Volvo Construction Equipment Lubricants

Lubrication Training

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Program overview

VOLVO

Module Overview

- Lubrication Principles
- Engine Lubrication
- Transmission Lubrication
- Automatic Transmission Fluids
- Grease Lubrication

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Program overview

Lubrication Principles - Section Overview

- Refining Process
- Refinery Products from Crude Oil
- Lubricant Base-stocks
- Key Lubricant Functions
- Key Lubricant Properties
- Viscosity
- Viscosity Classification System (SAE)
- Mono-grade Vs. Multi-grade
- Pour Point / Flash Point / Volatility
- Conventional Vs. Synthetic lubricant ?
- Synthetic Lubricants
- Lubricant Additives
- Additive Types

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Refining Process

- Two Main Processes:
  - Separation Processes
    - » Selects Desirable Components from the Crude
    - » Includes Distillation, Solvent Extraction, Solvent Dewaxing
  - Conversion Processes
    - » Convert Undesirable Elements into Useful Lube Oil Components
      - Aromatics, Sulfur, Wax, etc.
    - » Includes Hydrotreating, Hydrofinishing, Hydrocracking and Catalytic Dewaxing
    - » To achieve desired properties

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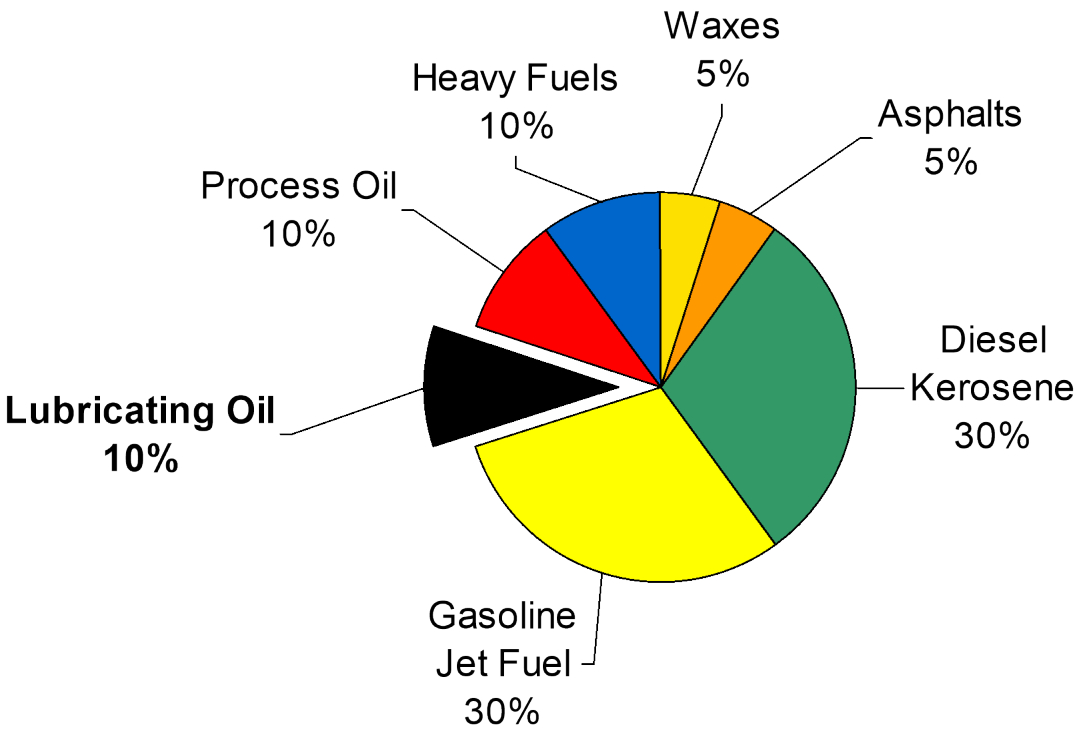
Refinery Products from Crude Oil



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Lubricant Basestocks

BASESTOCK
SELECTION

ADDITIVE
SELECTION

FINISHED LUBRICANT

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Lubricant Basestocks

- Mineral Oil Basestocks Refined from Crude Oil
- True Synthetic Basestocks are Derived from Chemical Reactions
- Some companies now consider very highly refined mineral oil as “Synthetics”

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Key Lubricant Functions

- Separate moving surfaces
- Cooling
- Sealing
- Wear protection
- Rust, corrosion and foam inhibition
- Anti oxidation
- Dispersancy
- Detergency

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Key Lubricant Properties

- Viscosity
- Pour Point
- Flash Point
- Volatility

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Viscosity

- Measure of a fluid's resistance to flow
- Changes with
  - Temperature – higher temperature, lower viscosity
  - Pressure – higher pressure, higher viscosity
  - Shear Rate – higher the shear rate, lower viscosity

