



Lubrication and Filtration For Off-Highway Equipment

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Lubrication and Filtration For Off-Highway Equipment

The webinar will begin in less than 10 minutes.

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Lubrication and Filtration For Off-Highway Equipment

The webinar will begin in less than 5 minutes.

Steven Bowles

Sr. Product Specialist

CITGO Petroleum Corp.

Steven Bowles

- CITGO Sr. Product Specialist
- BS, Zoology
- MS, Environmental Science
- 17 Years Experience in Lubricants
- 16 Years Experience in Laboratory Supervision/Analytical Chemistry
- STLE Certified
 - Certified Lubrication Specialist
 - Oil Monitoring Analyst I



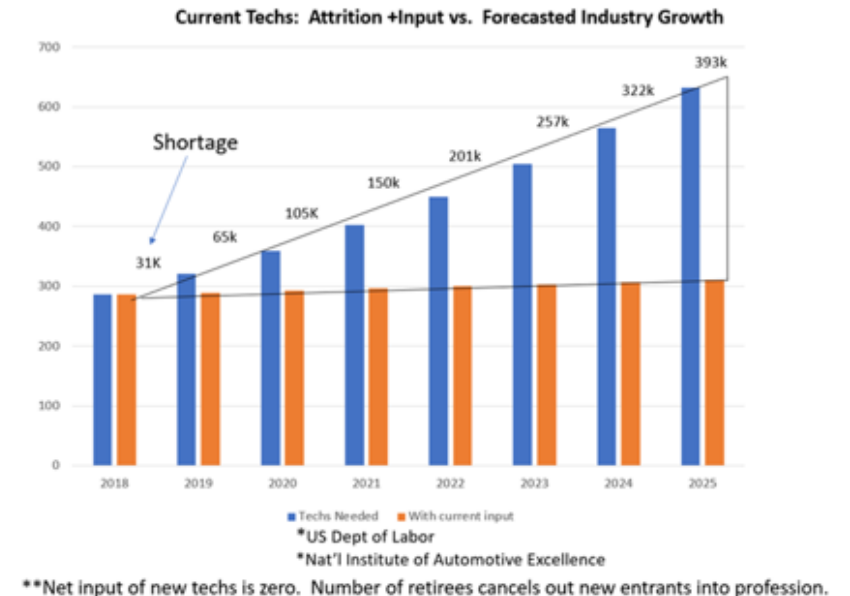
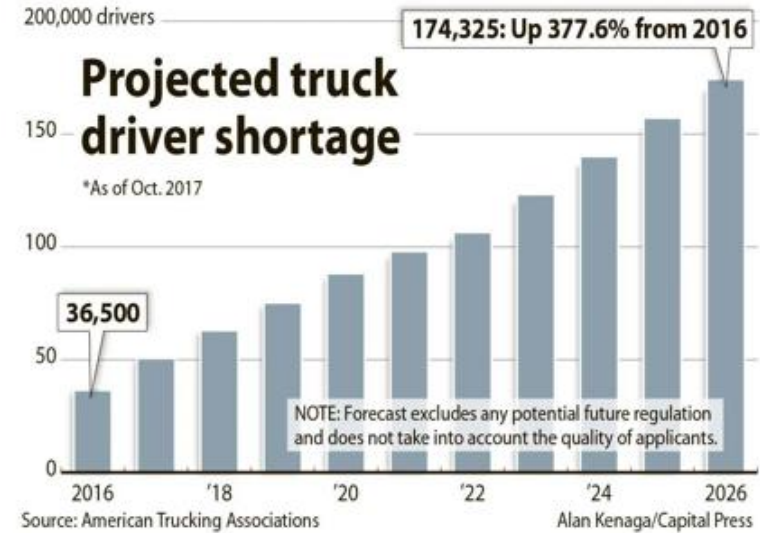


Agenda

- Industry Issues
- Lubrication Fundamentals
- Lubricants
- Filtration and Contamination Control
- Questions and Answers

Industry Issues

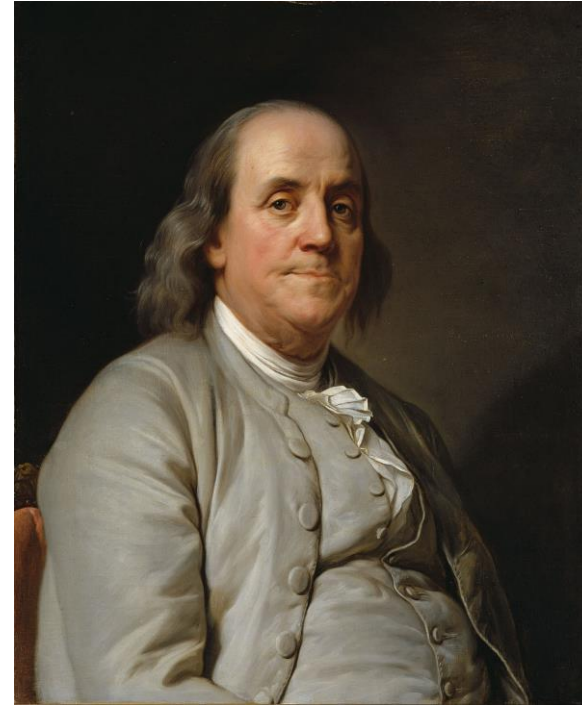
- Supply Chain Issues:
 - Difficulty of obtaining base oils and additives
 - Difficulty of obtaining packaging materials
- Transportation Issues:
 - Truck driver shortage
 - Port Congestion
 - Diesel Mechanic shortage



"The Diesel Mechanic shortage will get much worse. Here's how we solve it."
By Timothy Spurlock

