Cummins Engine RV 2012

Jennifer Ziegenhagen
Lubricating System Requirements
Make up of engine oils:

- Typically an engine oil is made up of 80 to 85% base oils (neutrals and bright stocks) and 15 to 20% performance additives.

- The base oils are transporters. They carry the additives to work.
  - Refined petroleum oils- high quality hydro-finished base oils from a refinery
  - Synthetic- “man made” chemically reacting materials to make a product with planned and predictable properties
  - Semi-Synthetic- a combination of refined base oils and synthetic oils.

- The additives are the fighters.
  - In the heat of battle…they die or get used up.
  - Changing your oil brings in new troops
Additives - the fighters:

- Metallic detergents - keep pistons clean
- Ash less dispersants - suspend soot, other by-products
- Anti-wear / EP agents - provide wear protection
- Oxidation inhibitors - provide longer service life
- Rust & corrosion inhibitors - protect parts from contaminant attack
- Anti-foam agents - minimize foam generation
- Viscosity index improvers - allows for multigrade oils
- Pour point depressants - lets oil flow at low temperatures
Engine Oils

Cummins Inc. has established a number of Cummins Engineering Standards (CES) which describe the performance levels of engine oils that must be used in various engines. In addition, Cummins Inc. works through the Engine Manufacturers Association (EMA) and with the many technical and marketing organizations responsible for lubricant quality around the world, to develop industry specifications that meet Cummins Inc. requirements. Table 1 lists the Cummins Engineering Standards and those North American and international performance classifications which most closely satisfy them.

Table 1: Cummins Engineering Standards (CES) for Lubricants:

<table>
<thead>
<tr>
<th>CES</th>
<th>Application</th>
<th>North American Classification</th>
<th>International Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>20081</td>
<td>Heavy Duty and MidRange Engines with Exhaust Aftertreatment and 15 ppm Sulfur Diesel Fuel</td>
<td>API-4 CJ-4</td>
<td></td>
</tr>
<tr>
<td>20078</td>
<td>Heavy Duty and MidRange Engines with EGR</td>
<td>API-1 CH-4</td>
<td></td>
</tr>
<tr>
<td>20077</td>
<td>Premium Oil for Heavy Duty and High Horsepower Engines outside North America without EGR</td>
<td>See note 6</td>
<td>See note 7</td>
</tr>
<tr>
<td>20076</td>
<td>Premium Oil for Heavy Duty and High Horsepower Engines without EGR in North America</td>
<td>See note 6</td>
<td></td>
</tr>
<tr>
<td>20075</td>
<td>Minimum quality oil for MidRange engines without EGR in applications outside North America</td>
<td>API-1 CF-4/SG</td>
<td>ACEA® E-27 E-2, JAMA® 8, DH-1</td>
</tr>
<tr>
<td>20072</td>
<td>Standard oil for engines without EGR in all parts of the world</td>
<td>API-1 CH-4</td>
<td>Global DHD-1® ACEA® E-5</td>
</tr>
<tr>
<td>20071</td>
<td>Standard oil for engines without EGR in all parts of the world</td>
<td>API-1 CH-4, API® CH-4/SJ</td>
<td>Global DHD-1®</td>
</tr>
<tr>
<td></td>
<td>Categories not recommended® Do NOT Use</td>
<td>API-1 CA CB CC CD CE CG-4</td>
<td>ACEA® E-1</td>
</tr>
</tbody>
</table>

The values listed in the table below are guidelines only. The absolute value of these numbers will vary with the situation.

| CES 20078 and CES 20081 Oil Compatibility with 500 PPM and 15 PPM Sulfur Fuel |
|-------------------------------|-------------------------------|-------------------------------|
| Fuel Type                     | Oil Type                      |
| 350 to 500 PPM Sulfur Fuel   | CES 20078 (CI-4)             | CES 20081 (CJ-4)             |
| 15 PPM Sulfur Fuel           | Yes                           | No or reduced oil drain internal |
|                               | Yes                           | Yes                           |
Engine Oils

