

Cummins

Maintenance and Operation Presentation



Cummins Inc.

- Sales of \$19.8 billion in 2020
- Over 1,300,000 engines built in 2020
- 58,000 global employees
- Headquarters – Columbus, Indiana

CMI
LISTED
NYSE



Summary of Cummins benefits

- **Premium driving experience with less fatigue**
 - Much lower noise levels, less downshifting in rolling terrain
 - 50% more torque...where you drive (highest torque wherever you cruise)
 - Supplemental engine braking for downhill grades
 - Air suspension and air brakes for better ride and handling
- **Cost of ownership**
 - Up to 50% better fuel economy for lower operational cost
 - Longer warranty period
 - Better fuel economy than gasoline
- **Convenience and Support**
 - Longer range for fuel stops
 - Less maintenance visits – annual (or 18 months) vs. semi-annual
 - 3500 service locations – engine and generator with 60 RV focused coach care locations
 - 800-CUMMINS, Shows/Rallies, PowerClub

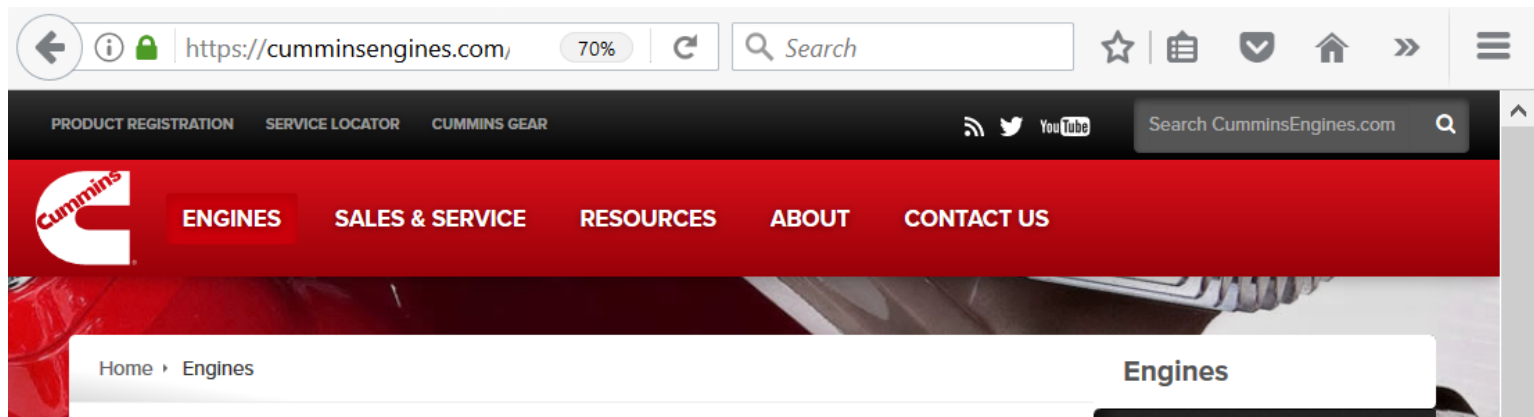
Agenda

- Product Information
 - Emissions history and technology
- Operation
 - Pre-Trip, Dash Lamps, Fuel Economy
- Maintenance
 - Fluids – Fuel, Coolant, Oil, DEF
 - Maintenance intervals
- Support
 - Cummins Care, Coach Care