Industry Issues

**AN OUNCE OF PREVENTION IS WORTH
A POUND OF CURE
- BENJAMIN FRANKLIN -**



Wikipedia

Free Lube Advice for dealing with today's issues:
Use a high quality lubricant and maintain it properly

Lubrication Fundamentals

Lubricant: A substance used to reduce friction between two surfaces in relative motion

Additional functions of lubricants:

- Reduce wear
- Prevent rust and corrosion
- Neutralize acids
- Emulsify/Separate water
- Transfer heat
- Transmit power

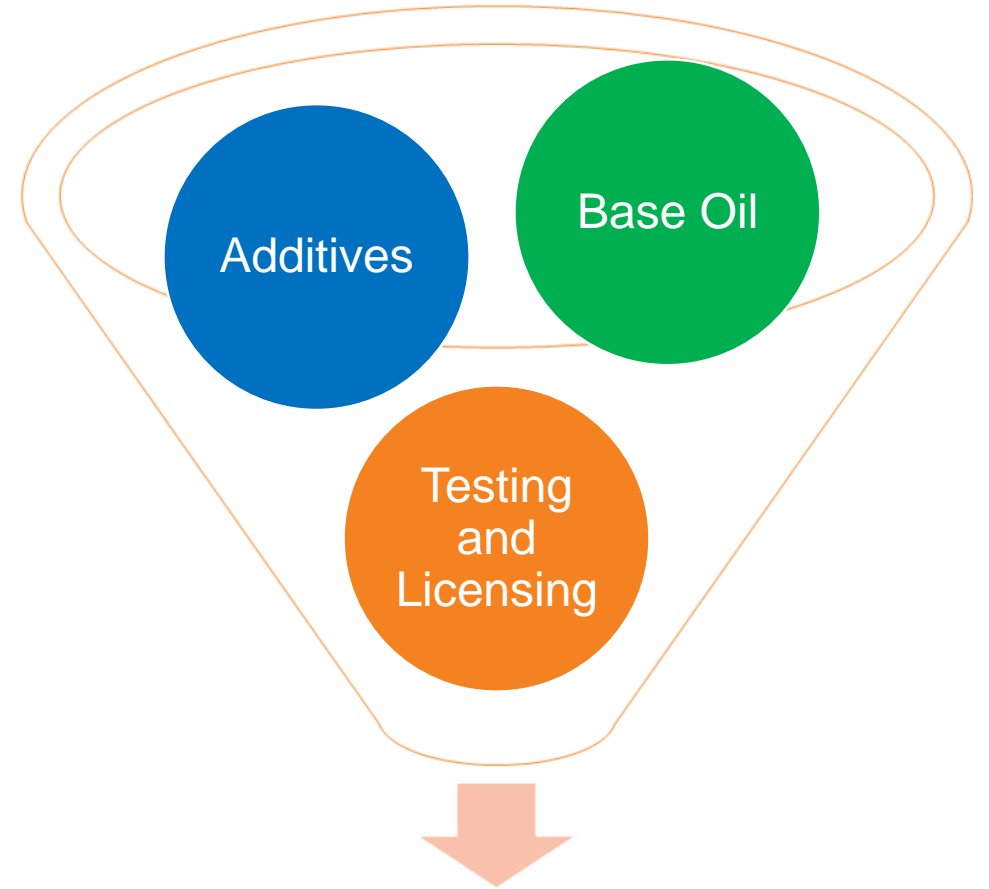


Equipment Condition

Equipment Performance

Lubrication Fundamentals

Where do Lubricants Come From?



Finished product meeting user, industry, and OEM specifications

Lubrication Fundamentals

Base stock types:

Petroleum (Mineral)

- Paraffinic
- Naphthenic
- Virgin or re-refined

Synthetic

- Synthetic hydrocarbons (ex: PAO)
- Esters (ex: diester, polyolester, etc.)
- Others (ex: PAG, silicone)

