



Lubricant Additives for the non-Chemist

The webinar will begin in less than 10 minutes.

David Turner, CLS, OMA-I, CLGS



Lubricant Additives for the non-Chemist

The webinar will begin in less than 5 minutes.

David Turner, CLS, OMA-I, CLGS



Lubricant Additives for the non-Chemist

David Turner, CLS, OMA-I, CLGS

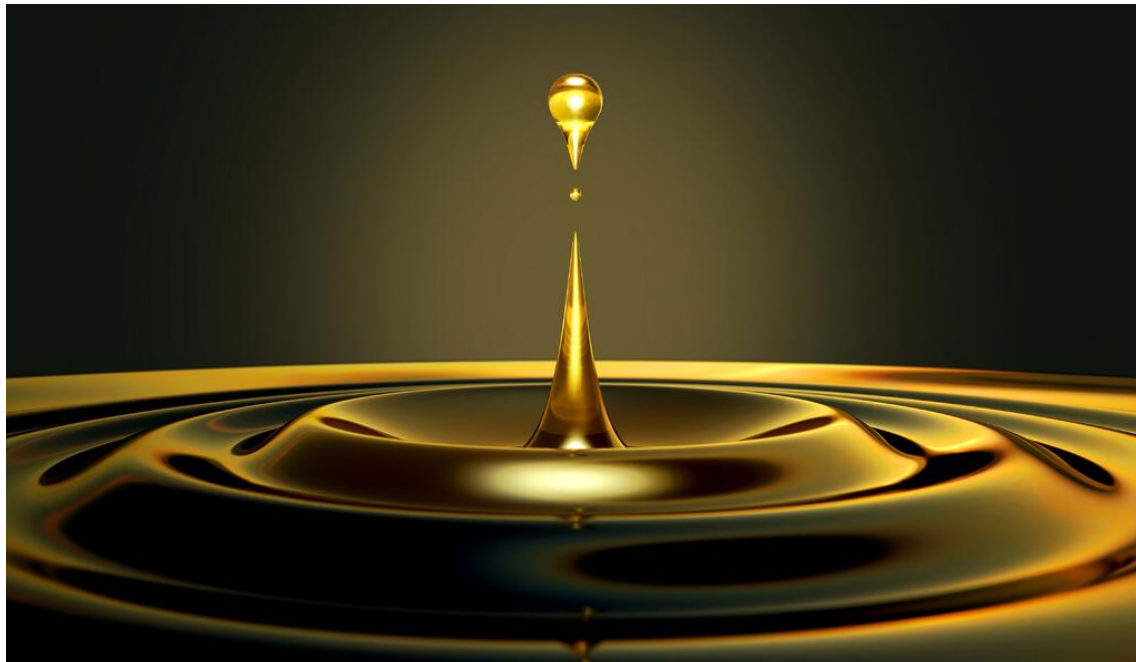
David Turner

- CITGO Sr. Technical Services Representative
- BS, Chemical Engineering
- 39+ Years Experience in Lubricants
- STLE Certified
 - Certified Lubrication Specialist
 - Oil Monitoring Analyst I
- NLGI Certified
 - Certified Lubricating Grease Specialist
- Active in STLE, NLGI, and ASTM