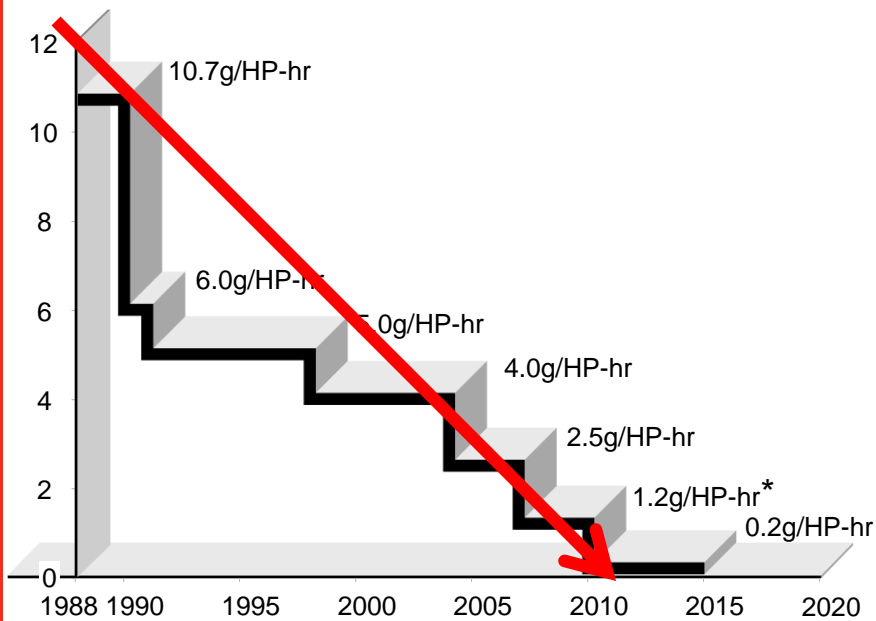
Handouts

- Presentation is available online
- www.cummins.com
 - Search for FMCA

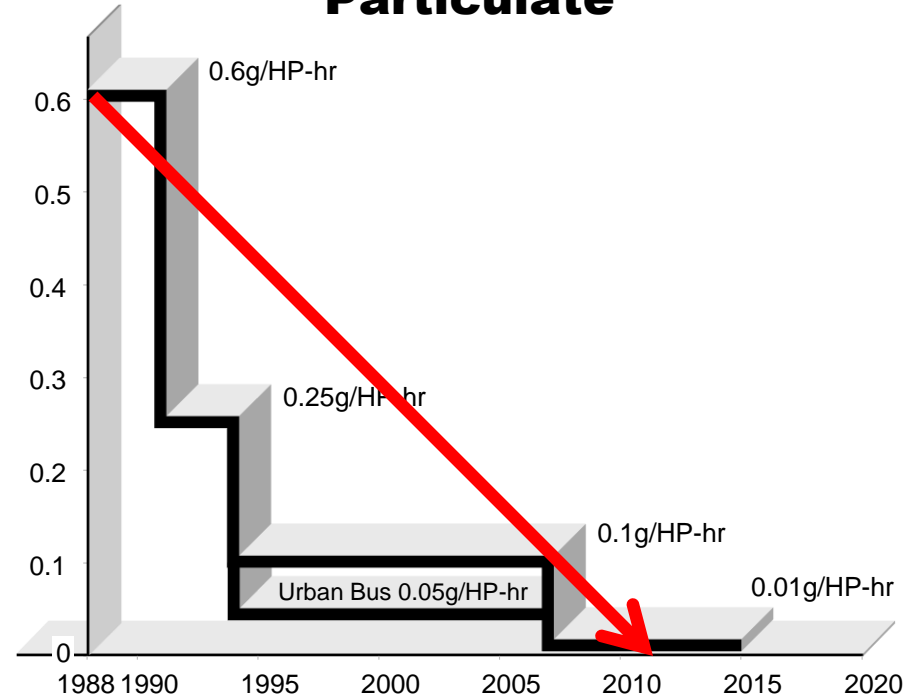


EPA Emissions – Clean Diesel

NOx / NOx+HC



Particulate

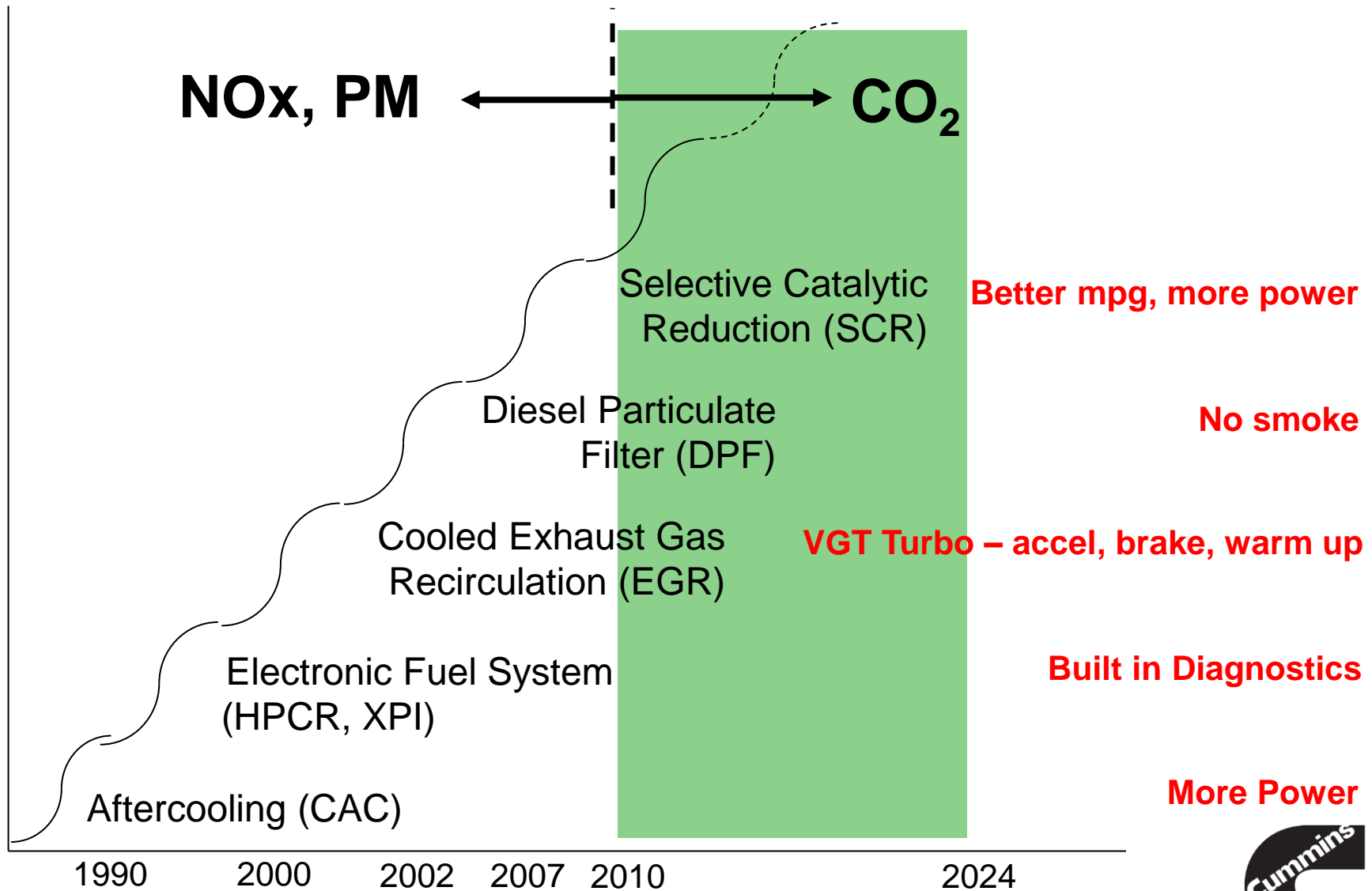


* Phase-In Average

Near Zero
Emissions



Technology for Emissions Helps Customers



Cummins Owns its Own Technology



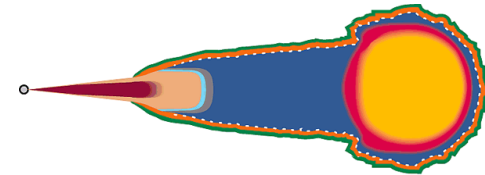
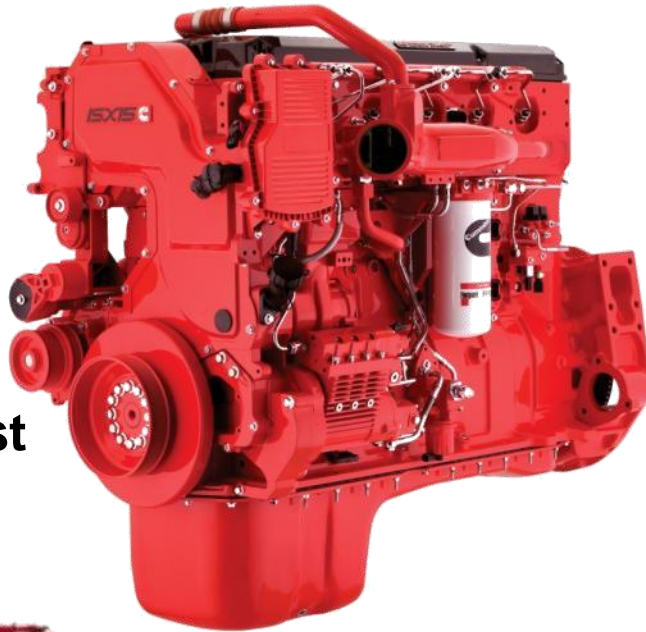
Filters and fluids



Electronic Controls



SCR catalyst and DPF



Combustion Technology

Variable Geometry Turbo (VGT)



Fuel Systems (XPI, HPCR)



Operation



Pre Trip Inspection

Before Starting

- **Check fluid levels – Oil, Coolant**
 - Level surface, wait 15 minutes for oil to drain to pan
 - Never remove radiator cap if coolant is hot (>120 degrees)
- **Air Intake**
 - Check Restriction indicator



After Starting – walk around coach

- **Check gage levels (DEF, fuel, air pressure)**
- **Water in Fuel lamp?**
- **Look for leaks, smoke**
 - Should be no smoke from exhaust on 2007 and newer
- **Listen for air leaks or other unusual noises**

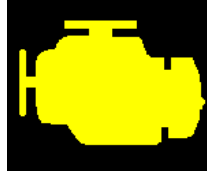
Operation – Dash Lamps



HEST (High Exhaust System Temperature) lamp
Elevated exhaust temperature. **Don't drive over leaf pile.**



DPF (Diesel Particulate Filter) lamp – soot is present in exhaust filter. **Increase system temperature by doing a highway drive for 30-40 minutes.**



Check Engine Lamp – check fluid levels, gages, sounds, and smells – **make a plan to get service.** Can be coupled with De-Rate



Stop Engine Lamp – **pull over as soon as it is safely possible.** This will require a visit to a Cummins service center.