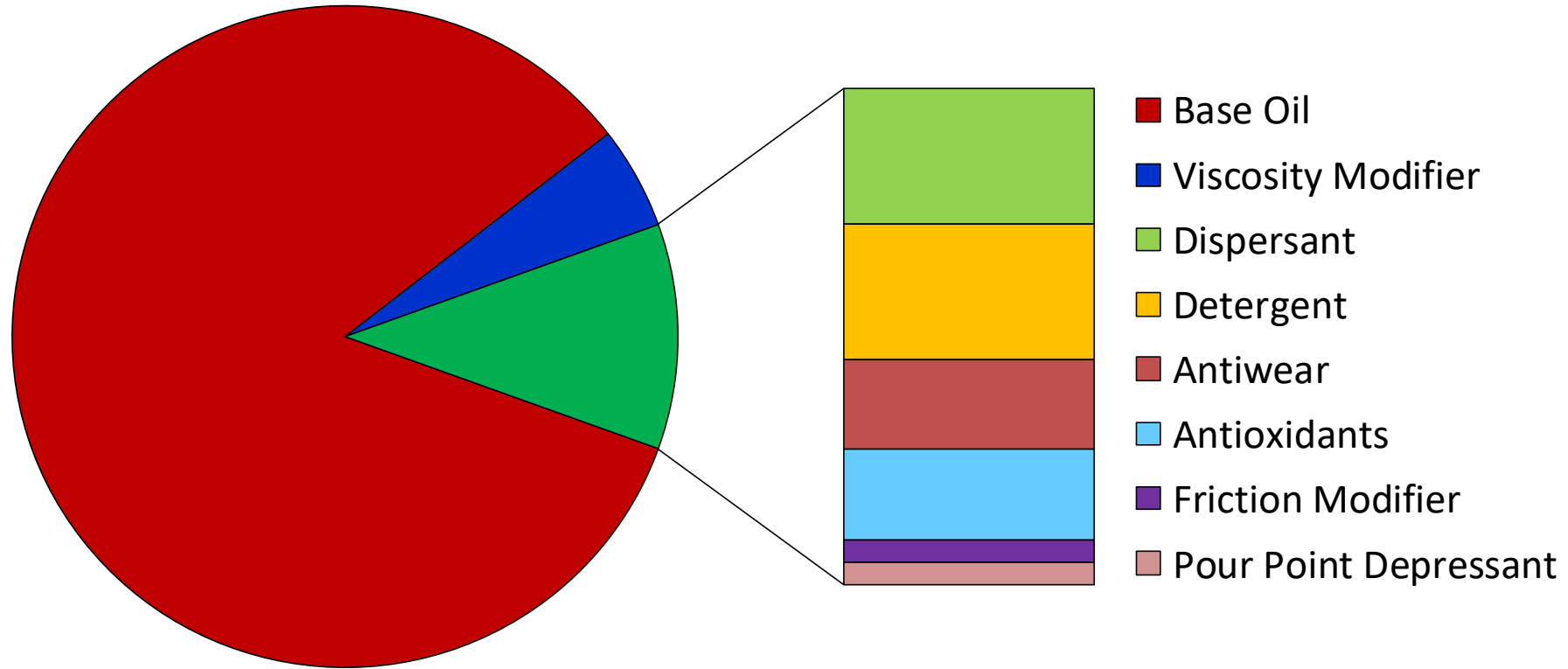
Vegetable (Bio-based)

- High oleic canola oil
- Sunflower seed oil
- Palm oil
- Rapeseed oil



Lubrication Fundamentals

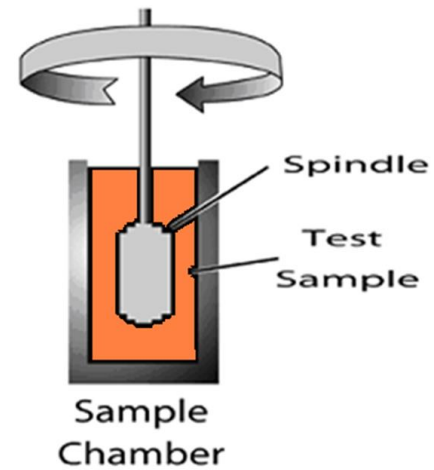
Engine Oil



Lubrication Fundamentals

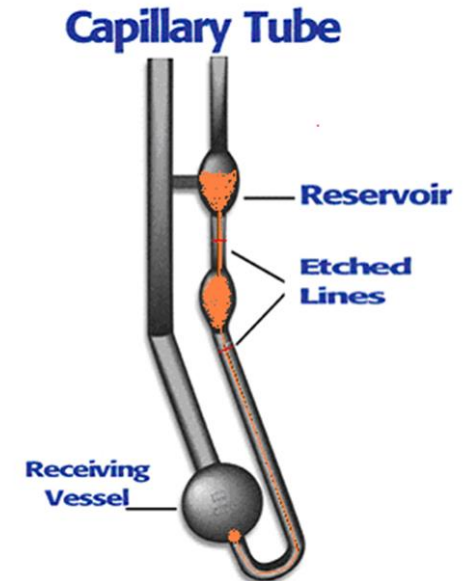
Viscosity: a fluid's resistance to flow

**Dynamic
(Absolute)**



**Dynamic
(shear)**

Kinematic



**Kinematic
(time)**

Lubrication Fundamentals

Viscosity Selection

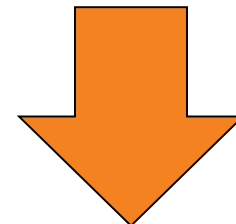
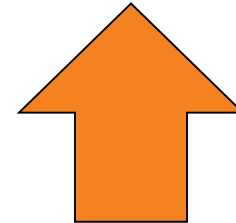
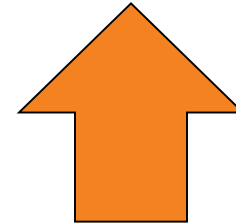
Operational Condition