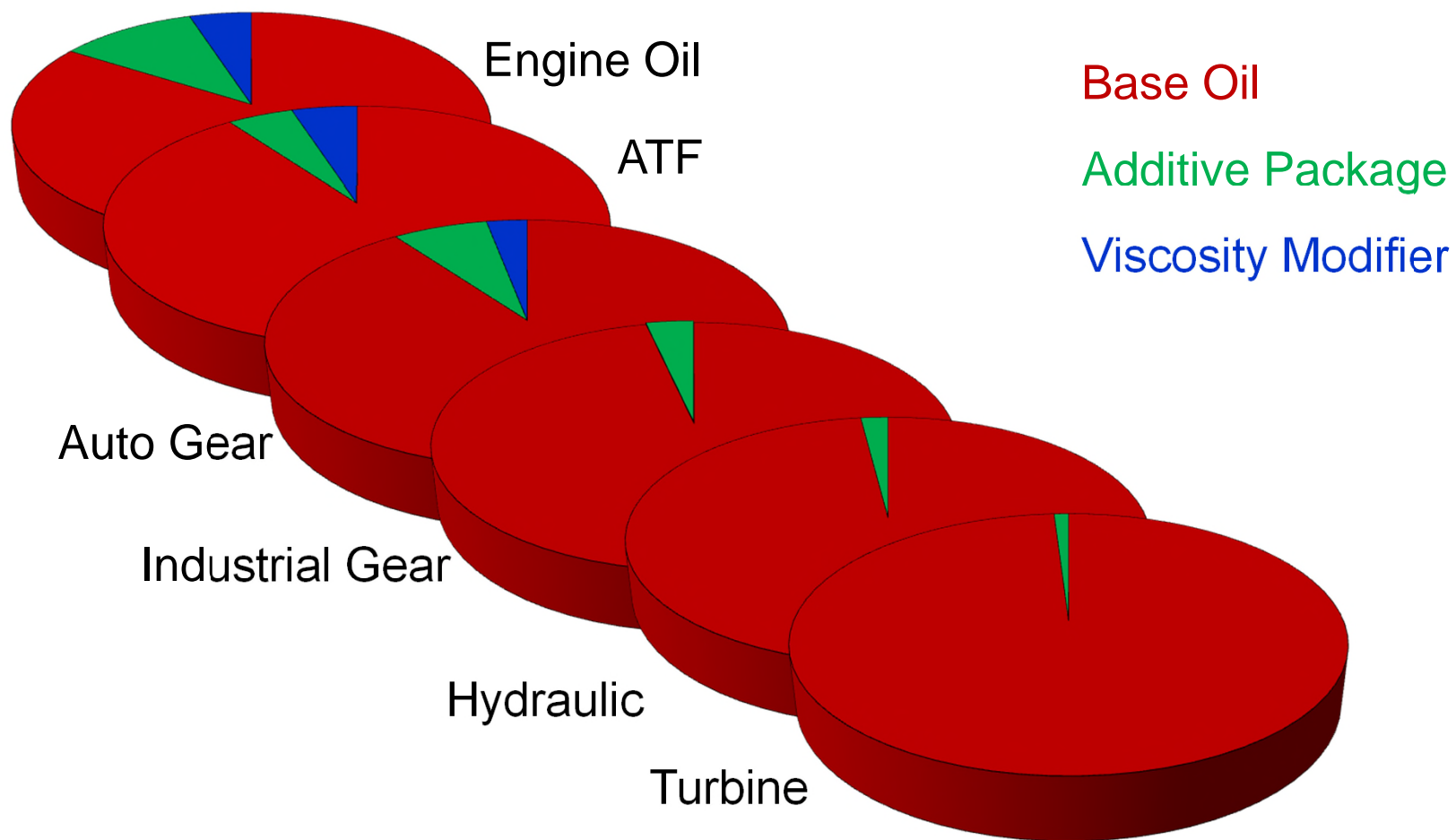
Agenda

- Basic Lubricant Compositions
- Additive Types and Functions

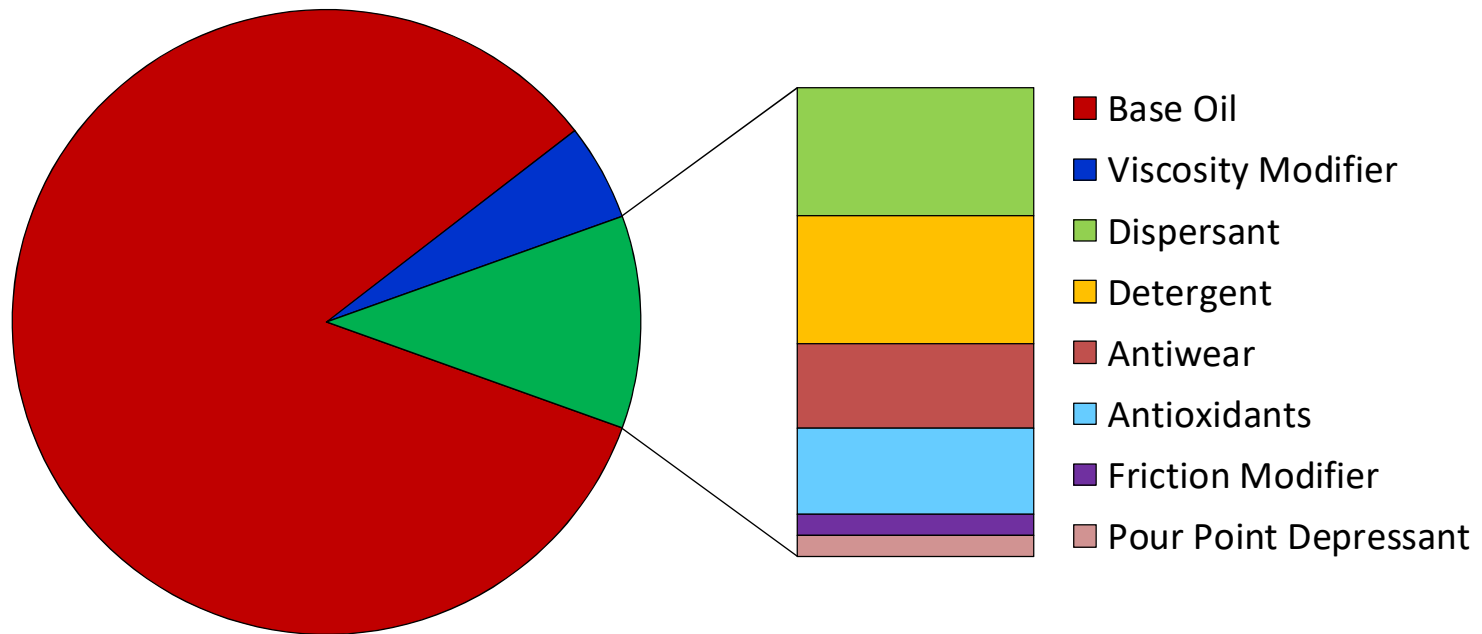


Basic Lubricant Compositions

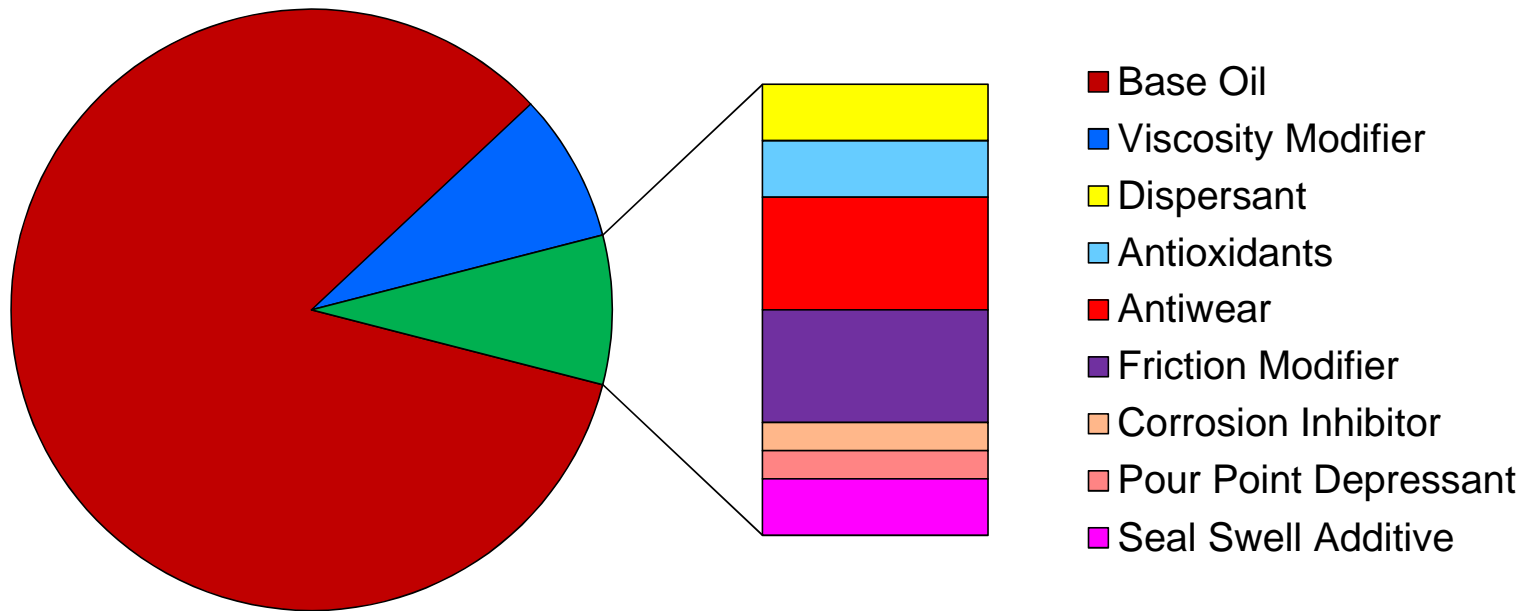
Typical Lubricant Composition