- Viscosity Index
  - Effect of change of temperature on the viscosity of an oil

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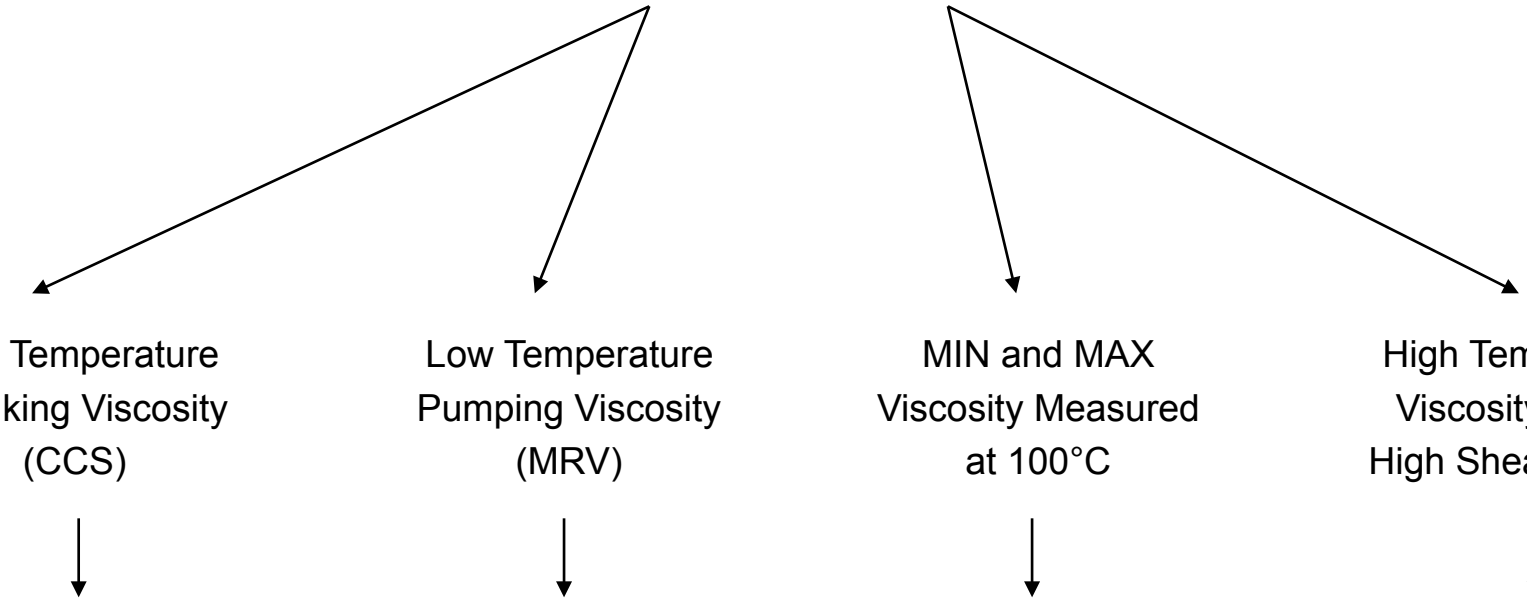
Viscosity Classification System (SAE)

E.G.: SAE 15W-40



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Mono-grade Vs. Multi-grade

- Mono-Grades
  - Meets the requirements of one SAE viscosity grade
  - e.g. SAE 15W (Winter Grade) or SAE 40 (Summer Grade)
  - Low temperature viscosity critical for winter grades, high temperature viscosity critical for summer grades

- Multi-Grades
  - Meets the requirements of more than one SAE viscosity grade (Both winter & summer grades)
  - Combine ‘summer’ and ‘winter’ SAE grades in one oil
    - » e.g. SAE 15W-40 has the low temp. properties of SAE 15W & the high temp. properties of SAE 40
  - Higher VI than Mono-Grades

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Pour Point / Flash Point / Volatility

- Pour Point
  - Defines the Temperature at Which Fluid no Longer Flows
  - Has Direct Effect on Fluid Pumping Temperature
  - Gives an indication of cold flow properties
- Flash Point
  - Temperature at which vapor from a heated oil ignites when exposed to a naked flame
  - Indicates the fire hazard
- Volatility
  - A measure of an engine oil's tendency to evaporate at high engine temperatures

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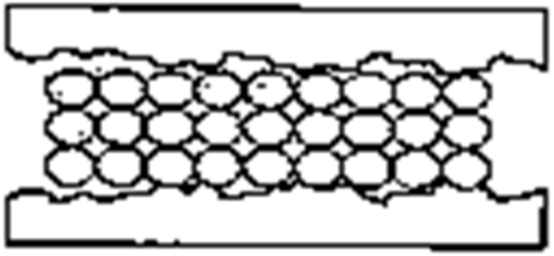
Conventional Vs. Synthetic lubricant ?

Conventional

- Conventional Lubricant
  - Produced from Crude Oil
  - Basestocks are Obtained by REMOVING Undesirable Components

Synthetic



- Synthetic Lubricant
  - Produced from Chemical Feedstocks
  - Basestock is Engineered Through a Catalytic Process (Creating a synthesized material)

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Synthetic Lubricants

- Advantages
  - Replaces Volatile Light Mineral Oil
    - » Reduced Lubricant Consumption
    - » Improved Fuel Economy
  - Improves
    - » Low Temperature Performance
    - » Oxidation Stability

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Lubricant Additives

- Chemical Compounds Which are Added to Lube Oil Stocks to Improve Their Performance Properties
- Supplement or Reinforce Well-refined, High-quality Basestocks
- Perform Two Critical Functions:
  - Maximize Beneficial Properties
  - Minimize Destructive Processes
    - » Oxidation
    - » Wear
    - » Rust/Corrosion
    - » Shear
    - » “Combustion”

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Additive Types

- Dispersants
- Detergents
- Anti-Wear Agents
- Friction Modifiers
- Oxidation Inhibitors
- Rust Inhibitors
- Viscosity Index Improvers
- Pour Point Depressants
- Foam Inhibitors

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Engine Lubrication - Section Overview