Higher load

Higher
temperature

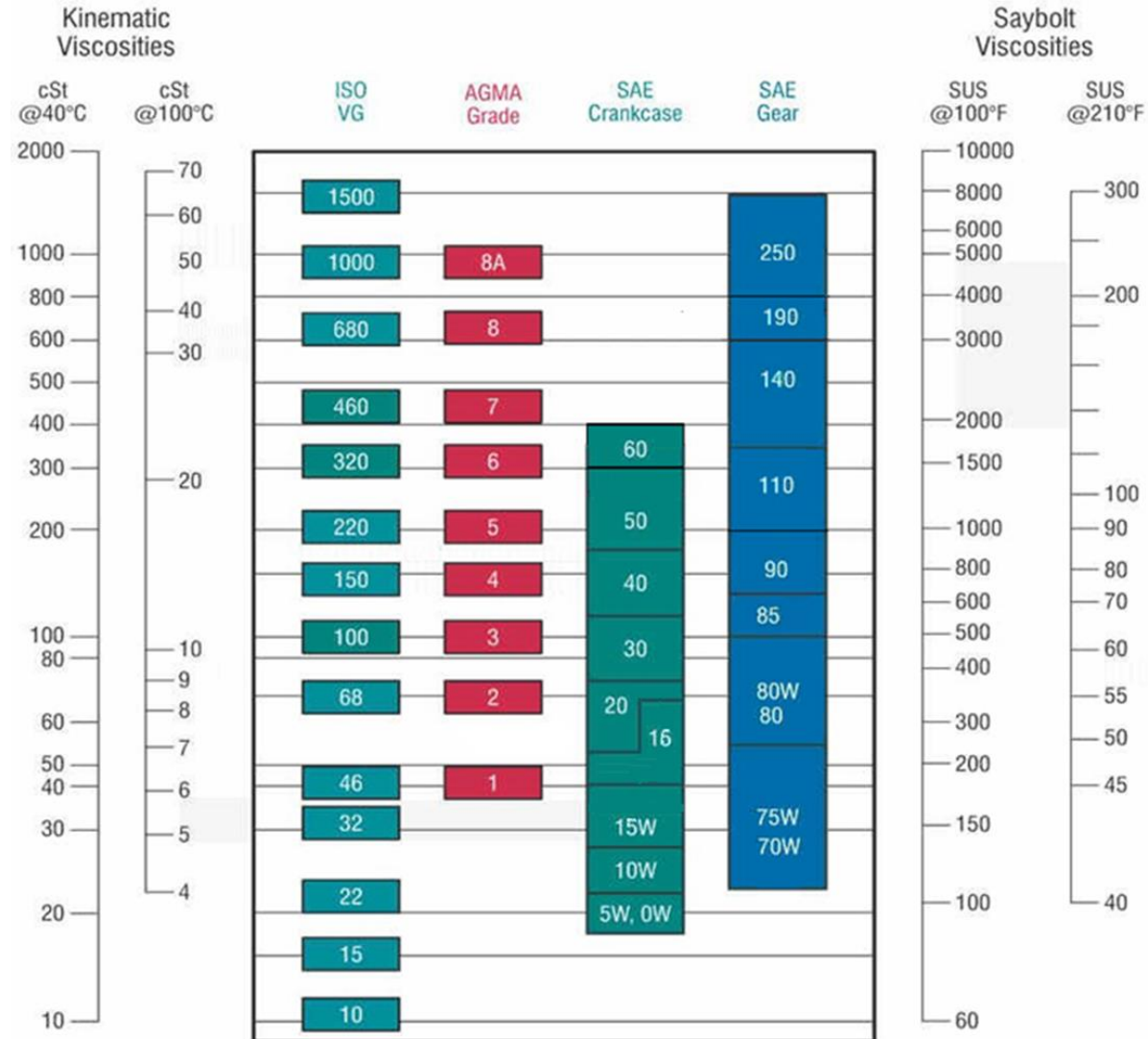
Higher speed

Viscosity Needed

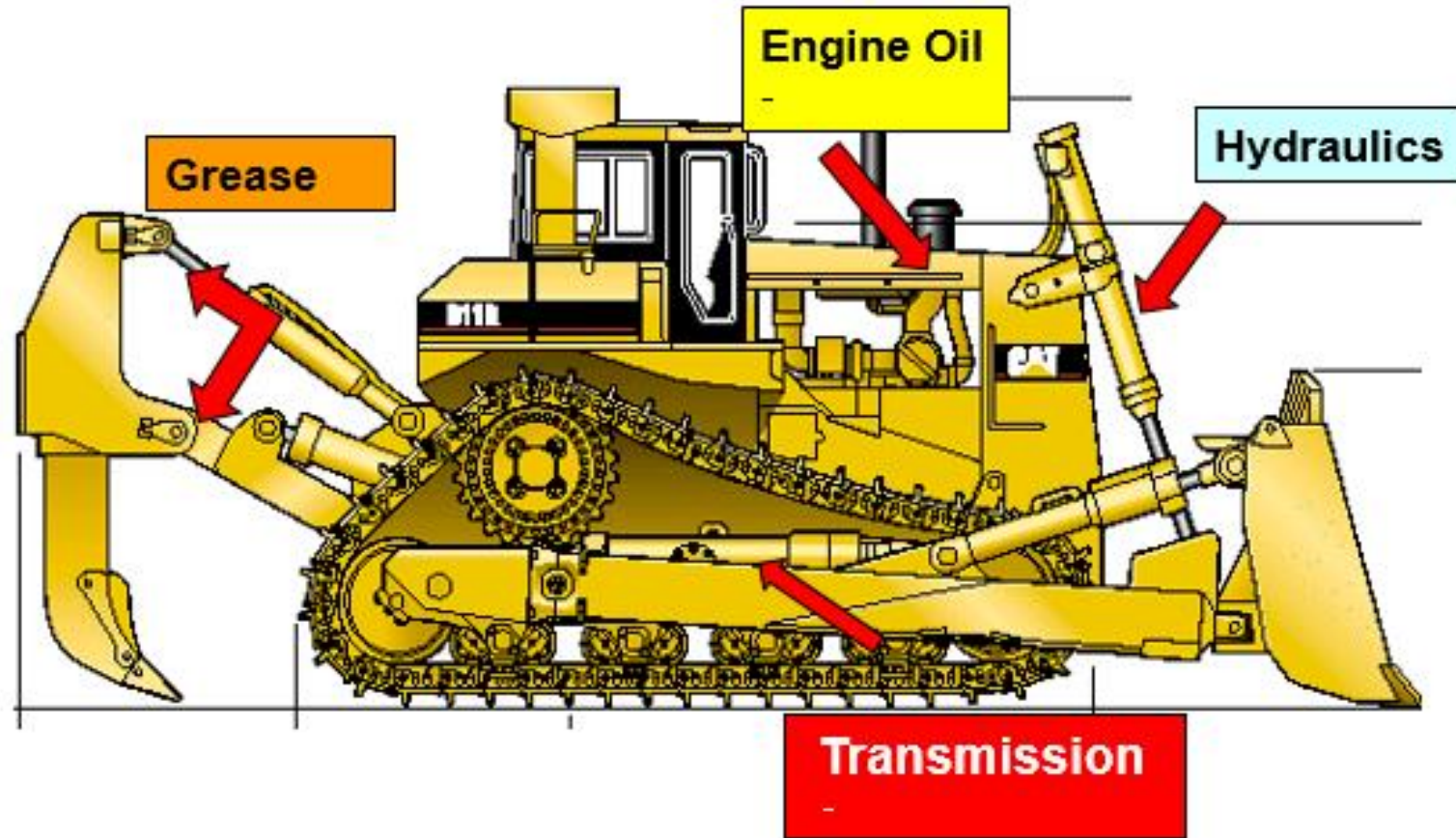


Lubrication Fundamentals

Table 2. Comparative Viscosity Classifications



Lubricants



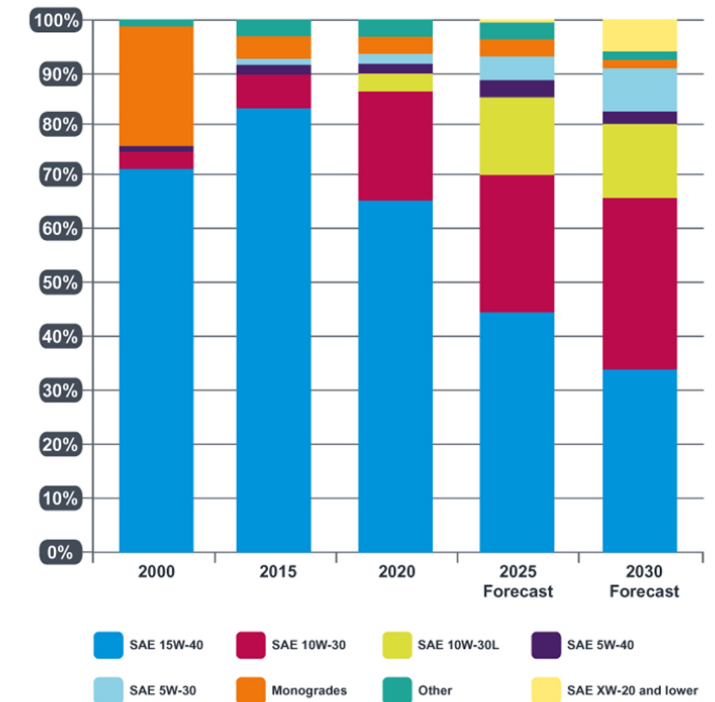
Lubricants

Engine Oil

- Current API Specifications
 - CK-4 or FA-4 (Diesel)
 - SP (Gasoline)
- Diesel OEM Approvals
 - Cummins CES 20086
 - Detroit Diesel DFS 93K222
 - Volvo/Mack/Renault VDS-4.5/EOS-4.5/RLD-3
- On-Highway
 - All OEM's fill with 10W-30
- Off-Highway
 - Mixture of 15W-40 and 10W-30