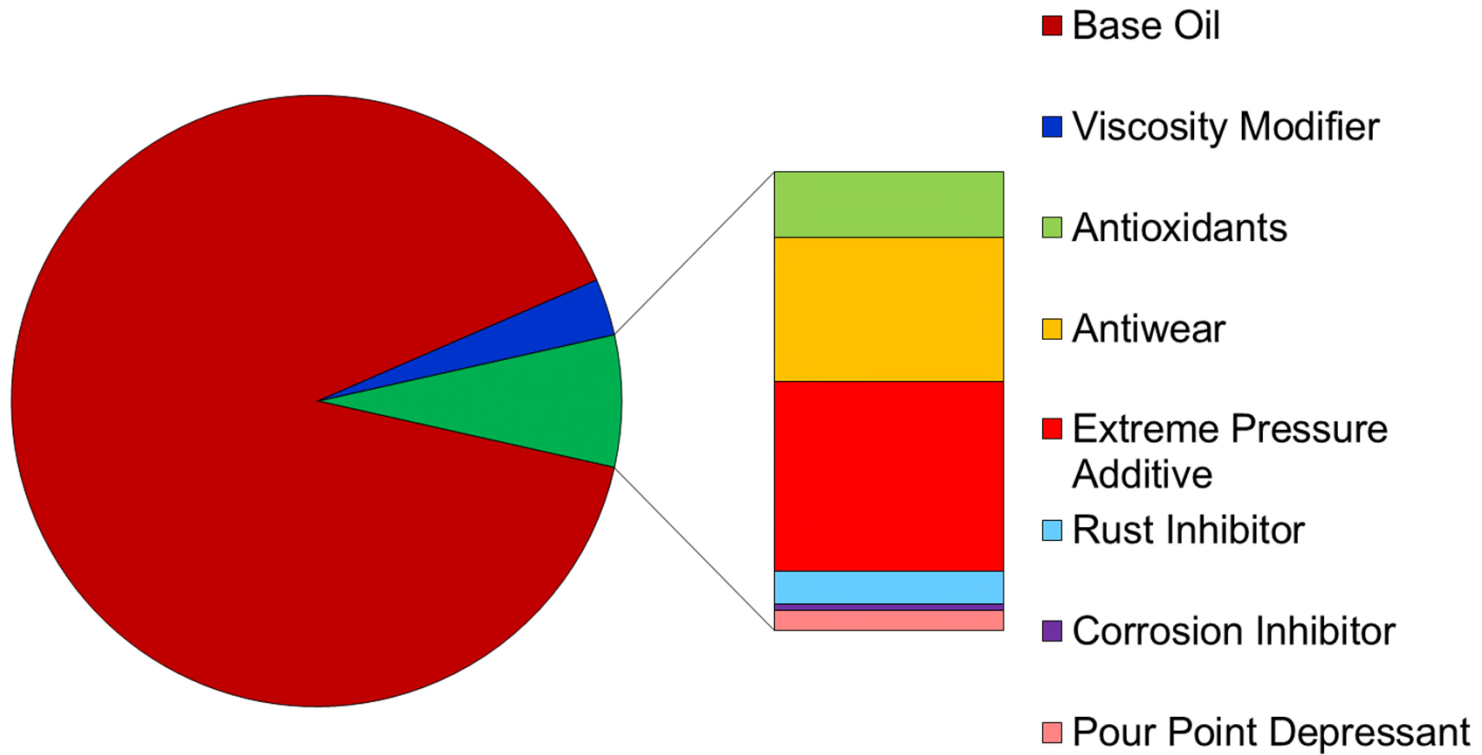
Engine Oil



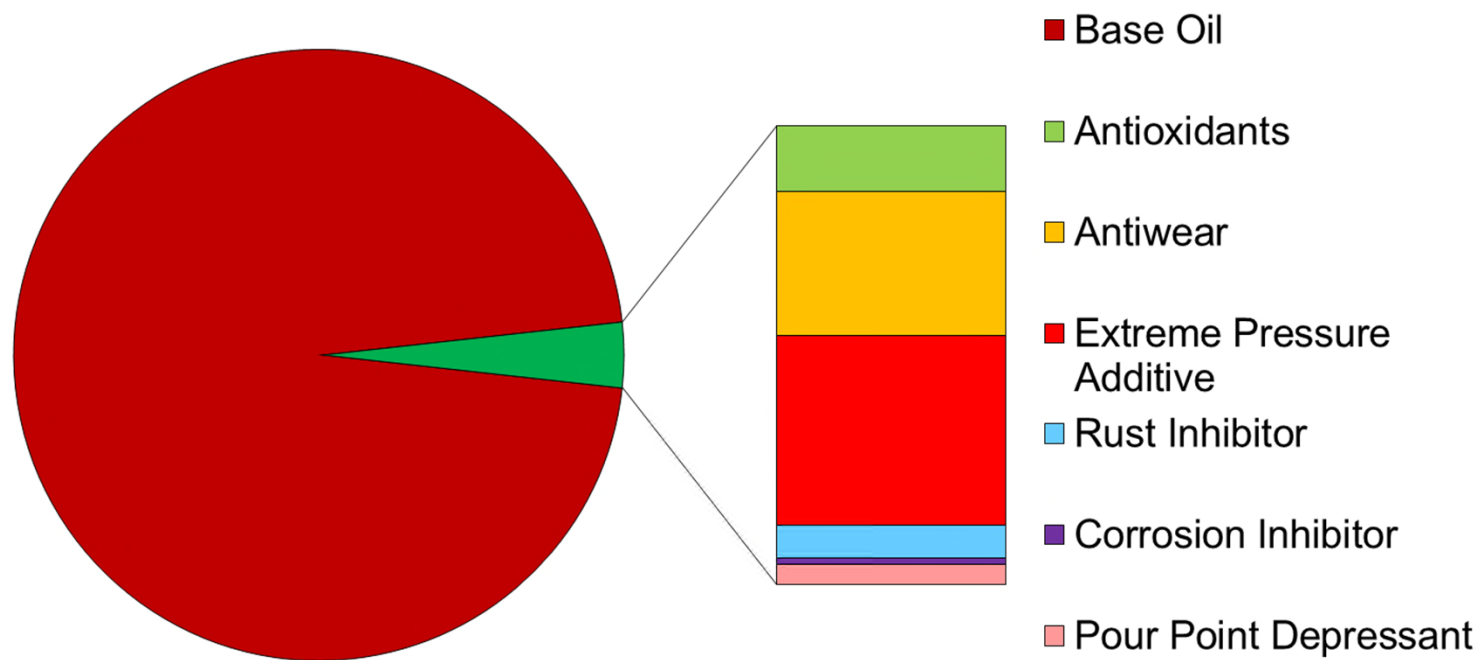
Automatic Transmission Fluid



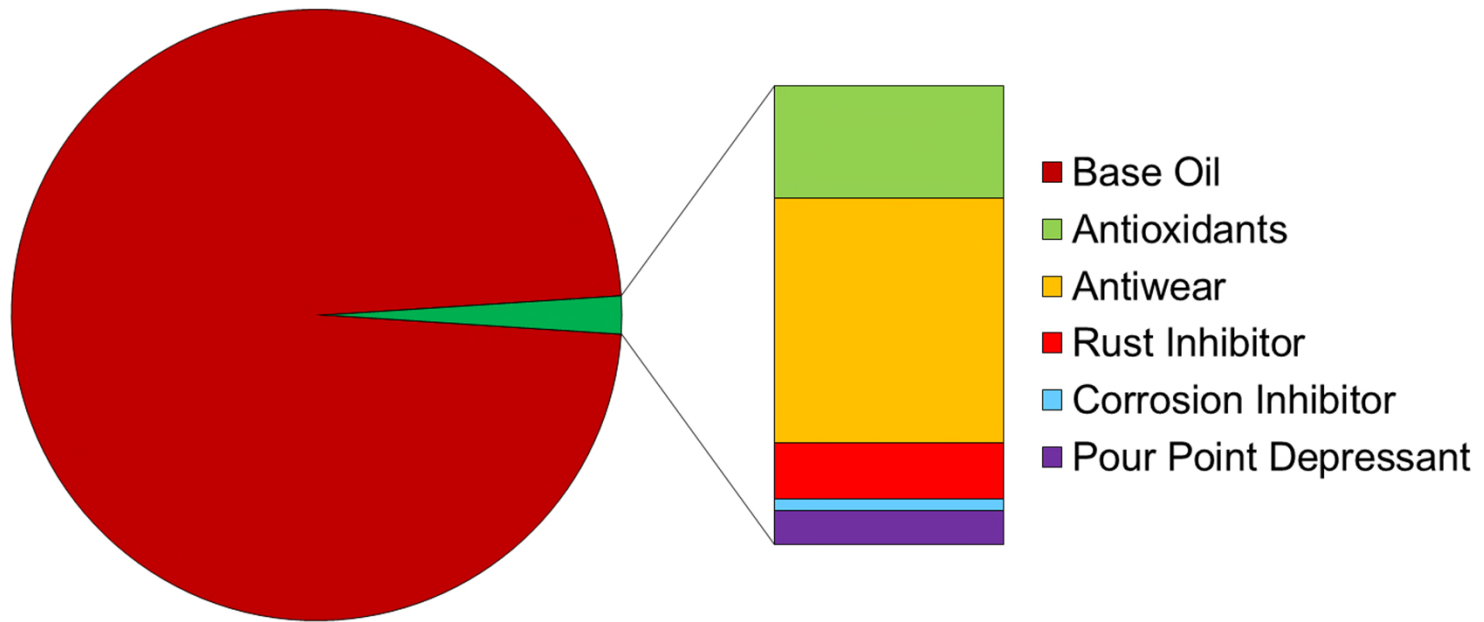
Automotive Gear Oil



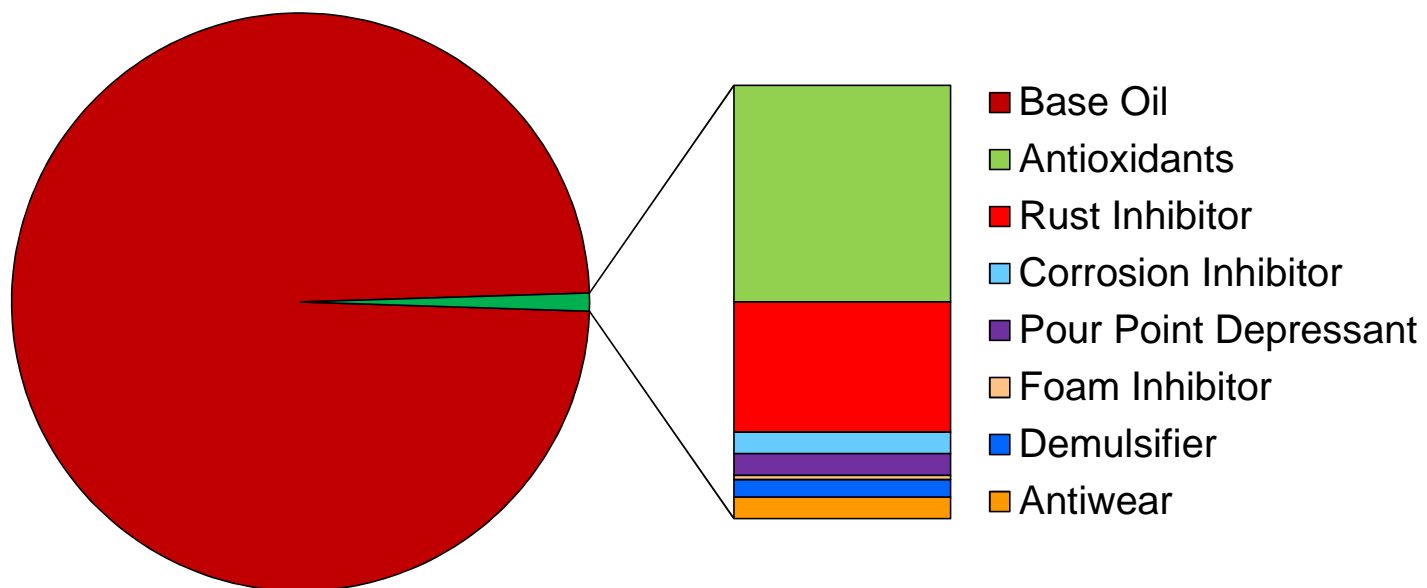