- Use a good name brand multi-grade oil … consult Owner’s Manual for specifications
- Synthetic oils are OK to use provided they meet the performance & chemical requirements.
- Consult Owner’s Manual for specific oil and filter change intervals.
- Synthetic oils cannot be used to extend oil change interval.
CES 20081 Oils

Advanced lubricant protection for diesel engines

Engine Oil

Valvoline's Premium Blue Engine Oil is endorsed by Cummins Engine Company and has been tested extensively by Cummins in stationary and on-road EGR engines, including those equipped with DPFs. It is approved against the CES 20081 specification. It will also be approved against Mack EO-O Premium Plus 2007, Volvo VDS-4, and DDC Power Guard 93K218 specifications. It exceeds the lubrication requirements for Caterpillar, Detroit Diesel, Navistar, other heavy duty diesel engines, including engine performance requirements of Caterpillar ECF-3 and the Global DHD-1 Specification. The product meets API CJ-4, API CI-4 Plus, API CH-4, CG-4, CF-4, CF / SM, the performance requirements of ACEA E3-96, E5-02, E7-04 and the engine requirements of DB 228.3, MTU Type 2/Type 1, DDC 2000/4000 Series Type2/Type 1, MAN 3275, MAN 271. It provides excellent performance in “mixed fleet” gasoline engines, pickup and delivery, city fleet, long haul over-the-road, and off-highway applications.
Improvement in Overhead Wear

- Typical Data By Oil Category

M11 High Soot Test at CTC

CG-4 (1994)
CH-4 (1998)
CES 20076 (1999)
*CI-4* (2002)

Relative Valve Train Wear

Soot (%)
The Battles in your engine....

- 85% of a diesel engine’s wear occurs at start-up
- Retarded timing increases soot generation. Soot is abrasive, can plug filters, passages. You need dispersancy.
- New oil must last longer, less top-off, extended drains.
- Engines show greater sensitivity to piston deposits. Ring zone is closer to top of piston. Higher heat. Loss of oil control and emissions may occur. Piston crown land carbon a major factor. Ash levels of oil may contribute.
- HUEI injection systems and higher temps, need foam control.
- Higher rings expose oil to higher temps, greater heat and oxidation control.
Battles, cont’d:

- Stay in grade shear stability of multigrade oils is needed.
- Use of lighter metals in engines may result in new corrosion concerns.
- Low sulfur diesel fuel, lubricity of fuel system by fuel
- Handle more soot, more retarded timing
- Greater piston deposit control
- Reduced ring / liner valve train wear
- Better control of oil consumption
- Extended service intervals
- Impact of EGR and emission catalysts
Lubricant Handling & Storage

**Bulk Storage Tanks:**

- Keep tanks in a containment area properly labeled on multiple sides
- Maintain bottom water draw-offs every 6 months
- Remove rain water accumulation off tank farm floor on a regular interval
- Label all hoses, reels, lines for proper ID
- Check top hatches closed to rain
Oil Sampling

Great Sampling Techniques

– If you aren’t pulling samples correctly… ..why bother pulling them at all

– Why Sample Oil?
  • Check for abnormal wear metals, contaminants, excessive fuel, antifreeze, etc…
  • Single Point (Analysis) vs Trend
  • Trend is better!
Oil Sampling

- **Take time to do it right**
  - **PROCEDURE FOR STREAM SAMPLE:**
  - Samples should be pulled from components of equipment that is at operating temperature
  - Sample should be pulled at “mid-stream”
  - Sample bottle, cap, and rags or towels should be clean
  - Sample bottle label should be filled out **completely** right after sample is taken. Do not pull another sample before filling out last sample bottle label, actual hours on oil
  - Make sure cap is on tight, hours on unit
  - Use all appropriate packaging to repack and send immediately, not as a group.
Oil Sampling
Does & Doesn’t

- May spot impending failures
- Does not measure piston deposits
- Cannot determine proper drain interval
- Does not determine if additives are used up
COOLANT FUNCTION

- Absorb Unwanted Engine Heat
- Radiate Heat Away
- Component Protection
- Antifreeze/Antiboil Protection
Heavy Duty
Fully Formulated Coolant