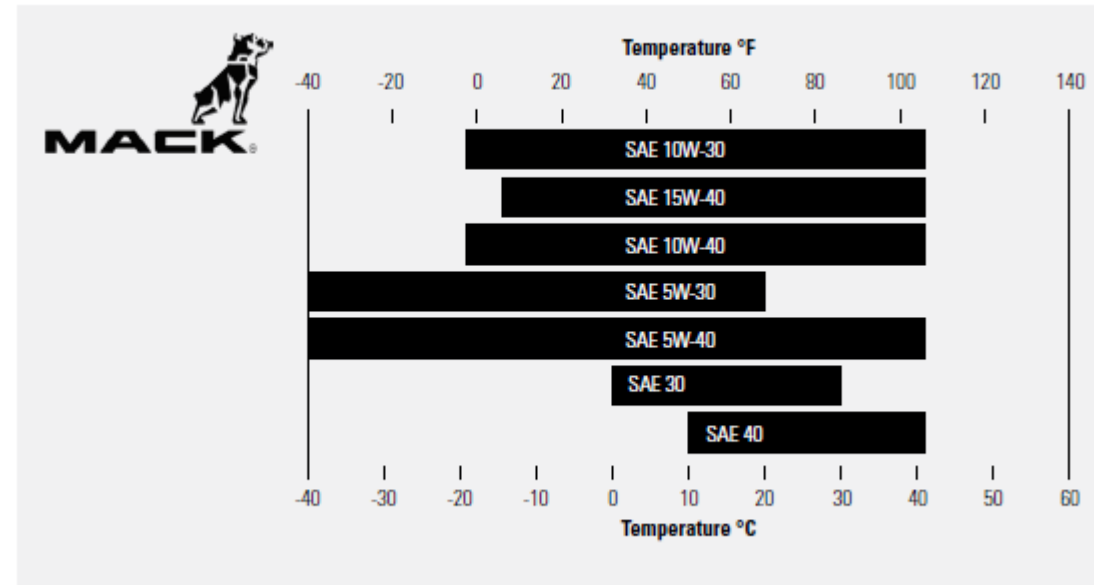
North America HDD Viscosity Grade Trends



Lubricants

Engine Oil

- Always follow OEM guidelines for Viscosity and Oil Drain Intervals (ODI)



OEM Diesel Engine Oil Drain Recommendation Summary*

	Service	API CK-4
Cummins	Light (>7.0 MPG)	75,000 (up to 100,000 with Cummins Oil Guard Program)
	Normal (6.0 – 6.9 MPG)	50,000
	Short Haul (<5.0 – 5.9 MPG)	40,000
	Severe	25,000

* For API category comparison purposes only; refer to OEM service literature for official oil drain details. Chart used with permission from Infineum.