- Main Engine Parts
- Gasoline Vs. Diesel
- Diesel Engine Designs
- Turbocharger
- Engine Oil Functions
- Engine Oil Components
- Major International Engine Oil Specifications
- API Classification
- API Diesel Oil Quality Levels
- ACEA Classification
- Other Classifications
- Engine Builder Trends

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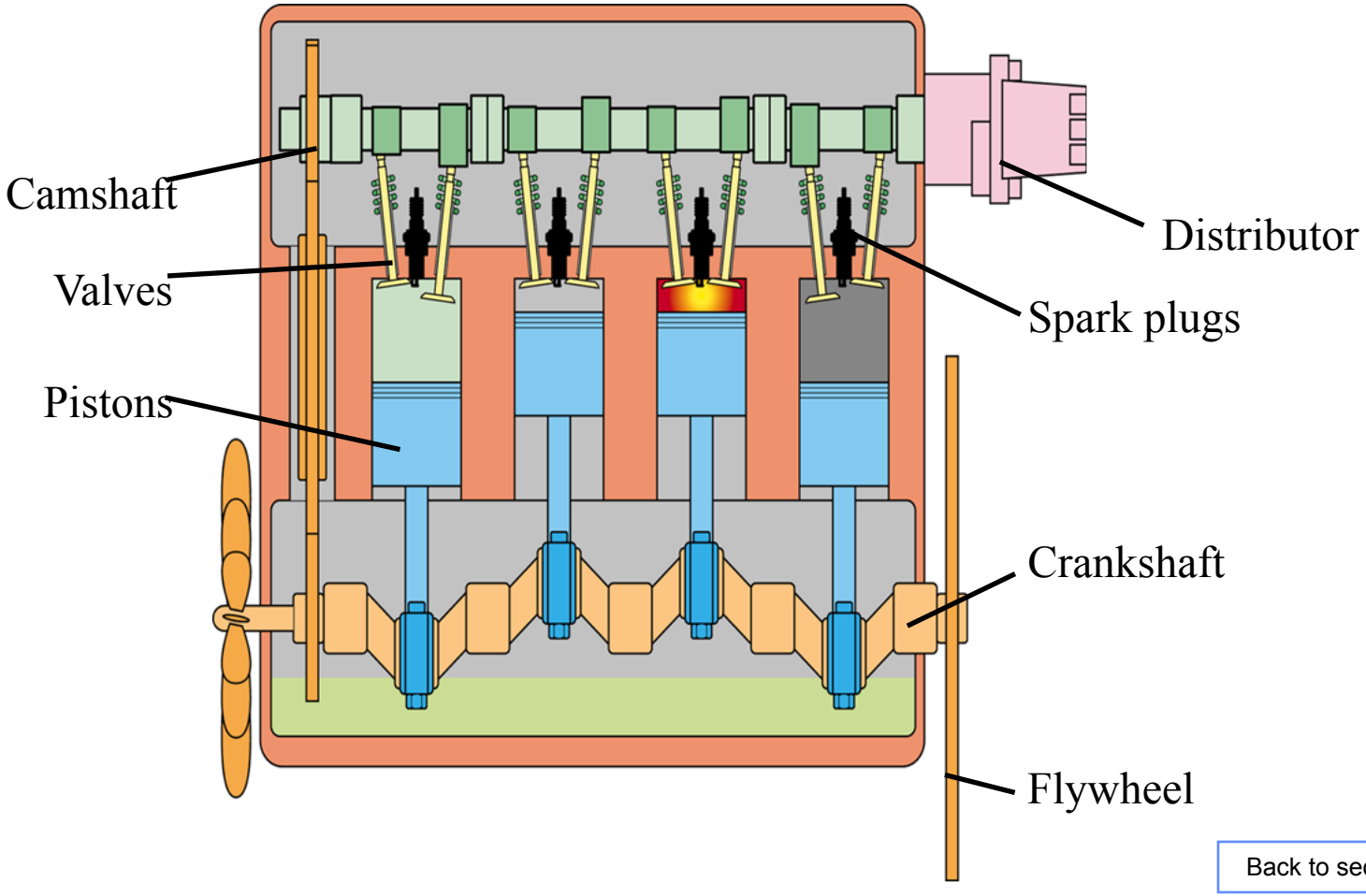
Main Engine Parts