Diesel Exhaust Fluid (DEF) lamp – indicates when DEF level in tank is low. **Correct with refilling DEF tank.**



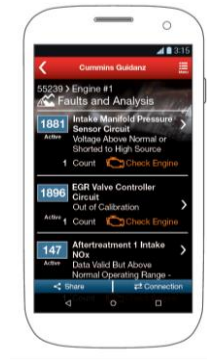
Malfunction Indicator Lamp (MIL) – OBD and emissions control system related – **make a plan to get service.**

Two lamps on dash? make a plan to get service



Do you speak engine?

- Cummins Guidanz – 2007 and newer
 - Read your check engine light from your smart phone
 - App is free



- Inline Mini adapter (part number 5299909)
 - Bluetooth datalink adapter
 - Plugs under dash near steering wheel
 - Can move from vehicle to vehicle



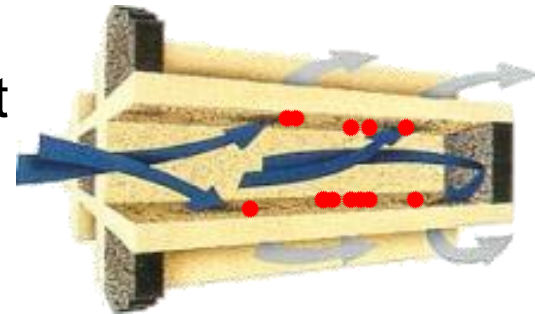
- Process
 - If CEL comes on, plug in and read code
 - Call local Cummins service location
 - Click “share” to open email to send your ECM data

Operation: What is Regeneration?

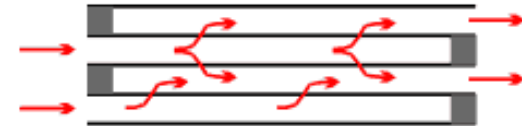
- Soot accumulates in the DPF
- Without regeneration, DPF can plug
- We oxidize the soot by regeneration
 - Passive – any time exhaust system is hot
 - Active – extra fuel creates extra heat
- All that is left is ash (minerals)



**Similar to how your
self cleaning oven works**



Wall-flow



Fuel Economy



- What consumes horsepower?
 - **Aerodynamics (>50 mph)**
 - Air drag is a function of speed (10 mph = 1 mpg)
 - Customer control – **slow down**
 - **Rolling Resistance (<50 mph)**
 - Function of weight, road surface, tires, tire pressure
 - Customer control – **proper inflation and tire selection**
 - **Accessories**
 - cooling fan/alternator/freon compressor (40-60 hp)
 - Customer control – **clean radiator and keep dash a/c system charged**
 - **Changes in Speed**
 - Customer control – **use cruise control**