Cold box testing at -22°F (-30°C) of used oil demonstrates the superior flow characteristics of SynDurance PLUS Synthetic 5W-40

Lubricants

Recommended Engine Oils

- CITGARD 1000 Full Synthetic 5W-40
- CITGARD 800 Synthetic Blend 15W-40
- CITGARD 700 Synthetic Blend 10W-30
- CITGARD 600 15W-40
- Mystik JT-8 Synthetic Blend SHD 15W-50



Lubricants

Hydraulic Oil

- Common Manufacturer Specifications:
 - Parker Denison HF-0, DIN 51524-2, Fives Cincinnati P-68, 69, 70, others
- Viscosity measured at 40°C using ISO Grades
 - Typical ISO Grades 32, 46, and 68
- Functions:
 - Primary – transmit power
 - Secondary – Lubricate and prevent wear, transfer heat, protect system components, seal out contaminants
 - Other – Fire resistance, low toxicity, biodegradability



Lubricants

Hydraulic Oil

- Can be mineral oil, synthetic, or vegetable oil-based
- Anti-Wear can be Zinc-Containing or Zinc-Free
- Dyed or Un-Dyed
- Some have seal-swell to help prevent leaks
- Hydraulics for Cherry-Pickers have to have good Dielectric Values



Leak Cost Calculation Data²

Oil Type	Leak Severity	Level	Gallon Loss Per Year	Leak Cost Per Year
Petroleum Based Hydraulics and Oils	1 drop / 10 seconds	A	42	\$210
	1 drop / 5 seconds	B	84	\$420
	1 drop / 1 second	C	420	\$2,100
Synthetic Hydraulic Fluid	1 drop / 10 seconds	A	42	\$1,050
	1 drop / 5 seconds	B	84	\$2,100
	1 drop / 1 second	C	420	\$10,500

Lubricants

Recommended Hydraulic Oils

- JT-9 LeakShield AW Hydraulic Oils
- HyDurance AW All Temp Fluids
- HyDurance AW Fluids
- HyDurance AW NZ Fluids
- HyDurance AW CP Fluid



Lubricants

Transmission Fluid

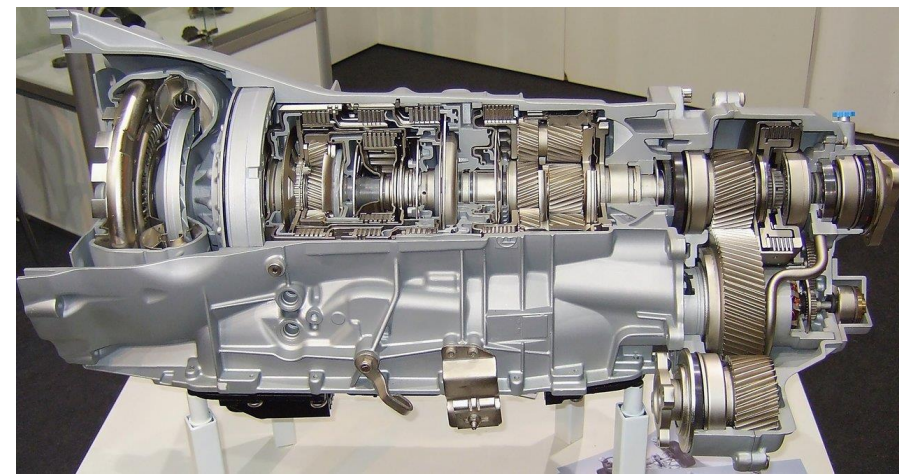
- Fluid requirements based on OEM
- Common Off-Highway Specifications
 - CAT TO-4, TO-4M, FD-1
 - Allison C-4
 - Komatsu Micro-Clutch
 - John Deere J20C
- Common On-Highway Specifications
 - Allison TES 668
 - Eaton PS-386
 - Detroit DT-12
 - Volvo I-Shift/Mack mDrive



Lubricants

Transmission Fluid

- Common Off-Highway viscosity grades:
 - SAE 10W, 30, 40, 50
- Common On-Highway viscosity grades:
 - SAE 50, 40, 75W-90, 75W-85
- Fluid Properties:
 - Compatible with clutch materials
 - Rust and corrosion control protect gear cases and drive trains
 - Reduces brake chatter in wet-brake applications
 - Protect gears



Lubricants

Recommended Transmission Fluids

- SynDurance Synthetic All Seasons HD Transmission Fluid
- TRANSGARD HD Transmission Fluids
- TRANSGARD Tractor Hydraulic Fluid
- Mystik JT-5 Synthetic Blend TFX Trans-Hydraulic Tractor Fluid



Lubricants

Grease

- Grease Industry Organizations
 - NLGI (National Lubricating Grease Institute)
 - ASTM International (American Society for Testing and Materials)
 - STLE (Society of Tribologists and Lubrication Engineers)
 - SAE (Society of Automotive Engineers)
 - AGMA (American Gear Manufacturers Association)
- What is Grease?
 - Oily semi-solid material
 - Oil (80 – 98%), Additives (0-5%), and Thickener (2-20%)
- Where is Grease used?
 - 80% of all bearings are grease lubricated
 - Cars, Airplanes, Industrial Plants