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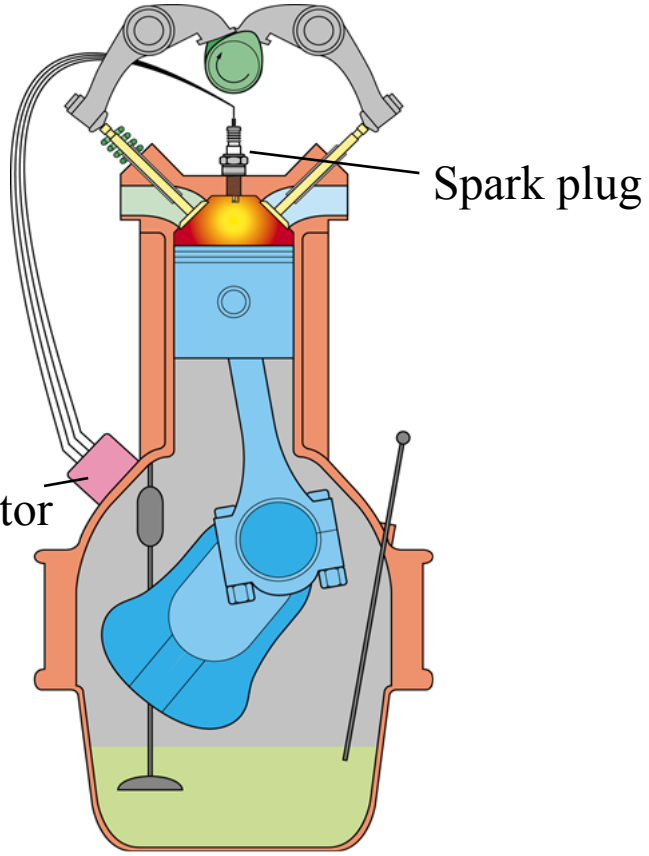
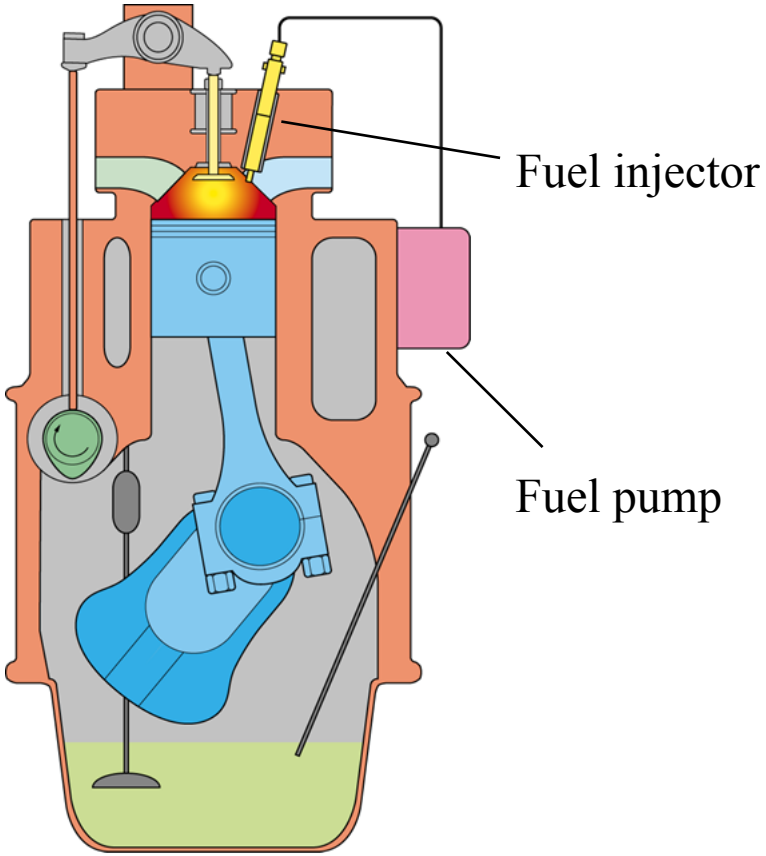
Gasoline Vs. Diesel

Typical gasoline engine



Typical diesel engine



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Gasoline Vs. Diesel

- Gasoline
  - Quieter
  - Lighter
  - Faster
  - Better acceleration
  - Lower initial cost
  - Catalyst emissions control

- Better fuel economy
  - Heavier
  - Longer life
  - Good reliability
  - Catalyst and particulate trap emissions control

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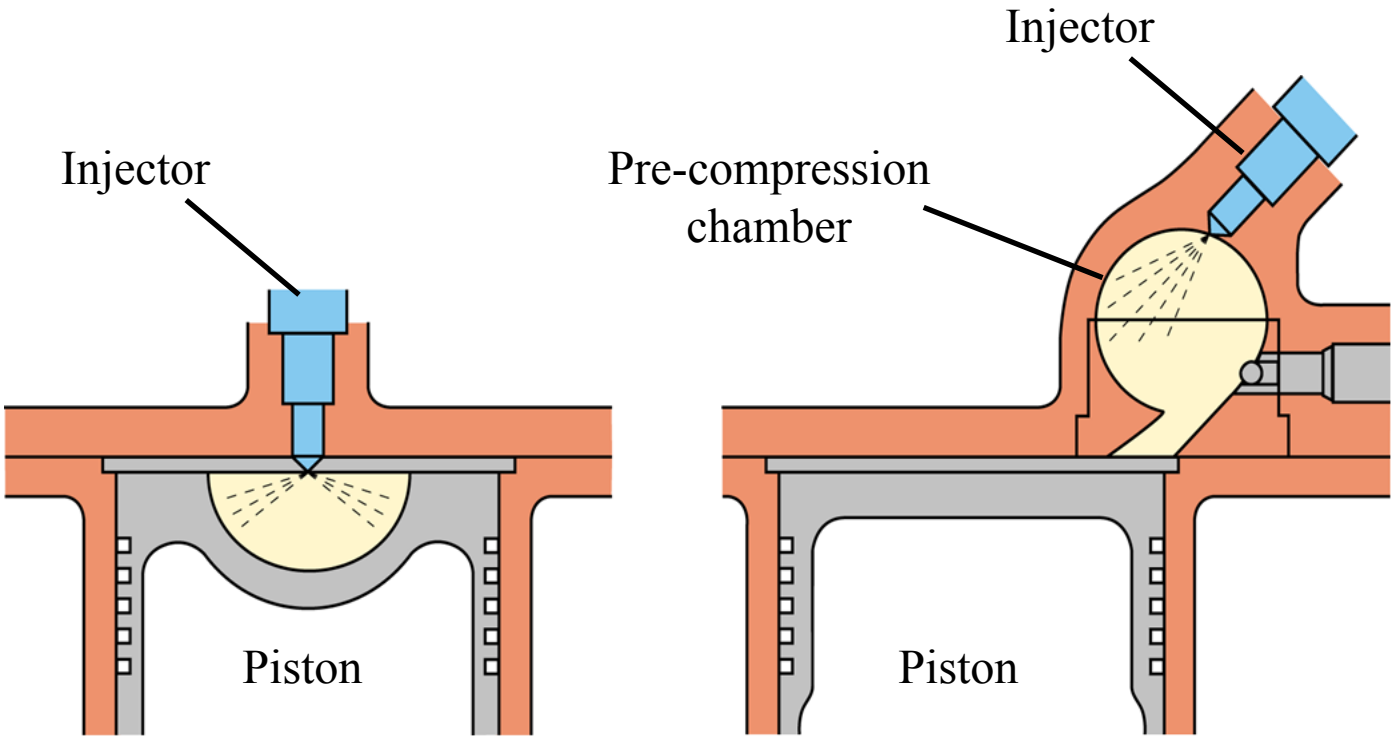
Diesel Engine Designs