Engine braking

- Two types of auxiliary braking
 - **VGT Exhaust brake** – restricts exhaust
 - Switch ON/OFF on dash (B6.7/L9)
 - **Compression brake** – releases compression
 - Switch ON/OFF and Switch HI/LOW or HI/MED/LOW (L9/X12/X15)
- Benefits
 - Better vehicle control
 - Eliminates brake fade downhill
 - Service brake life – but not a factor in motorhomes



Compression brake usage

- Maximum braking at higher engines speeds – this is why the transmission downshifts
- Allison will not force a downshift that will overspeed
- Do not use during icy or slick road conditions
- Okay to leave switch in on position
- Won't engage unless accelerator pedal is at 0%
- Works in cruise control but hysteresis 7-10 mph over set speed



■ Low vs. High

- Typically use low for supplemental around town driving
- Downhill with 3 stage brake
 - Start on high – if you slow too much, simply switch to medium
 - If medium slows you too much, switch to low
 - If low isn't enough for you to hold speed, switch back up to medium



Other operating tips

- **Warm-up** – operate with light throttle until coolant temperature reaches 150 degrees
- **Cooldown** – light load – idle for 3-5 minutes
- **Monthly engine exercise**
 - You are exercising the generator monthly, why not the engine?
 - Good – run engine at high idle (use the cruise set switch) until reaching operating temperature
 - Better – run engine at high idle and move coach forward and back
 - Best – go for a 20-30 minute drive at highway speed
- **Idle Speed** - Engine may automatically increase speed to warm up or reduce soot in DPF



Maintenance



Motorhome Maintenance Intervals

	B6.7 (200-360hp)	C8.3/L9 (330-450hp)	ISX12 (500hp)	ISX15/X15 (550-605hp)
Coolant testing	6 months	6 months	6 months	6 months
Oil and oil filter*	12-18 months 15,000 miles	12-18 months 20,000 miles	6 months 25,000 miles	12 months 30,000 miles
Fuel filter*	12-18 months 15,000 miles	12-18 months 20,000 miles	6 months 30,000 miles	12 months 30,000 miles
Coolant Filter*	n/a	n/a (optional)	n/a	12 months 50,000 miles
Overhead* Adjustment	150,000 miles	150,000 miles	24 months 250,000 miles	500,000 miles
Crankcase Breather Element+	Every 3rd or 4th oil change	Every 3rd or 4th oil change	150,000 miles	125,000 miles
DEF filter	200,000 miles	300,000 miles	300,000 miles	300,000 miles
DPF cleaning	200,000 miles	200,000 miles	200,000 miles	200,000 miles

*Whichever occurs first ‘

+2021 engines do NOT have a crankcase breather element

**Chassis Builder – Coolant, Air Filter, Air Dryer Cartridge, Radiator
Belts – 5 year inspection**



Air System

- **The most expensive mistake you can make**
 - Only takes a teaspoon of dust to create major damage
 - Dirt can damage turbo, cylinder head, power cylinders
- Maintenance
 - Follow chassis manufacturer recommendation (12-24 mos)
 - Check restriction indicator when fueling
 - Pay attention when installing the filter
 - Check for loose or broken clamps



Fluids – Fuel



- Buy from high volume location (truck stop)
- Cummins does NOT require fuel additives
 - Two special cases where fuel additives can be useful:
 - Black “slime” in fuel filter
 - Biocide and fuel filters
 - Cold weather operation
 - Fuel can gel at temperatures below 15 degrees
 - PowerService Diesel Fuel Supplement +Cetane Boost (white bottle)
- Biodiesel
 - Suggest not storing long term with Biodiesel
 - EPA2002 and later – OK to B20; All OK up to B5



Fluids – Oil



- Use a name brand oil
- API Classification
 - Preferred: **CK-4** (don't use FA-4)
 - **Pre2021 – 15w40**
 - **2021 and later – 10w30; 15w40 acceptable**
- Synthetic Oils
 - More expensive than mineral based oils
 - Do NOT extend oil drain intervals
 - Main benefit – very low temperatures (-13 deg F) or very high temps
- Oil analysis
 - Can be useful to detect contaminants
 - Should NOT be used to extend drain intervals



Fluids – Coolant

- Coolant has many jobs
 - Protect against corrosion and liner pitting
 - Cool engine and transmission, lubricate seals
- Know what coolant you have
 - Top off only with the same brand
 - Tell your service provider what coolant you want
- Test
 - 2x per year for freeze point (CC2806)
 - Annually for proper chemistry (CC8997 – OAT)
 - If coolant fails – drain, flush, refill
 - Especially Freightliner chassis prior to 2017!
- Drain and refill after 5 years



Fluids - DEF

- Freezes at 11°F (does not degrade)
- ISO spec 22241-1 – 32% Urea, 68% deionized water
- Shelf life 1 – 2 years depending on temperature
 - Avoid direct sunlight and temperature above 78°F
- Non-toxic, non-polluting, non-flammable
- 2-6 gallons DEF for 100 gallons of diesel
 - Most motorhome DEF tanks are 10-15 gallons
 - Sized for about 2-3 complete fuel tank fill ups



DEF Lamp Sequence

or

- Just like your car
 - There is a DEF level gage on dash, a gage on tank, and warning lamps
 - Lamp comes on if you don't pay attention to gage