Quality Water
Anti-Freeze
Diesel Coolant Additive

Should meet CES 14603
Engine Coolant

- Use a 50/50 mix of water and low silicate antifreeze … ethylene glycol or propylene glycol are acceptable
- Supplemental coolant additives are required for all Cummins engines except the ISB
- Follow maintenance requirements listed in the Owner’s Manual.
- Extended life coolants are acceptable … Follow the proper recipe
Use a Fully-Formulated Engine Coolant

**FINAL CHARGE® Global Extended Life Coolant/Antifreeze** is the heavy-duty cooling system solution that can extend service intervals and reduce service and maintenance costs. Use our navigational toolbar to find your way around or look through the two useful links below.

**FINAL CHARGE 50/50 Pre-Diluted Global Extended Life Coolant** is recommended for use in the cooling systems of all types of heavy-duty diesel, gasoline and natural gas engines.

**Meets these specifications:**
- Cat EC-1
- Cummins 14603
- Detroit Diesel
- MTU 5048
- Behr Radiator
- ASTM D-3306
- ASTM D-4340
- ASTM D-5345

**Meets performance requirements:**
- John Deere H24A1, H24C1
- Mack Tuck SB232-014
- Navistar B1
- Mercedes DBL 7700
- ASTM D-6210
- SAE J1941
- SAE J1034
- TMC RP 329
ES COMPLEAT™ EG ANTIFREEZE COOLANTS are considered Lifetime Coolants, meet or exceed the performance requirements of the following specifications, and meet the low silicate limits of GM6038M antifreeze formulation requirements:

TMC RP 338 Extended Life  
TMC RP 329  
ASTM D-6210  
ASTM D-4985  
ASTM D-3306  
CID-A-A-52624  
GM 1899  

**Cummins CES 14603**

Cummins SB 3666132  
Caterpillar  
Detroit Diesel 7SE298  
John Deere 8650-5  
Thermo-King  
Case New Holland  

Navistar  
Freightliner 48-22880  
Volvo  
PACCAR  
Mack 014G817004  
EMD M.I. 1748E  
Waukesha 4-1974D
Antifreeze Levels
(Real World)

Percentage of 873 samples returned from the field
Coolant Additive Levels
(Real World)

Percentage of 873 samples returned from the field

- Under-concentrated: 50.1%
- Recommended Range: 24.4%
- Over-concentrated: 25.5%
PROBLEMS

Deposits & Scaling

Cavitation Corrosion

Water Pump Leakage

Silicate Gelation
Contaminated Coolant

- Deposits Foul Heat Transfer Surfaces
- Rusty Scale
- Oily Residue
SCA Over Concentration
Plugged Passages Restrict Flow
## WATER QUALITY

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PROBLEM CAUSES</th>
<th>LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium Magnesium (hardness)</td>
<td>Deposits on liners, heads &amp; coolers</td>
<td>170 ppm</td>
</tr>
<tr>
<td>Chlorides (such as sea salt, sodium chloride)</td>
<td>General Corrosion</td>
<td>40 ppm</td>
</tr>
<tr>
<td>Sulfates</td>
<td>General Corrosion</td>
<td>100 ppm</td>
</tr>
</tbody>
</table>

### Engine Manufacturers limits on make-up water

- Calcium Magnesium (hardness): Deposits on liners, heads & coolers, limit 170 ppm
- Chlorides (such as sea salt, sodium chloride): General Corrosion, limit 40 ppm
- Sulfates: General Corrosion, limit 100 ppm
LINER PITTING or cavitation erosion caused by imploding vapor bubbles will erode through the liner wall.

Shock wave impact measured at 15 to 20,000 PSI
Nitrite & Molybdate form a hard oxide film that protects the liner from cavitation corrosion.
WP Seal leakage from Hard Water Scale Formation and / or High Dissolve Solids Content
DCA4 Service Requirements

**Above 3.0 Units**

Do not replace DCA4 filter or add DCA4 liquid until concentration drops below 3.0 units per gallon. Test every subsequent oil drain interval.