Direct Injection

Indirect Injection

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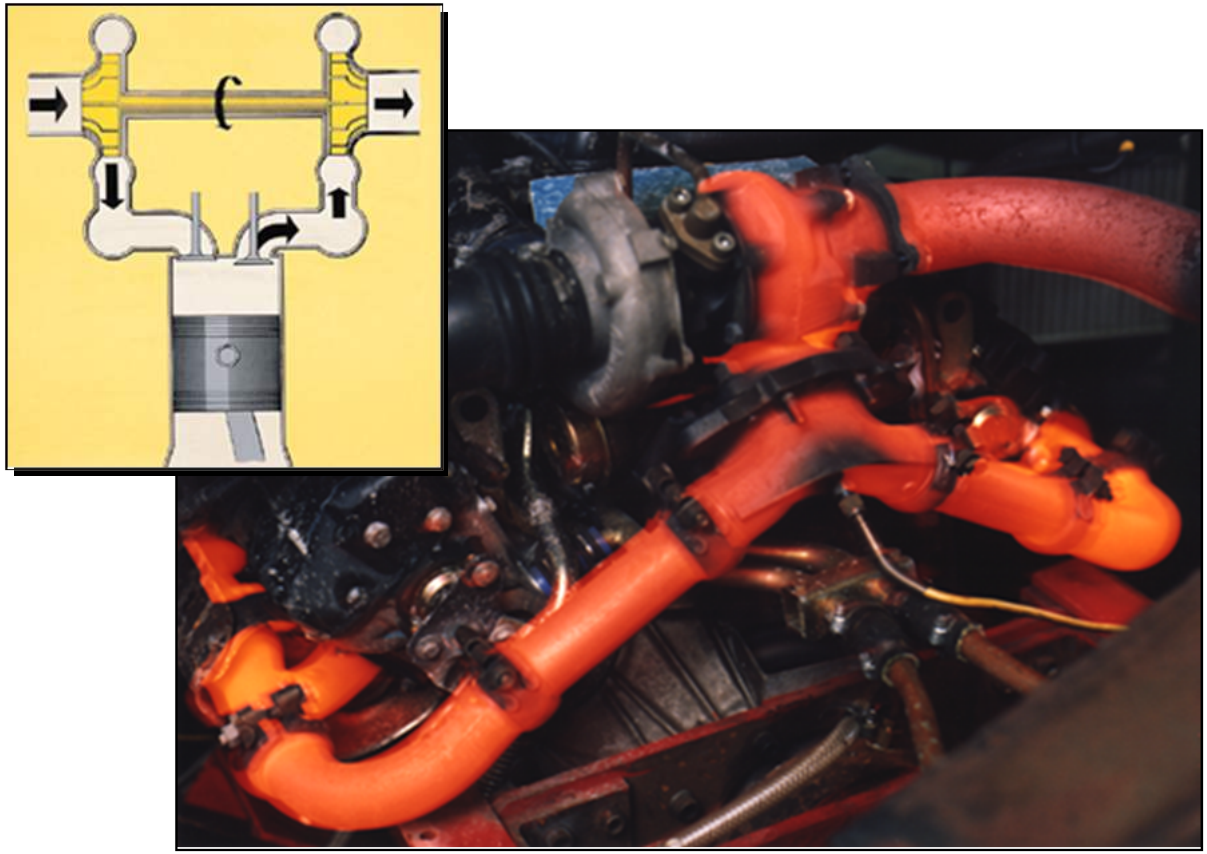
Turbocharger



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Engine Oil Functions

- Friction & Wear Reduction
- Cooling
- Sealing
- Detergent & Dispersant
- Rust & Corrosion Inhibitor
- Diagnosis
- Foam Inhibitor

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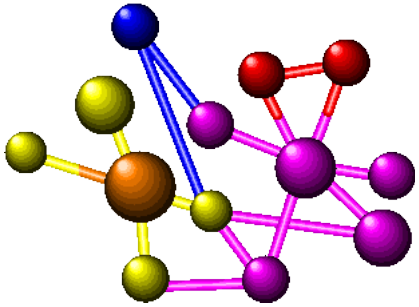
Engine Oil Components