Industrial Gear Oil



Hydraulic Fluid



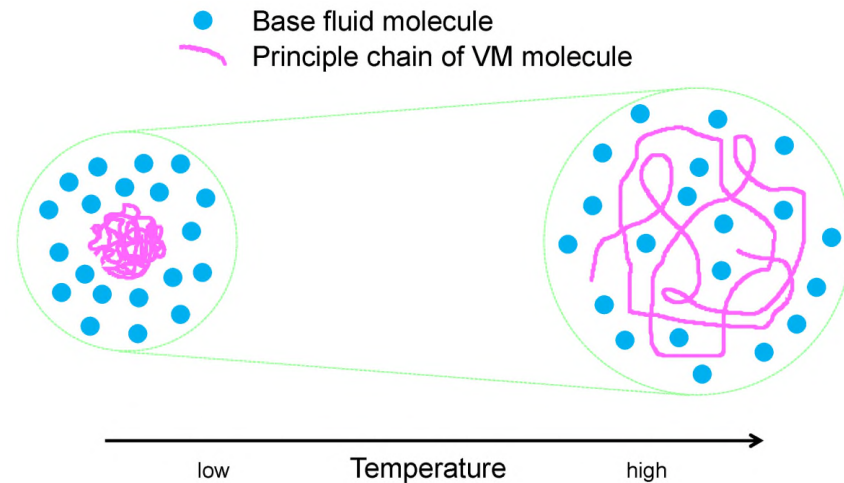
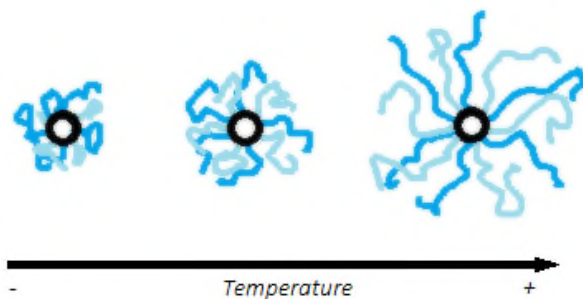
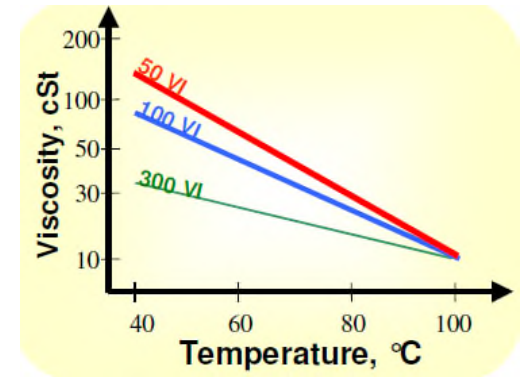
Turbine Oil



Additive Types and Functions

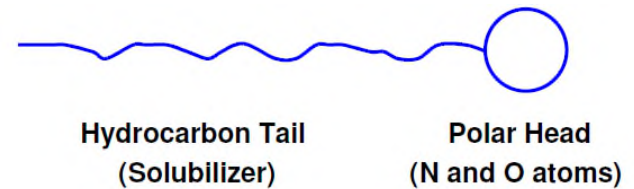
Viscosity Modifier (VM)

- Polymer molecule
- Viscosity Index Improver (VII)
- Contracts at lower temperature
- Expands at higher temperature
- Helps to maintain oil viscosity over a range of temperatures
- Multi-grade engine oils
- High VI hydraulic oils



Dispersant

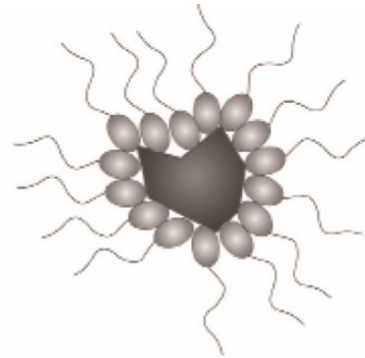
- Found in engine oils
- Polar non-metallic (ashless) organic cleaning agent
- Solubilize and disperse contaminants:
 - Soot
 - Sludge
 - Deposit precursors