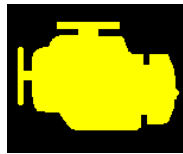
- Lamp sequence



1. Solid



2. DEF Solid
CEL Solid



3. DEF Blinking
CEL Solid



4. DEF Blinking, CEL Solid
and Stop Engine

- If you ignore the lamps, there are consequences
 - Torque derate (Step 2 – 25% derate, Step 3 – 45% derate)
 - Step 4 – limited to 5 mph – “inducement”
 - If Step 4 - don't idle >1 hour, don't fill fuel without DEF, don't key off

Long term storage (6 months) suggestions

- Better to change oil/filters before storage than after
- Fill fuel tank (prevent condensation)
- Don't store with Biodiesel or use the exercise program
- A monthly exercise program is good
 - Operating temperature, lubricate parts, charge batteries
- Tighten DEF cap – prevent the “brick”
- Check coolant freeze protection (northern states)



RV Maintenance and Operation ISL Electronic Diesel



Quick Reference Guide

Cooling

Routine Maintenance Recommendations

The ISL was designed to utilize supplemental coolant. The ISL (COOL) oil has a coolant reservoir. Check COOL level every 1000 miles or 1000 hours, whichever comes first.

Coolant level should be checked routinely. A good practice is to be observant of liquids that may have leaked on the ground while the motorhome is stopped.

Check coolant concentration annually. However, if the coolant is a mixture of ethylene glycol and propylene glycol, it is not necessary to check the concentration versus a floating ball device due to accuracy.

Definition of Heavy-Duty Coolant

A combination of 50/50 water and low silicate antifreeze (ethylene glycol or propylene glycol and stable) protects to -34°F. Freeze protection decreases to -60°F with 60% antifreeze. In addition to freeze protection, antifreeze is essential for overheat and corrosion protection.

Antifreeze must meet ASTM D4985 (GM9038M) specs.

Water Quality Requirements

Calcium/Magnesium Max: 170 ppm as CaCO₃
Chloride Max: 40 ppm as Cl⁻
Sulfur Max: 100 ppm as SO₄

A conservative approach to cooling system maintenance would include an analysis of your water supply. Your Cummins distributor can provide the test kits as well as sample bottles and other testing devices. Consider using pre-formulated antifreeze when on the road or when water quality is unknown. The use of distilled water is also acceptable.

Fully Formulated Coolant

Fully formulated coolant, such as Coolant, is recommended by Cummins and offers a vehicle owner the convenience of a pre-mixed antifreeze solution containing high quality water and antifreeze.

Ether

Ether MUST NOT be used for ISL engines. The ISL comes equipped from the factory with an integrated gnd heater for cold starting.

Information

Cummins 1-800-DIESELS (1-800-343-7357)
Cummins Website everytime.cummins.com

Consult Owners Manual or a Cummins Distributor for additional details.

Lubricating Oil

Routine Maintenance Recommendations

A good general practice is to check oil level as part of the daily pre-trip procedure.

Check oil level with the engine at normal operating temperature. Pressurized oil level indicator system is used on the ISL. Check oil level every 1000 miles or 1000 hours, whichever comes first.

CAP Fuel System: 18,000 mile or 1 year, whichever comes first.

Lube Oil Specifications

The primary Cummins recommendation is to use SAE 15W-40 oil for normal operation at ambient temperatures above 5 °F (-15 °C). Consult the Owners Manual or a Cummins Distributor for recommendations concerning colder operating temperatures.

ISL CM2150 Use high quality SAE 15W-40 heavy duty oil which meets or exceeds CES 20081 (API CJ-4/SL). Note an oil may meet API CJ-4/SL and Cummins Engineering Standard (CES) 20081. CES 20081 represents a low ash oil that will maximize the efficiency of the Cummins Particulate Filter (CPF) and extend the CPF service interval. A non-low ash oil meeting CES 20078 (CI-4/SK) can be used with no change to the oil change interval, but will reduce the service interval of the CPF.

High-Pressure Common Rail Fuel System (Pre ISL CM2150) Use high quality SAE 15W-40 heavy duty oil which meets or exceeds CES 20078 (API CI-4/SK).

CAP Fuel System Use high quality SAE 15W-40 heavy duty oil which meets or exceeds CH-4/CI-4 oil.

Synthetic Oils

Use of synthetic engine oil made with API group 3 or 4 base stocks is permitted subject to the same performance and viscosity limitations of petroleum (mineral) based engine oils. The same oil change intervals as petroleum based engine oil must be applied.

Supplemental Oil Additives

Cummins does not recommend the use of aftermarket oil additives. Current high quality engine oils are very sophisticated, with precise amounts of additives blended into the lubricating oil to meet stringent requirements. Aftermarket oil additives are not necessary to enhance engine oil performance and in some cases can reduce the engine oil's capability to protect the engine.

Oil Analysis

Oil analysis, as a method to extend drain intervals, is NOT recommended. Different methods of measuring soot, lack of correlation among testing labs, and differing driving patterns and idle time are the basis of right recommendation.

RV Maintenance and Operation Quick Reference Guides

B6.7

all years

bulletin 4971286

L9

all years

bulletin 4971288

ISX12

all years

bulletin 4971384

X15

all years

bulletin 5410810



Customer Support



Types of Cummins service locations

- Cummins Coach Care locations (60+)
 - RV friendly repair locations
 - Meet certain criteria (tools, facilities, amenities)
 - **Top of the line locations**
- Cummins Distributor locations (200)
 - Names start with Cummins (e.g. Cummins Sales & Service, etc)
 - Parts and service for both engines and generators
 - **Specialists**
- Cummins Dealer locations (3500)
 - Have a Cummins sign
 - Typically dealers of a truck OEM (Navistar, Freightliner, etc)
 - Parts and service for chassis and engine
 - **General Practitioners**



Cummins Care



- 1-800-CUMMINS™
 - Engines, generators, parts, service information – “One Cummins”
 - 24/7/365