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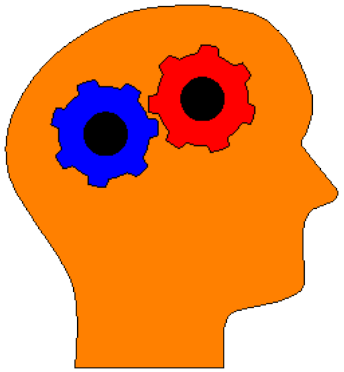

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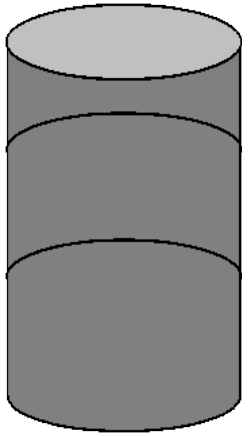

Base Oil

Additives

Final Product

- Base Oil: 70% to 95% of final product
- Additives: 30% to 5% of final product

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Major International Engine Oil Specifications

- API (American Petroleum Institute)
- ACEA (Association des Constructeurs Européens d'Automobiles)
- VDS (Volvo)
- MB
- MAN
- Scania
- RVI (Renault)
- Allison
- CAT (Caterpillar)
- ZF

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API Classification

- Gasoline
  - SA (Obsolete)

  - SG (1989)
  - SH (1993)
  - SJ (1996 Introduced)

- Diesel
  - CA (Obsolete)

  - CD (1965)
  - CE (1988)
  - CF (Heavy Duty Off Highway)
  - CF-2 (Two Cycle) (1994)
  - CF-4 (1990)
  - CG-4 (1994 Low Emissions)
  - CH-4 (1998 Low Emission)
  - CI-4 (2002 Low Emission)

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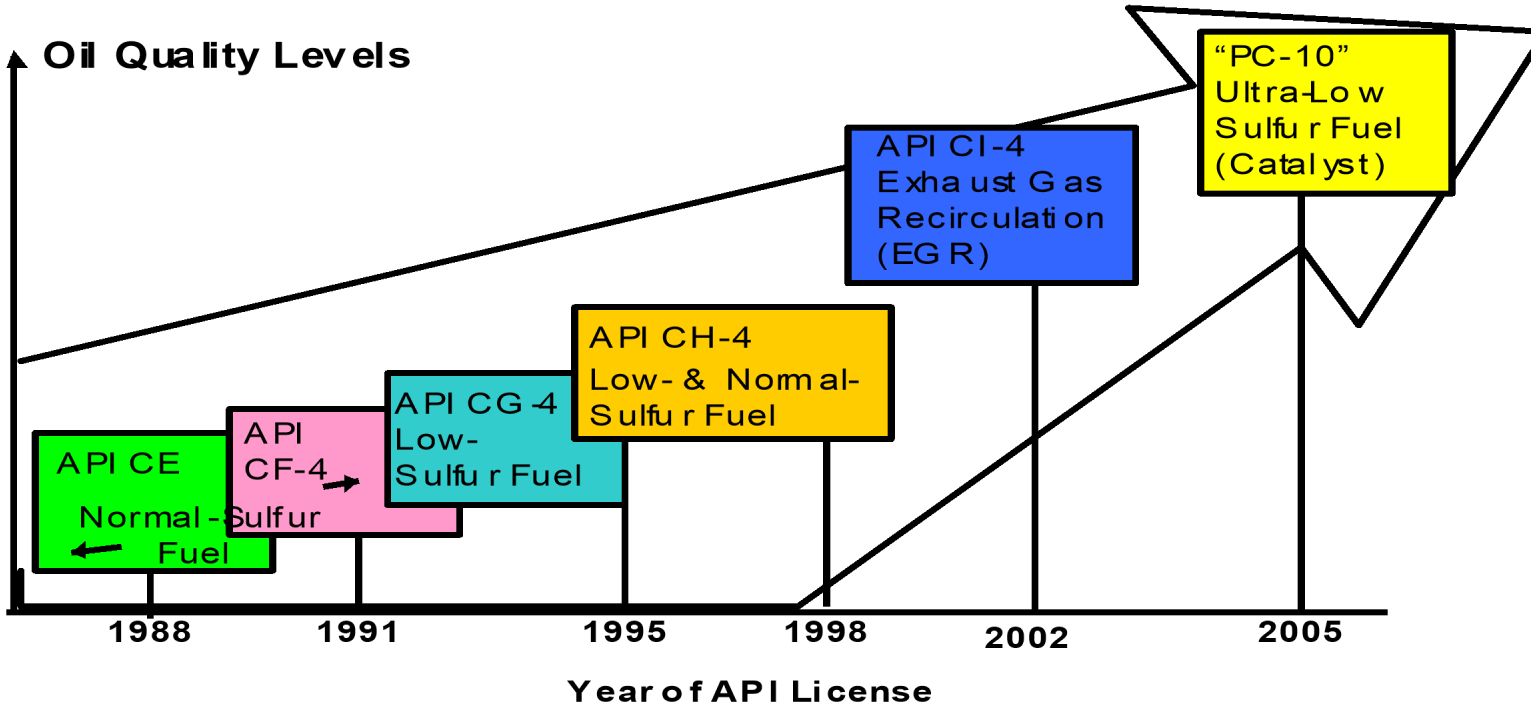
API Diesel Oil Quality Levels

Reduced-Cycle Time for New Categories
Driven by EPA'S Exhaust Emission Standards



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ACEA Classification

- Gasoline
  - A1-98
  - A2-98
  - A398
- Passenger Car Diesel
  - B1-98
  - B2-98
  - B3-98
  - B4-98
- Heavy Duty Diesel
  - E1-98 (obsolete)
  - E2-98
  - E3-98
  - E4-98
  - E5-99