Dispersant molecules
with polar head and
oil-soluble tail



Solid contaminant particles
(e.g. soot)

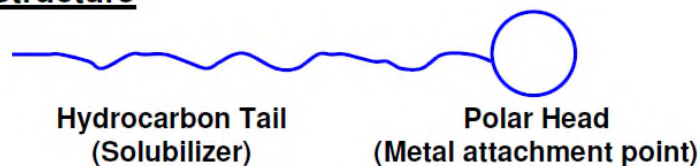


Polar head attaches to
solid particles, while the oil-soluble
tail prevents them from agglomerating
and depositing on engine surfaces

Detergent

- Found in engine oils, contribute to the Base Number (TBN)
- Polar organo-metallic compounds, typically containing calcium or magnesium
- Control deposits and keep the engine clean
- Neutralize acidic products of combustion
- Concentration in diesel engine oils is limited due to 1.0% sulfated ash limit in API CK-4/FA-4 diesel engine oils

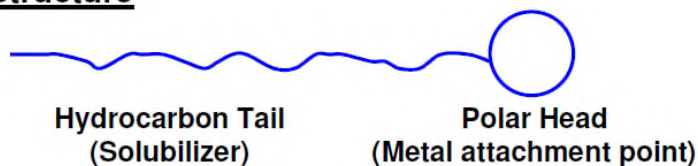
Structure



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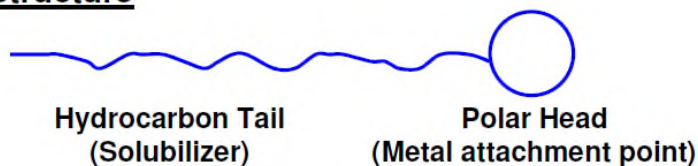
More Like This



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More Like This

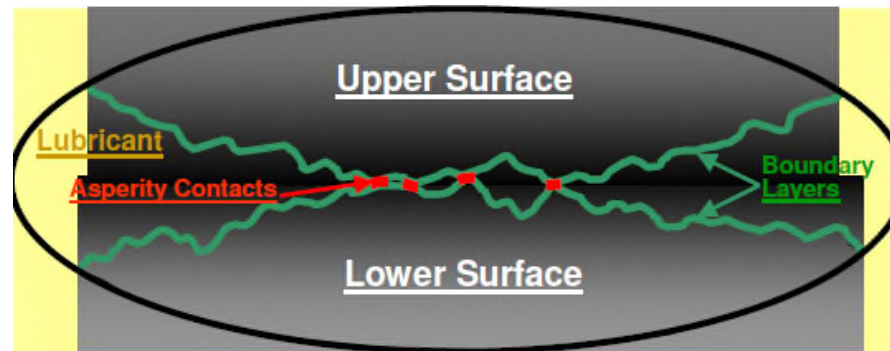


Than This



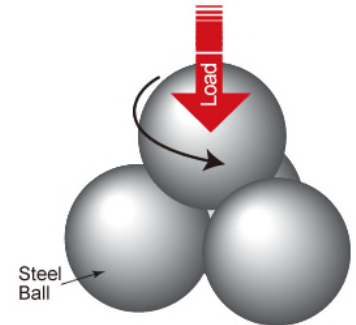
Antiwear (AW)

- Help to protect metallic surfaces in relative motion from wearing
- Attach to the metal surface to form a molecular film
- Effective at moderate loads and temperatures
- Typically sulfur and/or phosphorus containing compounds



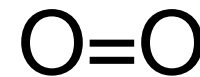
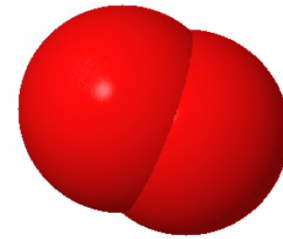
Extreme Pressure (EP)

- Enhance the load-carrying capacity of lubricants beyond the load-carrying ability of the oil alone
- React with metal surfaces to form a protective film
- Typically require elevated temperature and/or load to be activated
- Different types have different activation temperatures
- Prevent/reduce adhesion and interlocking of surface asperities
- Sulfur, phosphorus, and chlorine compounds are the most common EP additives



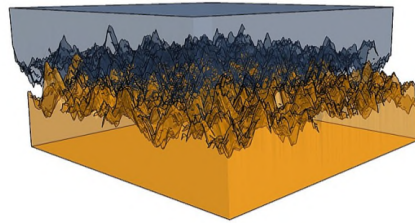
Antioxidants (AO)

- Found in almost all lubricants
- Oxidation can lead to:
 - Viscosity increase (oil thickening)
 - Formation of sludge and varnish
 - Formation of acids, leading to corrosion
- Two main types of AO:
 - Aminic
 - Phenolic
- Combinations are often synergistic
- Sacrificial materials, preferentially react with oxygen
- Protect the base oil from undergoing oxidation
- Extend the useful life of the lubricant
- Often have secondary and tertiary antioxidant functionality
- Many different ways of measuring oxidation stability