- Cummins Care representative
 - Will ask for information (Engine s/n and location)
 - Can help locate closest authorized repair location
 - Can assist you with scheduling the unit into the repair location
 - Can answer questions you might have



Service Information

- Cummins QuickServe Online
 - Quickserve.cummins.com
 - Free for up to 5 ESNs (limited owners plan)

The screenshot displays the Cummins QuickServe Online interface. The top navigation bar includes 'Parts', 'Service', 'Warranty', 'My Profile', 'Products', 'Promotions', and 'News'. The main content area is titled 'Service Information (ISX15 CM2350 X101)'. A yellow banner at the top of the content area reads: 'Free - Cummins Guidanz™ (Formerly Known As CSS) Live Training For North American Dealers. Participate and have a chance to win a FREE INLINE™ mini! No purchase necessary. Void where prohibited. [Click here](#) for drawing rules and more information.' Below this, there are tabs for 'Manuals', 'Campaigns', 'TRPs', 'ATCs', 'Service Bulletins', 'TSBs', 'What's New', and 'Service Tools'. Underneath, there are tabs for 'Fault Code Search', 'Symptom Search', and 'Related Information'. The 'Engine Fault Code Analyzer' section is active, showing a table with columns 'FAULT CODE' and 'DESCRIPTION'. The table contains five rows, each with a 'Remove' link and a number (1-5). Below the table are buttons for 'Add More Fault Codes' and 'Analyze'.

- QuickServe Mobile – for your handheld device

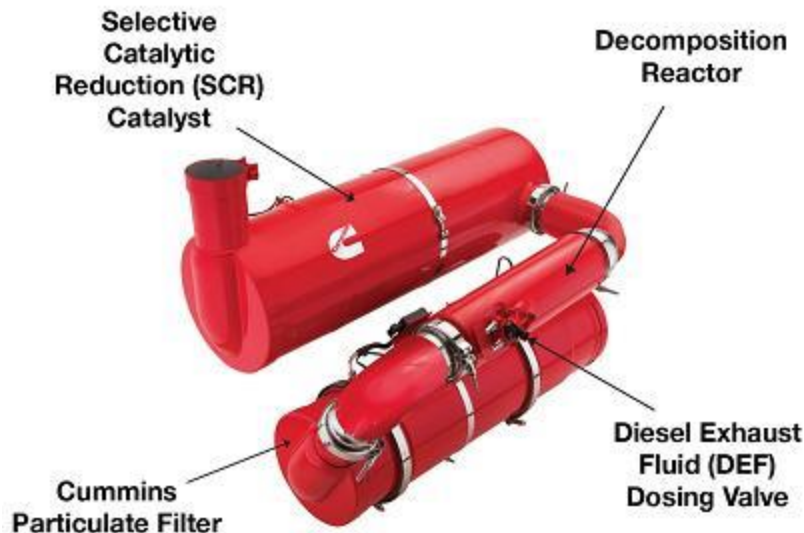


Appendix



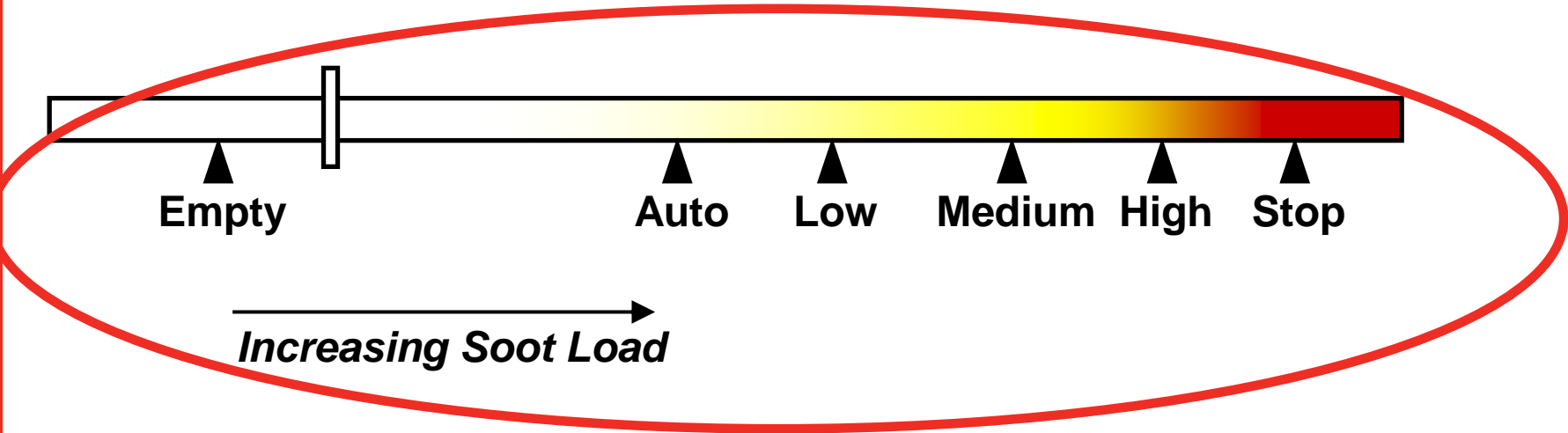
2010 - SCR

- **SCR** – Selective Catalytic Reduction
- DEF (urea) is injected to make ammonia
- Ammonia + NO_x react to form nitrogen and water
- Allows better engine tuning – mpg, power, maintenance