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Other Classifications

- Volvo
  - VDS
  - VDS-2
  - VDS-3
- MB
  - 227.0
  - 228.1
  - 228.3
  - 228.5
- Heavy Duty Diesel
  - MAN 270
  - MAN 271
  - MAN 3275
  - MAN 3277

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Engine Builder Trends

- Higher Horsepower up to 600 HP
- Higher Injection Pressures
- New metallurgy in components
- New timing maps - Expect higher soot levels
- Development of EGR Engines
- Greatly extended service intervals
- Alternate filtration systems
- New engine designs

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Transmission Lubrication - Section Overview

- Manual Transmission
- Types Of Gears
- Synchromesh Gears
- Differential
- Limited Slip Differential
- Functions of a Gear Lubricant
- Gear Oil Properties
- Gear Oil Specifications - API
- OEM Requirements - Mercedes
- OEM Requirements - ZF
- OEM Requirements - Volvo & Scania
- OEM Requirements - MAN
- Commercial Vehicle Trends
- OEM Drain Periods
- Comparative Viscosity Classes

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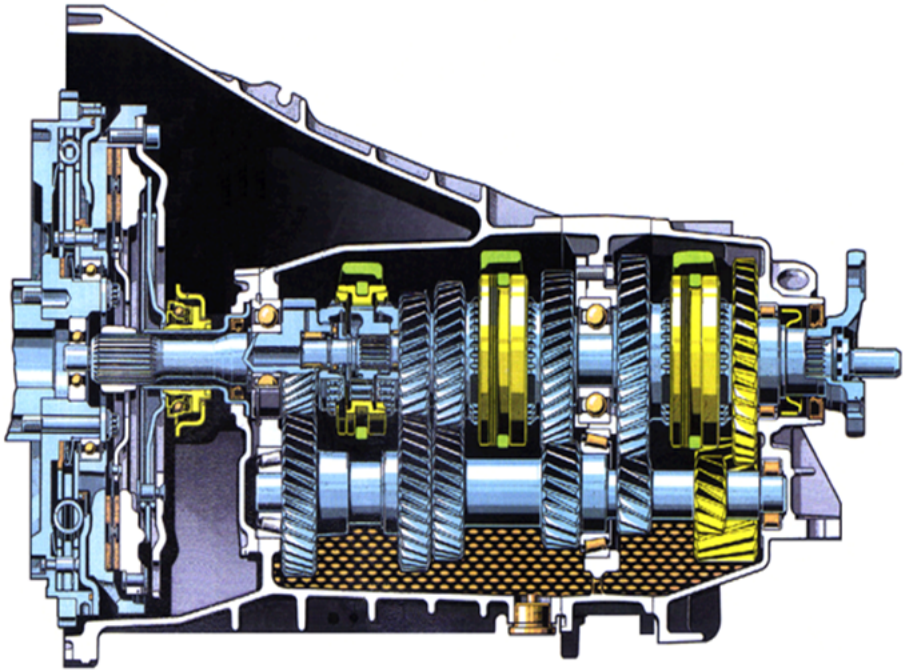
Manual Transmission

- Allows the driver to select the gear, and therefore the power output of the engine that is needed for the speed and control of the vehicle
- As the drive leaves the engine, it passes through the clutch
- It enters the gear box
- And leaves to the wheels



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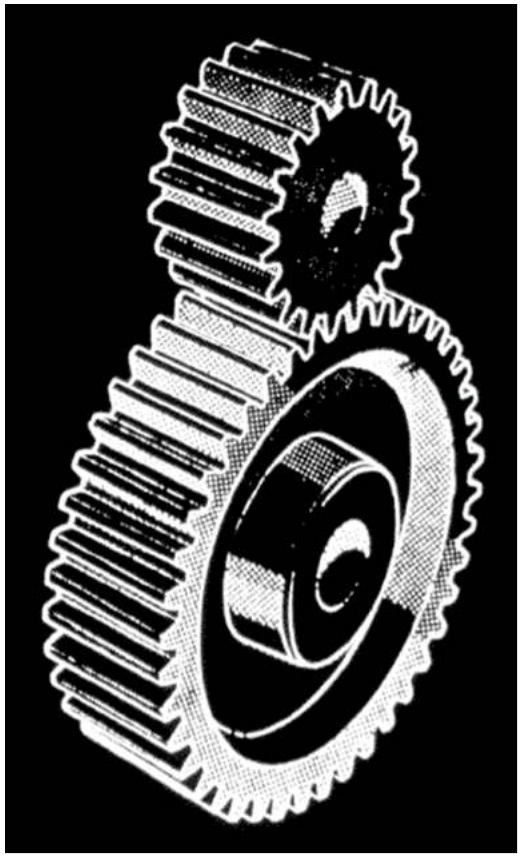
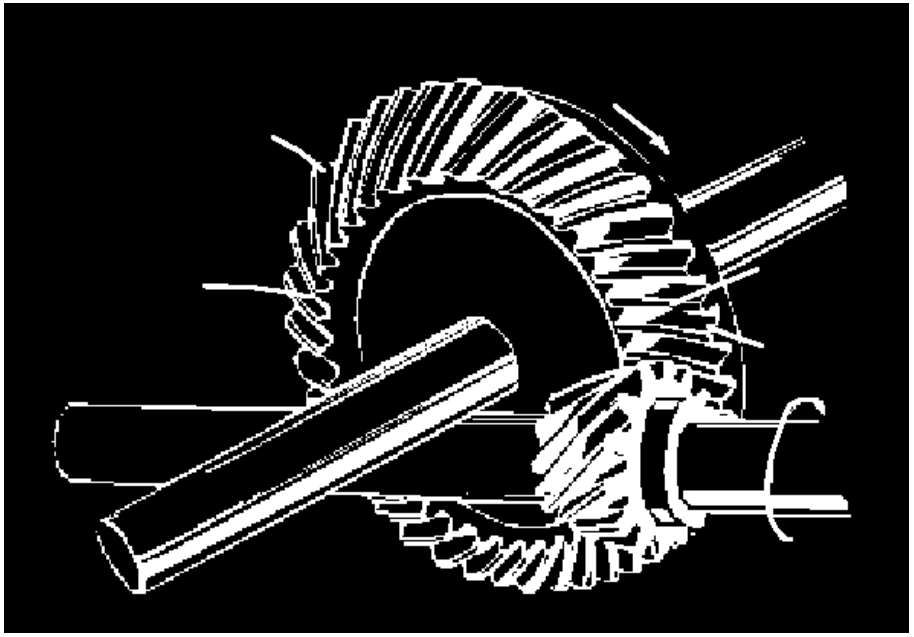
Types Of Gears