Lubricants

Grease

- Reasons to use grease instead of oil
 - Stays in place where oil can't
 - Seals components from contaminants
 - Carrier for solid additives
 - Cost effective maintenance
- Drawbacks of grease
 - Poor thermal conductivity
 - Does not remove contaminants



Lubricants

Recommended Greases

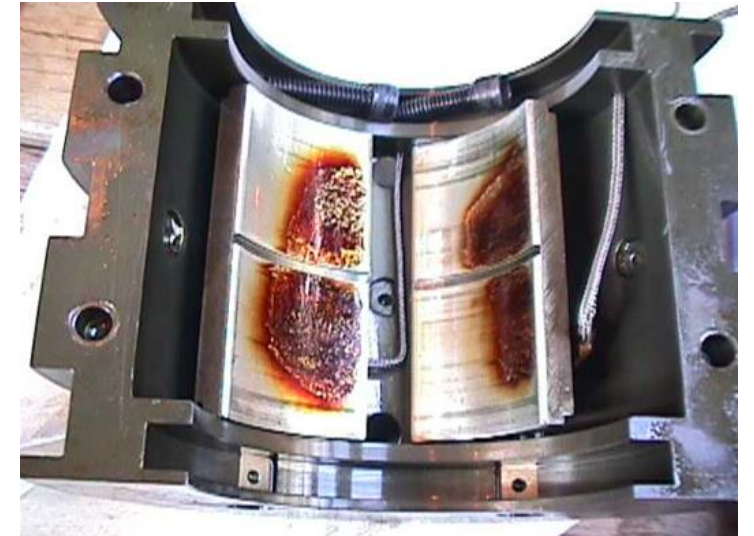
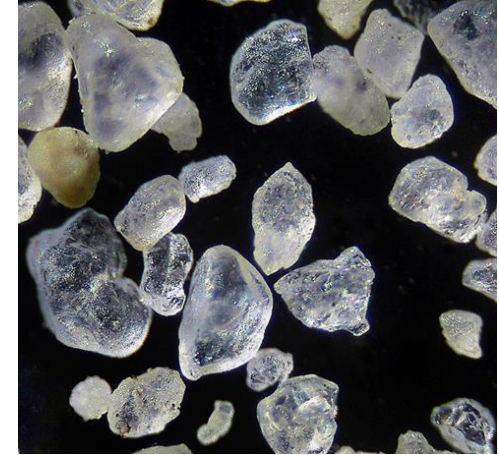
- Mystik JT-6 Heavy Duty SynBlend 460 #2
- Mystik JT-6 High Temp #2
- Mystik JT-6 Multi-Purpose #2
- Mystik Lithoplex 5% Moly #2



Filtration and Contamination Control

Types of Contaminants

- Solids
 - Dirt
 - Metal Particles
 - Soft Insolubles
 - Soot
- Water
- Heat



Filtration and Contamination Control

Sources of Solids

- New Oil
- Unsealed tank or drum
- Oil transfer containers
- Funnels
- Ventilation and breathers
- Seals
- Wear

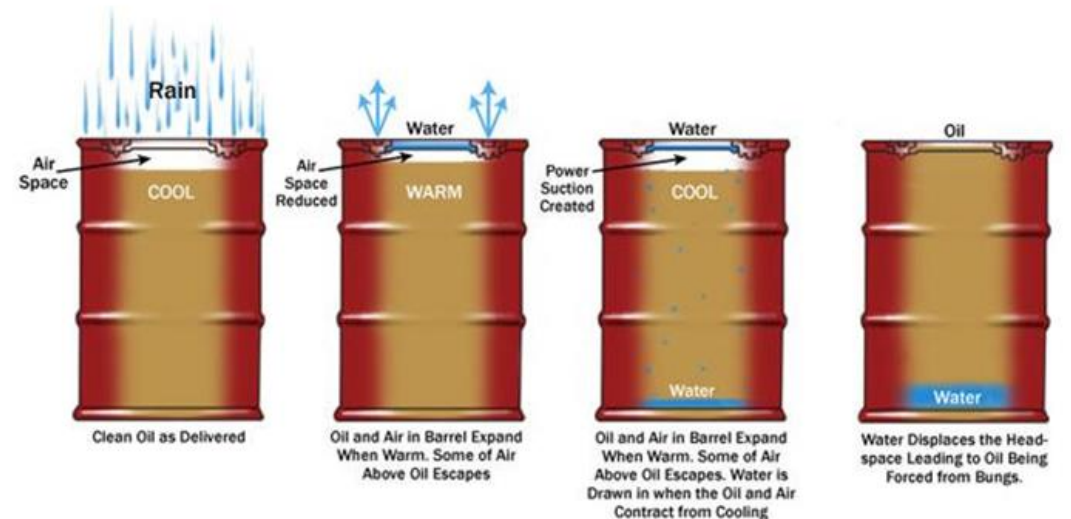
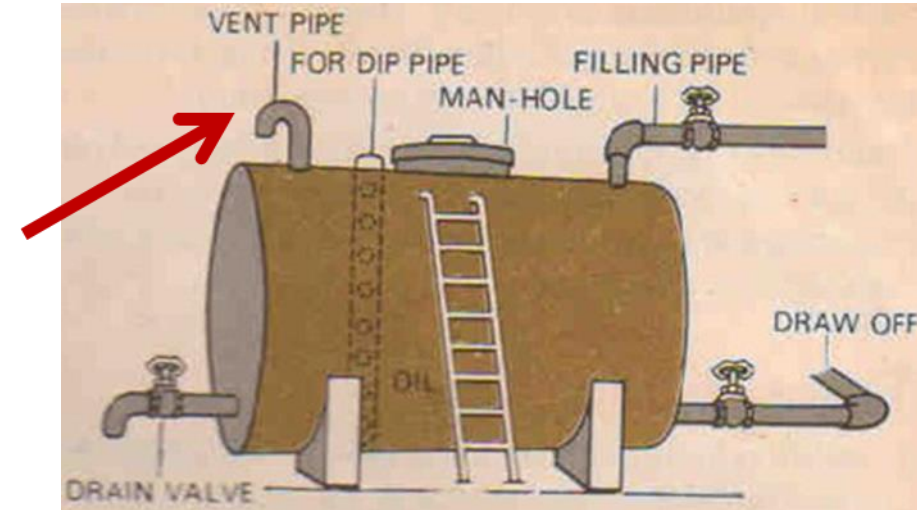
The primary cause of machine failure is the degradation of component surfaces – caused by particle contamination. The majority of damage is caused by particles between 3 and 10 microns in size (human hair ~80 microns, dust ~40 microns)