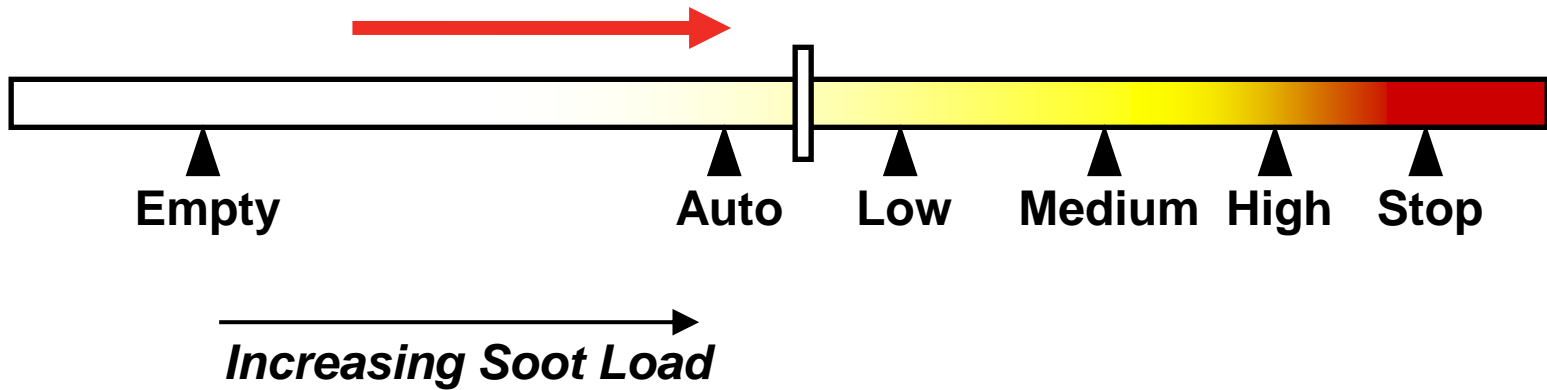
Regeneration Lamp Sequence





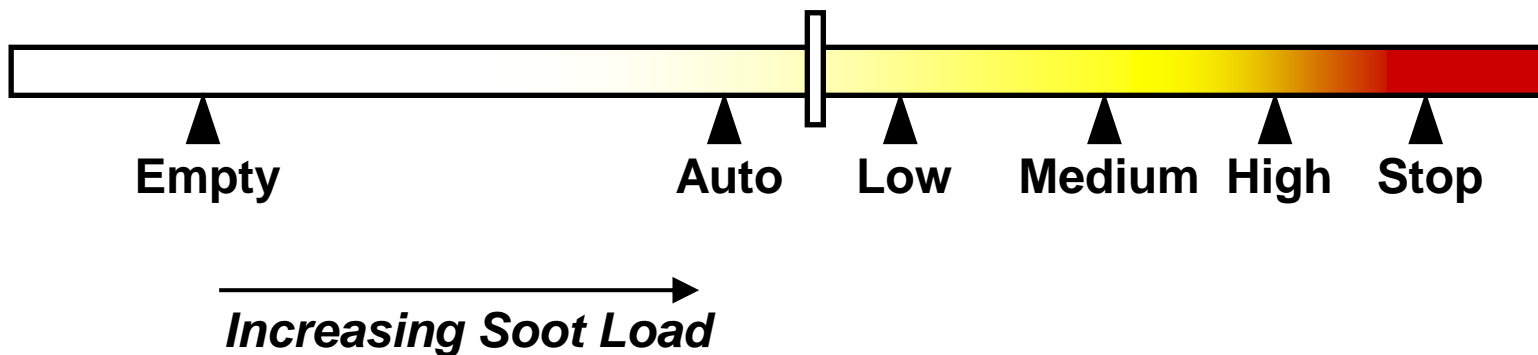
No lamps on
System is filtering exhaust
Soot is collecting in the DPF
Enjoy the ride



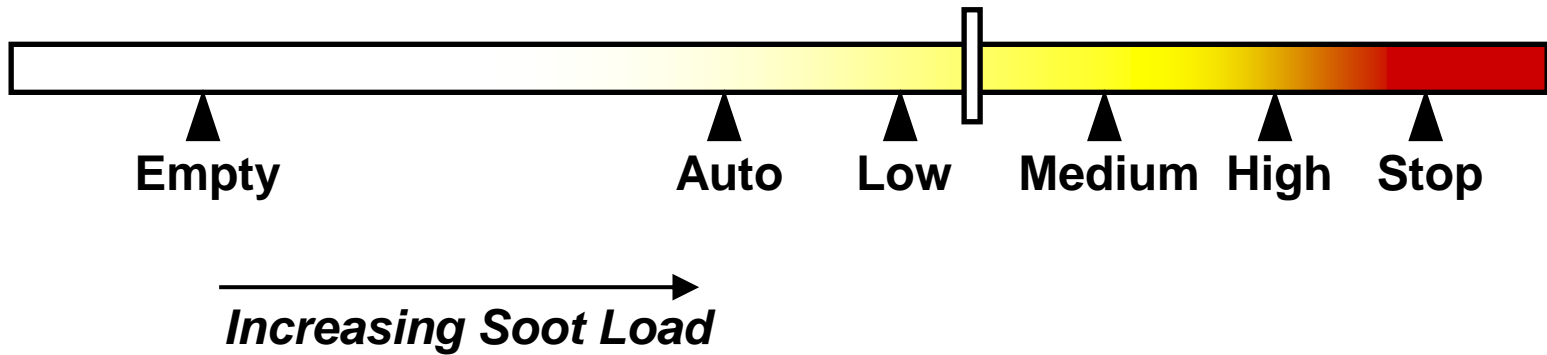


No lamps on
Passive regen is occurring
System may actively regenerate
Might hear different noise from turbo
Enjoy the ride