Spur Gears



Hypoid Gear



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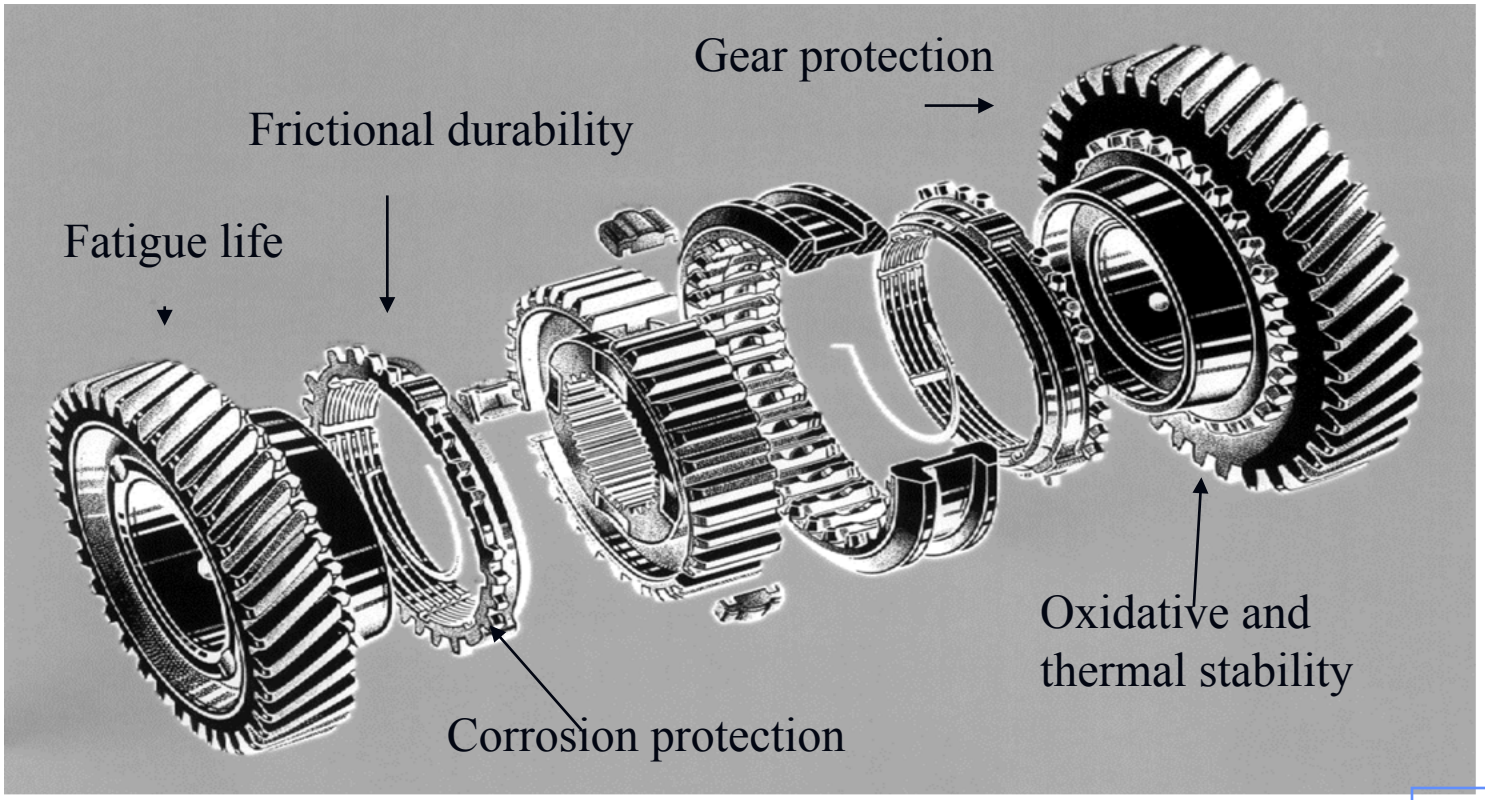
Synchromesh Gears

- When changing gears, the gears are rotating at the speed of either the drive shafts or the engine
- To prevent damage the synchromesh equalizes the speeds of the gear shafts before engaging the gears



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