



Visit www.mcicoach.com for
MCI products at unbeatable prices!



MOTOR COACH
INDUSTRIES

Welcome to the MCI LEARN Series

Your Webinar Will Begin Shortly

Today's Topic:

Regeneration 2010 Engine Technology for 2011 and Beyond:
A technology that assists emission control

If you do not have an audio connection, dial 877-739-5904 and enter the Audio PIN number given to you on your screen



MOTOR COACH
INDUSTRIES

Learning Objectives

- Know important facts about Exhaust Emissions and how they are controlled with After Treatment System (ATS)
- Be able to identify components of the different ATS
- Understand the operation of each stage of the ATS
- How the driver interacts with the ATS
- Learn the maintenance requirements
- Driver Area changes for 2010 engines
- Learn the proper handling of Diesel Exhaust Fluid (DEF)



MOTOR COACH
INDUSTRIES

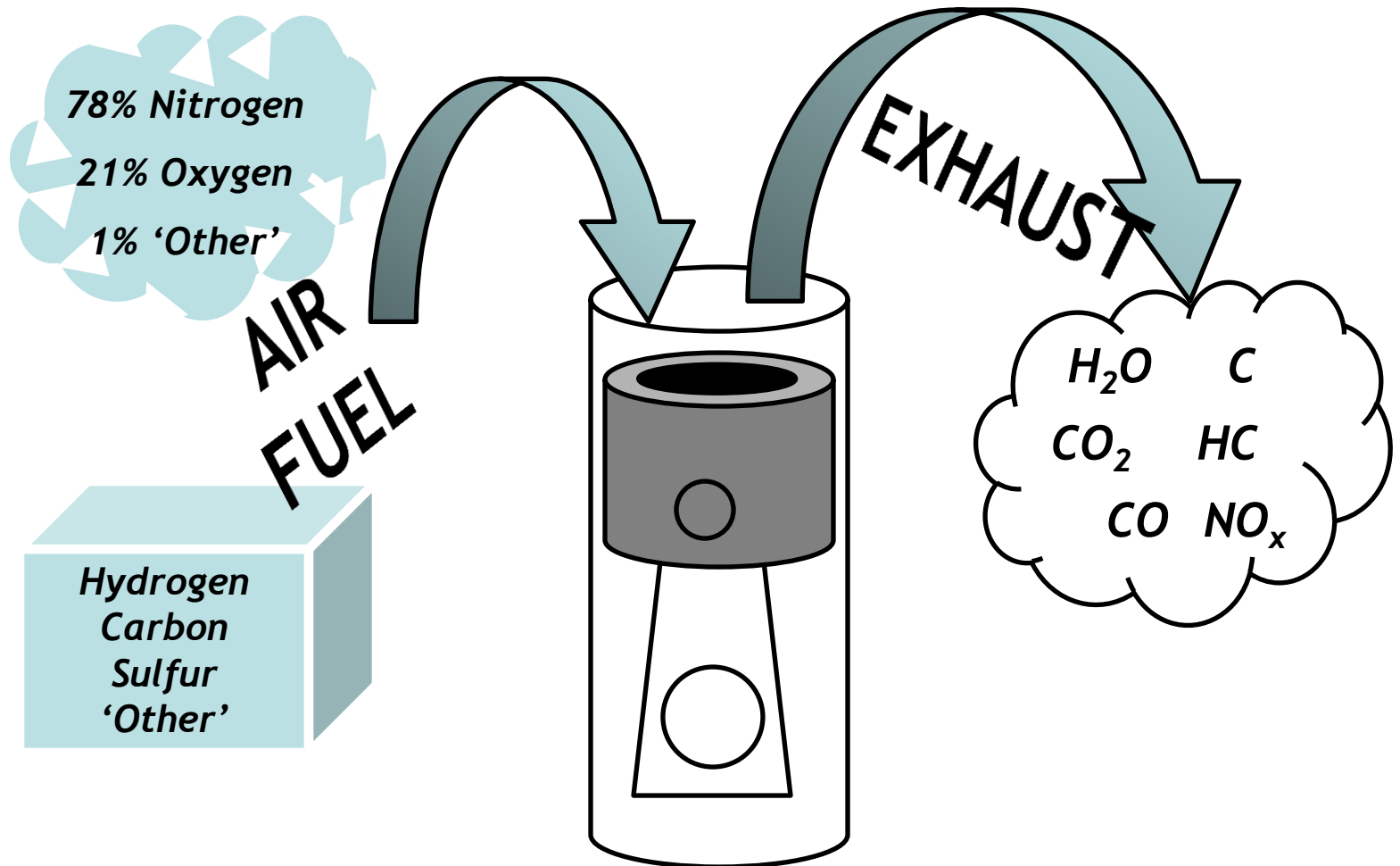
Exhaust Emissions and Controls: ATS Facts