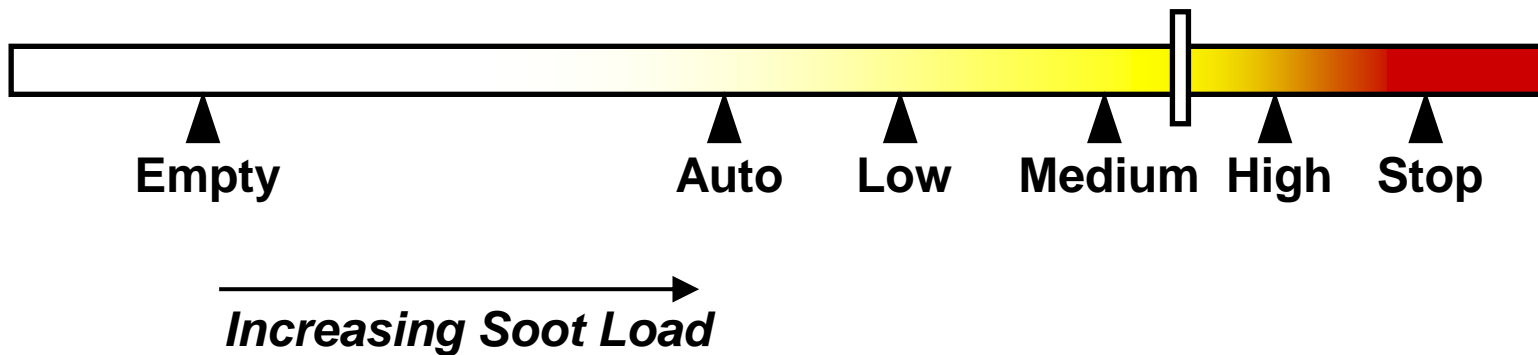


Exhaust temperatures are high
Don't drive over a dry leaf pile

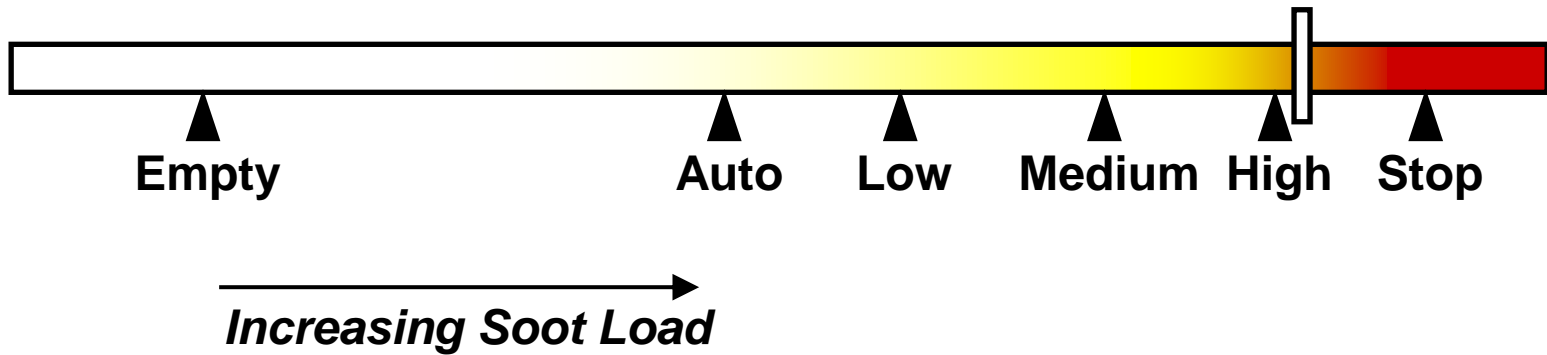


DPF lamp on solid
Low level of soot in DPF
Go for a highway speed drive





DPF lamp flashing
Medium level of soot in DPF
Go for a highway speed drive

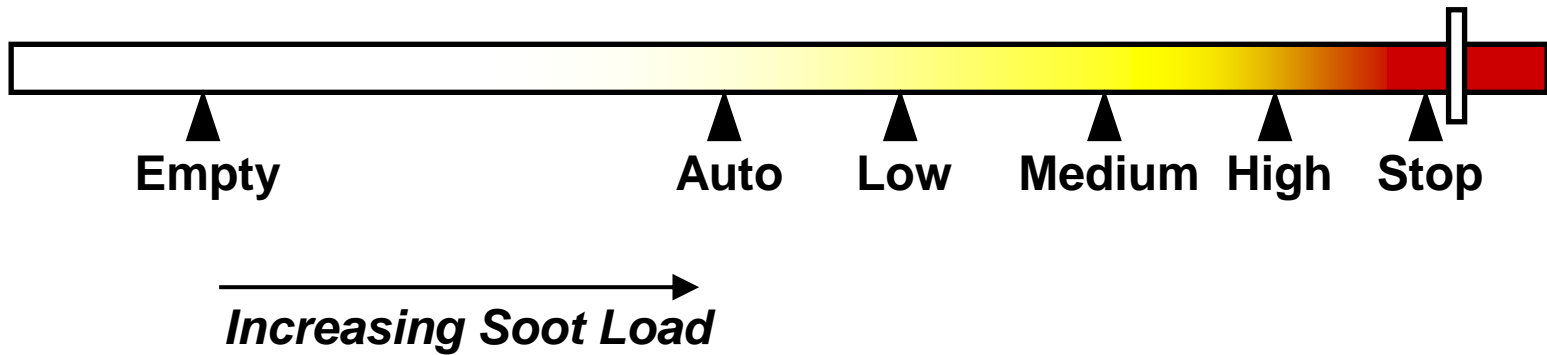


DPF lamp flashing – Check Engine Light on High level of soot in DPF

Go for a highway speed drive

Or make plans to visit Cummins shop





DPF lamp flashing – STOP Engine Light on
Stop operation as soon as it is safely possible
Will require a visit to Cummins shop

