) – PMA viscosity modifiers contain alkyl side chains that interfere with the formation of wax crystals in the oil, thereby providing excellent low-temperature properties.

Olefin Copolymer (OCP) – OCP viscosity modifiers are widely used for motor oils due to their low cost and satisfactory engine performance. Various OCPs are on the market, differing mainly in molecular weight and the ratio of ethylene to propylene.

Esters of Styrene Maleic Anhydride Copolymers (Styrene Esters) – Styrene esters are multifunctional premium viscosity modifiers. A combination of various alkyl groups imparts excellent low-temperature properties to oils containing these products. Styrene ester viscosity modifiers have been used in fuel-economy motor oils and are still used extensively in automatic transmission fluids and as pour point depressants.

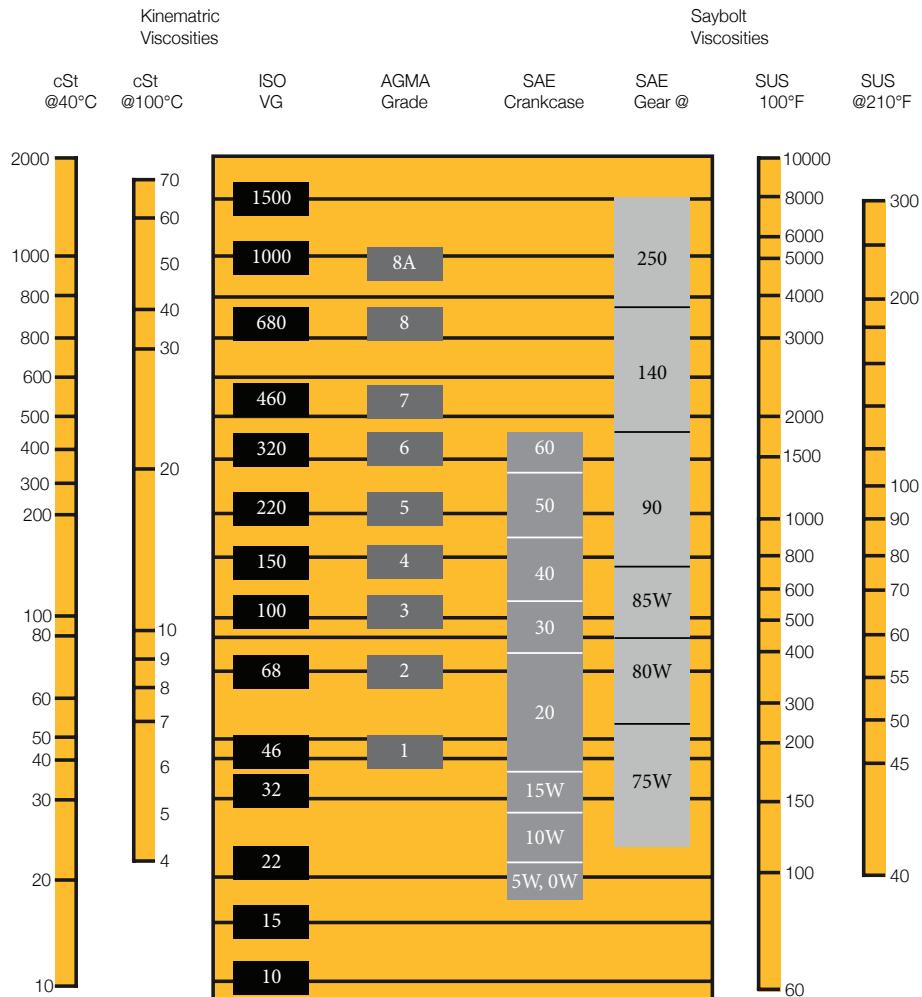
Hydrogenated Styrene-Diene Copolymers – Hydrogenated styrene-diene (isoprene or butadiene) viscosity modifiers are characterised by fuel economy benefits, good low-temperature viscometrics and good high-temperature engine performance.

Hydrogenated Radial Polyisoprene (STAR) Hydrogenated radial polyisoprene viscosity modifiers demonstrate good shear stability at relatively low temperature rates compared to other viscosity modifier types. Their low-temperature properties are similar to those of OCP viscosity modifiers.

Viscosity

Viscosity is the measurement of a fluid's resistance to flow. The common metric unit of absolute viscosity is the poise, which is defined as the force required to move a fluid surface of one square centimeter in area, past a parallel point at a speed of one centimeter per second, with the surfaces separated by a fluid film one centimeter thick. In addition to kinematic viscosity, there are other methods for determining viscosity, including Saybolt Universal Viscosity (SUV), Saybolt Furol viscosity, Engler viscosity, and Redwood viscosity. Since viscosity varies inversely with temperature, the value must always be reported at the temperature at which it is tested.

Comparative Viscosity Classifications



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All dimensions are shown in millimetres, unless otherwise stated between brackets.
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BELL INTERNATIONAL: Tel: +27 (0)35-907 9431
E-mail: marketing@bellequipment.com Web: www.bellequipment.com

 Tel: +61 (0)8-9356-1033
 Tel: +49 (0)6631 / 91-13-0
 Tel: +27 (0)11-928-9700
 Tel: +44 (0)1283-712862

 Tel: +33 (0)5-55-89-23-56
 Tel: +7-495-287-80-02
 Tel: +1-855-494-2355

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