Exhaust Emissions

Created during INCOMPLETE Combustion

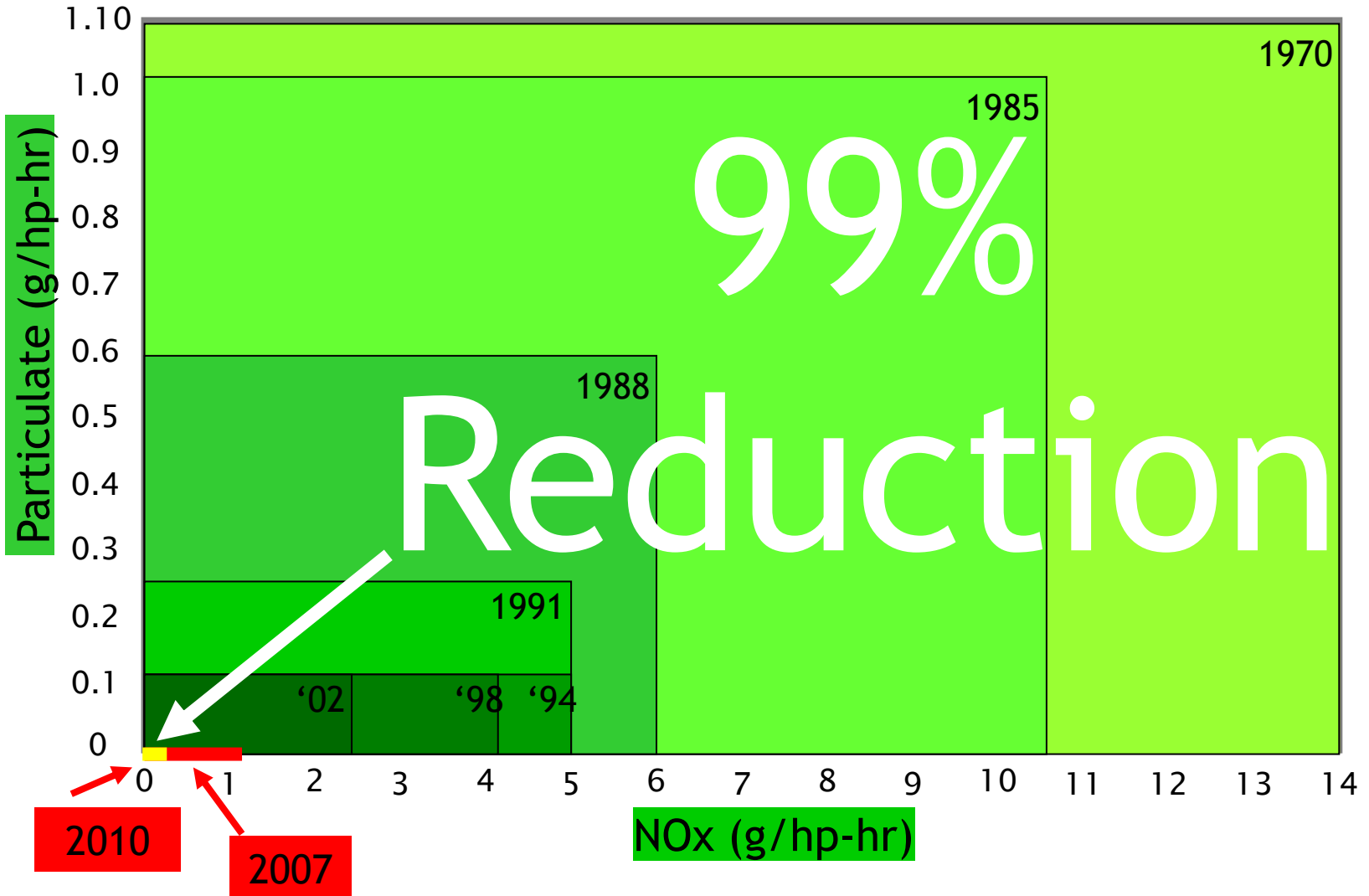
- Controlled by Prevention and Treatment





How Did We Get Here?