**1.2 to 3.0 Units**

Continue to replace service coolant filter or add liquid SCA service dose at each oil drain interval.

**Below 1.2 Units**

Replace the service filter and add 1 pint of DCA4 per 4 gallons of system capacity.
Check Coolant Concentration and Additive Level

Fleetguard® Field Maintenance Tools for Engine Coolants
The easy and effective way to obtain valuable coolant maintenance information in the field in a matter of minutes!

Coolant Test Strips
3-Way™ SCA and Freeze Point Test Strips

Measuring the Freeze Point and Chemical protection in your engine's cooling system is essential for protection against liner pitting, corrosion and coolant dilution. Fleetguard's state-of-the-art 3-Way Heavy Duty Coolant Test Strips provide a simple and effective means of checking the coolant system. It is easy to use the 3-Way DIP and READ test strips. Simply take a sample of the coolant and dip the 3-Way Test Strip. Within 45-75 seconds, read the Freeze Point and Molybdate/Nitrite levels to obtain SCA units. Record the readings and continue coolant maintenance practices according to OEM recommendations. One strip does it all! NO fuss, NO coolant dilution, NO chemical mixing. The 3-Way Test Strips are available in bottles of 50 (CC2602); Packs of 4 (CC2602A); Single packs (CC2602B); and metric versions (CC2602M and CC2602AM).
Check Coolant Quality

QUIK-CHEK™ Coolant Quality Test Strips

With proper maintenance, Fleetguard ES Compleat™ coolant can last for the major overhaul life of the engine. However, when poor quality make-up water is added to the system or when minimum coolant maintenance is not observed, pH levels can rise or fall to dangerous levels and contaminants (Sulfate and Chloride) can rise to unacceptable levels. When this occurs, coolants must be drained and replaced immediately. To help customers determine the quality of their coolants, Fleetguard has developed revolutionary QUIK-CHEK™ Coolant Quality Test Strips. In a matter of minutes the pH, Sulfate and Chloride levels in a coolant can be determined. If results fall within acceptable limits, the coolant can be used until the next service interval with confidence. The QUIK-CHEK™ Coolant Quality Test Strips are available in boxes of 100 foil sealed test strips (CC2607B) or boxes of 25 foil sealed test strips (CC2607C).
Standard Service vs Extended Service Coolant

From Cummins Service Bulletin 3666132

Standard Service Interval Coolant versus Extended Service Interval Coolant

Both types of coolant follow the same general test schedule:

- Test at least twice a year for additive and glycol levels
- Test coolant at 240,000 km [150,000 mi], 4000 hours, or once per year, whichever occurs first, to determine if the coolant must be replaced.

The advantage to using an extended service interval coolant is that typically the coolant only needs additive replenishment and filter change once per year, compared to the standard service interval where the additive and filter is replenished at each oil change interval.

Section 2 of this bulletin details the standard service interval and Section 3 details the extended service interval.

Additional Information

If you have any questions about information in this bulletin or would like more information, please contact 1-800-DIESELS.
Can I mix coolant brands?

Compatibility of Fleetguard Coolants and SCAs with Competitor Products

This bulletin is in response to customer inquiries about mixing various Fleetguard Coolants and SCAs with competitors' products.
Can I mix coolant brands?

Fleetguard OAT coolant, ES Optimax™, derives its protection properties by the use of proprietary organic acids plus nitrite and molybdate. It has been designed to be fully compatible with coolants formulated with 2-ethyl hexanoic acid.

Testing and field experience with customers has shown that both DCA2-type, DCA4-type, and OAT chemistries have never had any negative chemical reactions nor failed to protect system components when used in accordance with manufacturer’s instructions.

While others may make marketing claims about contamination by addition of coolants not of their own manufacture or brand name, there is in fact no technical merit in saying that the coolants cannot be mixed.