Friction Modifier (FM)

- Found in automotive and heavy duty engine oils and some transmission fluids
- Form a thin, monomolecular layer on metal surfaces
- Oil soluble and some solids (e.g. graphite, PTFE)
- Reduce (engine) or control (transmission) frictional properties
- In engine oils, used to improve fuel economy



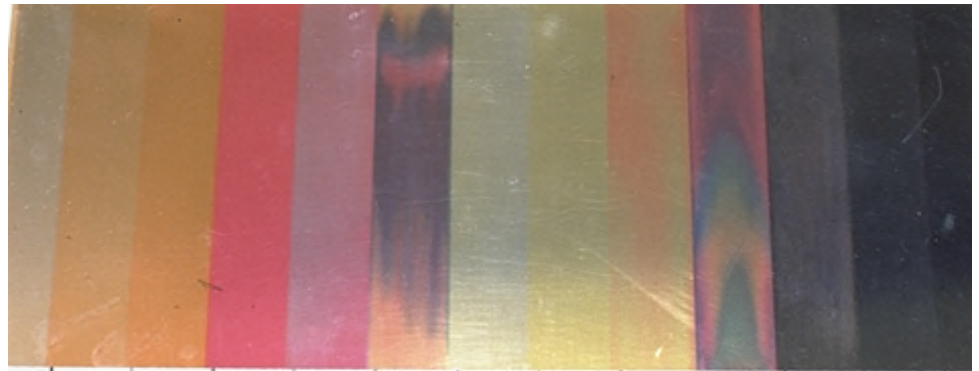
Rust Inhibitor (RI)

- Found in almost all lubricants
- Protect ferrous metal surfaces against chemical attack (water, acids, etc.)
- Form molecular films on metal surfaces by adsorption
- Compete with other surface active additives – dispersant, detergent, friction modifier, antiwear, extreme pressure



Corrosion Inhibitor (CI)

- Protect non-ferrous metals against chemical attack
- Metal passivator – sulfur scavenger
- Primary function is the protection of yellow metals (copper, bronze, brass, and related alloys)
- Some types form a surface film
- Some are oil-phase active
- Low concentration is effective



Pour Point Depressant (PPD)

- Polymeric compounds
- Improve flow properties of oil at low temperatures
- Disrupt the formation of wax crystals
- Modify the morphology (shape) of wax crystal structures



Without PPD



With PPD



Demulsifier

- Enhance the ability of an oil to separate water
- Some additives cause oils to emulsify more easily
- Demulsifier allows the product to shed water

Good
Demulsibility



Poor
Demulsibility

Foam Inhibitor or Antifoam (AF)

- Work at the surface of the lubricant
- Limited solubility in oil
- Destabilize foam (network of bubbles)
- Very low concentrations (<10 ppm)
- Two types:
 - Silicone fluid
 - Non-silicone
- Reduce:
 - Air entrainment
 - Cavitation damage
 - Oxidation
 - Lubricant starvation
- Silicone AF can interfere with paints



Seal Swell Additive / Seal Conditioner

- Absorbed by elastomers
- Makes old and shrunken elastomers expand
- Improved sealing
- High-mileage engine oil
- Transmission fluid
- Hydraulic fluid



Dye

- Dye is added to some products to produce a distinctive color
- Complex organic compounds
- Aesthetic effect only – no effect on performance
- Transmission fluids are dyed red to differentiate them from engine oils
- Some colors are unique to a brand
- Color can make a product more popular



Additives Unique to Grease

- Some other additives are typically found in grease:
- Tackiness additive - polymer
 - + Adhesiveness, water resistance
 - Pumpability, low-temperature handling
- Solid additives
 - Graphite, Molybdenum Disulfide, PTFE, etc.
 - Friction modifier, antiwear





A Word About Aftermarket Engine Oil Additives

- Lubricant additives are carefully balanced combinations of many different components
 - Surface active additives compete for space to react with or attach to metal surfaces
 - Soluble additives can negatively interact with each other if their concentration is too high
 - Goldilocks Principle:
 - Not too little
 - Not too much
 - Just the right amount
 - Aftermarket additives can throw the additive combination out of balance
 - Better not to add aftermarket additives
-



Questions

- Please post your questions using the Q&A function.
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How to Contact Us

- Lubes Answer Line

800-248-4684

8:00 AM - 12:00 PM, 1:00 PM – 5:00 PM CT
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8:00 AM - 12:00 PM, 1:00 PM – 4:30 PM CT
Friday

lubeshelp@citgo.com



Future Webinars

- | | |
|---------------|---|
| June 25, 2021 | Clarion Lubricants for the Food and Beverage Industry |
| July 9, 2021 | Lubricants for the Steel Industry |
| July 23, 2021 | Wear Modes and Failure Analysis |
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