Filtration and Contamination Control

Sources of Water

- The atmosphere (humidity, precipitation)
- Improper or ineffective vent or breather
- Improper lubricant storage
- Cooling system leaks
- Condensation
- Equipment wash-down



Filtration and Contamination Control

Heat

- Heat is one of the worst enemies of lubricants. The higher the oil temperature, the higher the rate of oxidation.
- For every 10°C (18°F) rise in oil temperature above 60°C (140°F), the rate of oxidation doubles, cutting the oxidation life of the product in half.
- An increase in temperature causes the viscosity of oil to decrease. The proper viscosity for the lubrication of the application may not be maintained at too high a temperature.



Machinery Lubrication: The hidden dangers of lubricant starvation

Filtration and Contamination Control

Controlling Contamination

Exclusion – keep contaminants from getting in

- New Oil
- Ventilation and breathers
- Seals
- Filter dumping
- Proper lubricant storage

The cost of keeping dirt out of oil is only about 10% of what it will cost to remove it from the oil



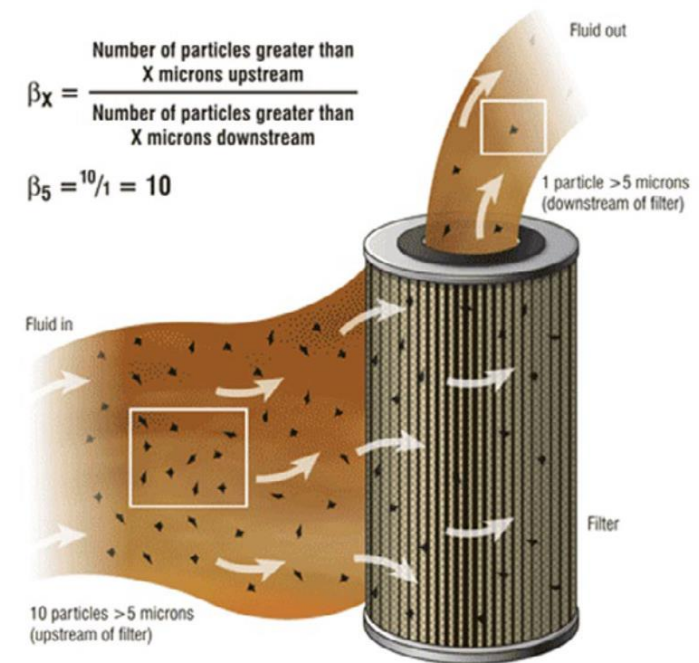
Filtration and Contamination Control

Controlling Contamination

Proper Oil Filter Selection

- Structural Integrity
 - May be constructed of steel, plastic, or even stiff cardboard
 - Valve seat may be plastic, metal or an elastomer
- Contamination (dirt-holding) capacity
 - Life-span of filter
 - ASTM F975-88 results not always shown
- Particle capture efficiency

The cost of high-performance filters over a machine's life will generally be much less expensive than a cheap, low-efficiency filter.



Filtration and Contamination Control

Controlling Contamination

Proper Oil Filter Selection

- Follow OEM guidelines
- Beta rating is the most prevalent filter rating in the industry
- Higher Beta Ratio = greater particulate removal efficiency
- Beta ratios do not indicate dirt-holding capacity or long term stability.
- Beta ratio is an indicator of expected performance

Beta Ratio (x = particle size in microns)	Efficiency
$\beta_x = 2$	50.0%
$\beta_x = 10$	90.0%
$\beta_x = 20$	95.0%
$\beta_x = 75$	98.7%
$\beta_x = 200$	99.5%
$\beta_x = 1,000$	99.9%

Table 1. Beta Ratios and Their Efficiency Percentage

Contaminant Challenge (particles/ml)	Downstream Fluid Quality (particles/ml)	Beta Ratio	Percent Efficiency
1,000,000	500,000	2	50
	50,000	20	95
	13,000	75	98.7
	5,000	200	99.5
	1,000	1,000	99.9

Table 2. Effect of Filtration Ratio (Beta Ratio) on Downstream Fluid Cleanliness

Questions

- Any Questions?





How to Contact Us

- Lubes Answer Line

800-248-4684

8:00 AM - 12:00 PM, 1:00 PM – 5:00 PM CT
Monday through Thursday

8:00 AM - 12:00 PM, 1:00 PM – 4:30 PM CT
Friday

lubeshelp@citgo.com



Future Webinars

- May 27, 2022 CITGO and Mystik Hydraulic Fluids – David Turner
- June 10, 2022 Low Viscosity HD Engine Oils and Fuel Efficiency – Steve Bowles
- June 24, 2022 Water, Water, Everywhere - David Turner