ES Compleat™, ES Optimax™, Fleetcool™ EX, Fleetcool™ Recycled, DCA2 and DCA4 are coolants and supplemental coolant additives that are known to us to be compatible with the following (but not all inclusive) list of coolant products:

INTAKE AIR SYSTEM

- Air Cleaner Housing
- Air Filter
- Hoses
- Clamps
- Charge Air Cooler
FILTER MINDER

- Typically signals at 25 in. of water restriction
- Can be a source of dirt into the intake
CHANGING AN AIR FILTER

- Inspect housing for cracks or looseness
- Vacuum dust out of housing before inserting new filter
- Check hoses for holes
Damage to Turbo from Dirt or Other Objects
CHARGE AIR COOLER (CAC)
Sources of Low Power

- Too Little Charge Air Temperature drop
  - Undersized
  - External plugging
- Cracks
- Plugging
  - External
  - Internal
EXHAUST SYSTEM

- Exhaust Manifold
- Turbocharger
- Oil Lines
- Exhaust Pipes
- Heat Shielding
- Source of Low Power
  - Leaks
  - Restriction
TURBOCHARGER

- Rotates over 100,000 rpm
- Cooled by engine oil
- Turbo Maintenance
  - No Oil leaks
  - No exhaust leaks
  - No suction side leaks
  - No Hot shutdowns
  - No Fast Starts
A Micron is the unit of measure used to determine the size of particles in a fluid which are filtered out by the filter.

- 1 micron = .000001 of a meter or .000039 of an inch
- 2 micron = Bacteria
- 8 micron = Red Blood Cells
- 10 micron = Cummins FS1000 Fuel Filter
- 25 micron = .001 of an inch = White Blood Cells (FS1212)
- Filters efficiency = How often a particle size can be removed
  - Absolute = 98.6%
- Filter Capacity
HOW BIG IS A MICRON?

HUMAN HAIR
2,000 TIMES SIZE
.0035 INCH
.0889 mm

.0001 INCH
.0254

.000039 INCH
.001 mm
Fuel Filter Maintenance

Mechanical B 5.9 and C 8.3
Fuel Filter Maintenance

CAUTION

Mechanical overtightening can distort the threads as well as damage the filter element seal or filter canister.

Do not fill the fuel filter with fuel before installation; instead, prime the fuel system using the fuel lift pump.

Be sure the center seal ring is installed onto the filter spud.

Install the filter as specified by the filter manufacturer.

Connect the water-in-fuel sensor and the fuel heater, if equipped.
Fuel Filter Maintenance

Primary Filter
Pre-Fill

Secondary Filter
Do Not Pre-fill
Fuel Filter Maintenance

ISM Engines
Bio-diesel

Performance and Durability Results

Cummins test data on the operating effects of biodiesel fuels indicates that typically smoke, power, and fuel economy are all reduced. However, as there are no firm industry standards on the content and properties for biofuels, consistency and predictability of biodiesel operation is not well documented.

Biodiesel provides approximately 5-7% less energy per gallon of fuel when compared to distillate fuels. To avoid engine problems when the engine is converted back to 100% distillate diesel fuel, do not change the engine rating to compensate for the power loss when operated with biodiesel fuels.

Elastomer compatibility with biodiesel is still being monitored. The condition of seals, hoses, gaskets, and wire coatings should be monitored regularly.

Cummins certifies its engines using the prescribed EPA and European Certification Fuels. Cummins does not certify engines on any other fuel. It is the user's responsibility to use the correct fuel as recommended by the manufacturer and allowed by EPA or other local regulatory agencies. In the United States, the EPA allows use of only registered fuels for on-highway applications. The EPA has additional alternative fuel information at: http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm

Given the current industry understanding of biofuels and blending with quality diesel fuel, it would be expected that blending up to a 5% volume concentration should not cause serious problems. For customers intent on blending biofuels above a 5% volume concentration, the following concerns represent what is currently known in the industry. Concentrations beyond 5% by volume could have an adverse effect on the engine's performance and the fuel system integrity/durability. The effects are more serious with increasing concentration levels.

Areas of concern when operating with biodiesel fuels include low temperature operability (fuel gelation, filter plugging), heat content (poor fuel economy), and storage and thermal stability (filter plugging, injector deposits). The oil change interval can be affected by the use of biodiesel fuels and some applications may require shortening intervals to half of the diesel equivalent. Lube oil dilution in applications with significant part load operation will fall under this guideline.
Requirements for Using Biodiesel Fuel in Cummins Engines

- Biodiesel fuel can be blended with an acceptable diesel fuel up to 5 percent volume-concentration (B5) for all Cummins engines.
- Biodiesel fuel can be blended with an acceptable diesel fuel up to a 20 percent volume concentration (B20) for the following Cummins engines....
B20 Approved Engines

- ISB CM850, ISB CM2150*, ISBe Euro 3, QSB4.5 Tier 3, and QSB6.7 Tier 3.
- ISC/ISL CM850, ISC/ISL CM2150*, ISCe/ISLe Euro 3, and QSC/QSL Tier 3.
  *For ISB CM2150 and ISC/ISL CM2150 products, Cummins requires fuel dilution monitoring. See below for details.

- ISM CM870 and CM570, ISM CM875, ISM CM876, QSM11 Tier 3, QSM11 Marine, and QSM11 G-Drive.
- ISX CM870, ISX CM871, QSX15 Tier 3, and QSX15 G-Drive.
Oil Sampling

- Fuel dilution of lubricating oil has been observed with the operation of biodiesel under certain operating conditions. Fuel dilution monitoring can be accomplished by performing oil sampling.
- Fuel levels in lubricating oil **must not** exceed 5%. Additional information on oil contamination and oil sampling can be found in Cummins Engine Oil Recommendations, Bulletin 3810340.
- For ISB CM2150 and ISC/ISL CM2150 products, end users are **required** to use oil sampling during the first 6 months of operation with biodiesel to monitor engine oil condition and fuel dilution of lubricating oil in order to determine if the oil change interval needs to be modified.
Fuel Water Separation

- Biodiesel has a natural affinity to water, and water accelerates microbial growth. Storage tanks **must** be equipped with a fuel water separator to make sure that water is stripped out before entering the vehicle tank.
- Make sure that the vehicle and storage tanks are kept full to reduce the potential for condensation accumulating in the fuel tank.
- Due to the solvent nature of biodiesel, and the potential for “cleaning” of the vehicle fuel tank and lines, new fuel filters **must** be installed when switching to biodiesel on used engines. Fuel filters will need to be replaced at half the standard interval for the next two fuel filter changes.
Low Temperature Performance

- Biodiesel fuel properties change at low ambient temperatures, which can pose problems for both storage and operation. Precautions can be necessary at low ambient temperatures, such as storing the fuel in a heated building or a heated storage tank, or using cold temperature additives.

- The fuel system can require heated fuel lines, filters, and tanks. Filters can plug and fuel in the tank can solidify at low ambient temperatures if precautions are not taken. A fuel heater is recommended for ambient temperatures below -5°C [23°F]. Consult your fuel and additive supplier for assistance in attaining proper cloud point fuel.
Microbial Growth

- Biodiesel fuel is an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of all commercially available conventional anti-microbial additives, when used in biodiesel, is not known. Consult your fuel and additive supplier for assistance.
Biodiesel Additives

- Cummins Inc. approves the use of Cummins Filtration Microbicide for use in biodiesel blends. Product details can be found in the “Additives” section of this Service Bulletin.
  1. Cummins Inc. approves the use of Cummins Filtration Asphaltene Conditioner Base for biodiesel blends. Product details can be found in the “Additives” section of this Service Bulletin.
  2. Cummins Filtration Biodiesel Winter Conditioner can be used to improve the pour point and cold filter plugging point of biodiesel blend, in addition to preventing ice formation in wet fuels during cold storage.
  3. Cummins Filtration Biodiesel Winter Conditioner is the only biodiesel fuel additive approved by Cummins Inc. for winter performance improvements. Contact your local Cummins Authorized Repair Location for product details.
Crankcase Ventilation

Cummins High-Efficiency Coalescing Filter

Oil Mist from Engine Crankcase

Filtered Oil Returned to Engine Crankcase
ISC/ISL 03
ISC/ISL 07
ISM 04 and ISM 07
ANY QUESTIONS