E.P.A. mandates for Exhaust Emissions





Emissions Facts Thru the Years

- E.P.A. Mandated reductions of Diesel Exhaust Emissions for NOx and Particulate Matter (soot)
- After Treatment Systems (ATS) devices prevent and reduce exhaust emissions up to 99% (*since 1970 levels*) and soot almost entirely
 - **Electronic Engine Controls** reduced emissions (HC, CO, Soot) with more precise fuel control
 - **Exhaust Gas Recirculation (EGR)** reduced NOx emissions by cooling the combustion temperature
 - **The Diesel Particulate Filter (DPF)** unit captures remaining soot and ash found in the exhaust
 - **Selected Catalytic Reduction (SCR)** and UREA (DEF) reduce remaining NOx to 2010 levels
 - More to come ...



MOTOR COACH
INDUSTRIES

Prevention and Treatment: After Treatment System Components



2003: E.G.R.

- Nitrogen (N_2) normally INERT gas
 - Will not combust / combine w/ Oxygen: O_2
- Temperature above @2500 F allows 'N' to combine in many different levels -

Oxides of Nitrogen

NO - NO_2 - NO_3 - NO_4

Assigned the variable 'x'

Commonly referred to as 'knocks'

- Exhaust Gas in A/F reduces Combustion Temp
- Reduces formation of NO_x
- Still a LOT of NO_x formed (*2010 mandates*)



MOTOR COACH
INDUSTRIES

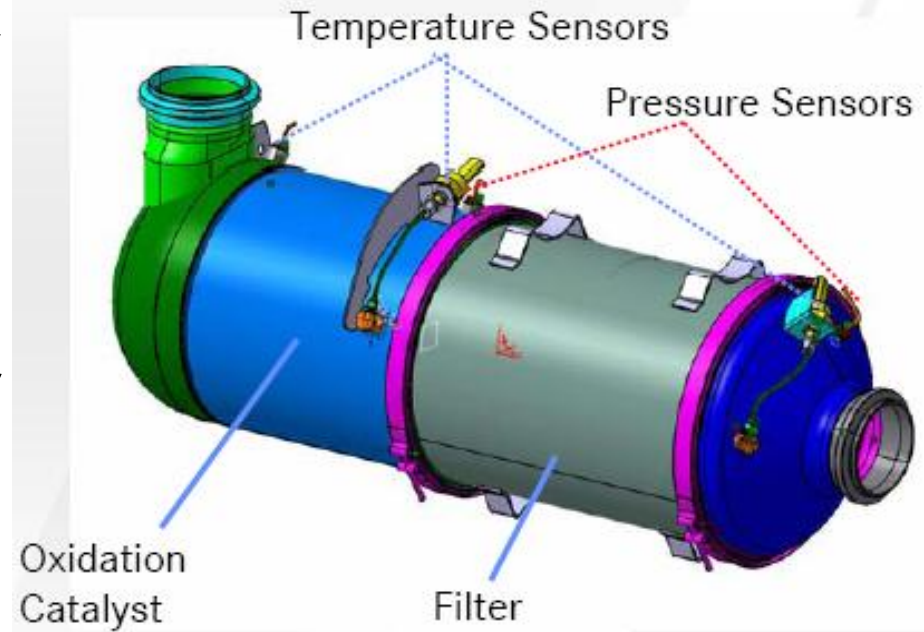
2007: D.O.C. and D.P.F.

- D.O.C. - Diesel Oxidizing Catalyst
 - Catalyst supports a chemical reaction
 - Chemical reactions help break down HC and CO into H₂O and CO₂
 - Generates great amounts of heat
- D.P.F.- Diesel Particulate Filter
 - Traps SOOT (black smoke / carbon) from combustion
 - Burns into vapor and ash
 - Vapor can pass thru filter structure
 - Ash collects
 - Requires periodic 'Regeneration' by the operator



Operation

- Diesel Oxidation Catalyst (DOC)
 - Raises temperature of exhaust
 - Reduces HC and CO
 - Reduces soot and ash to vapor
- Diesel Particulate Filter
 - Captures remaining soot and ash
- Temperature and pressure sensors notify the engine computer when regeneration is needed





2010: D.E.F. and S.C.R.

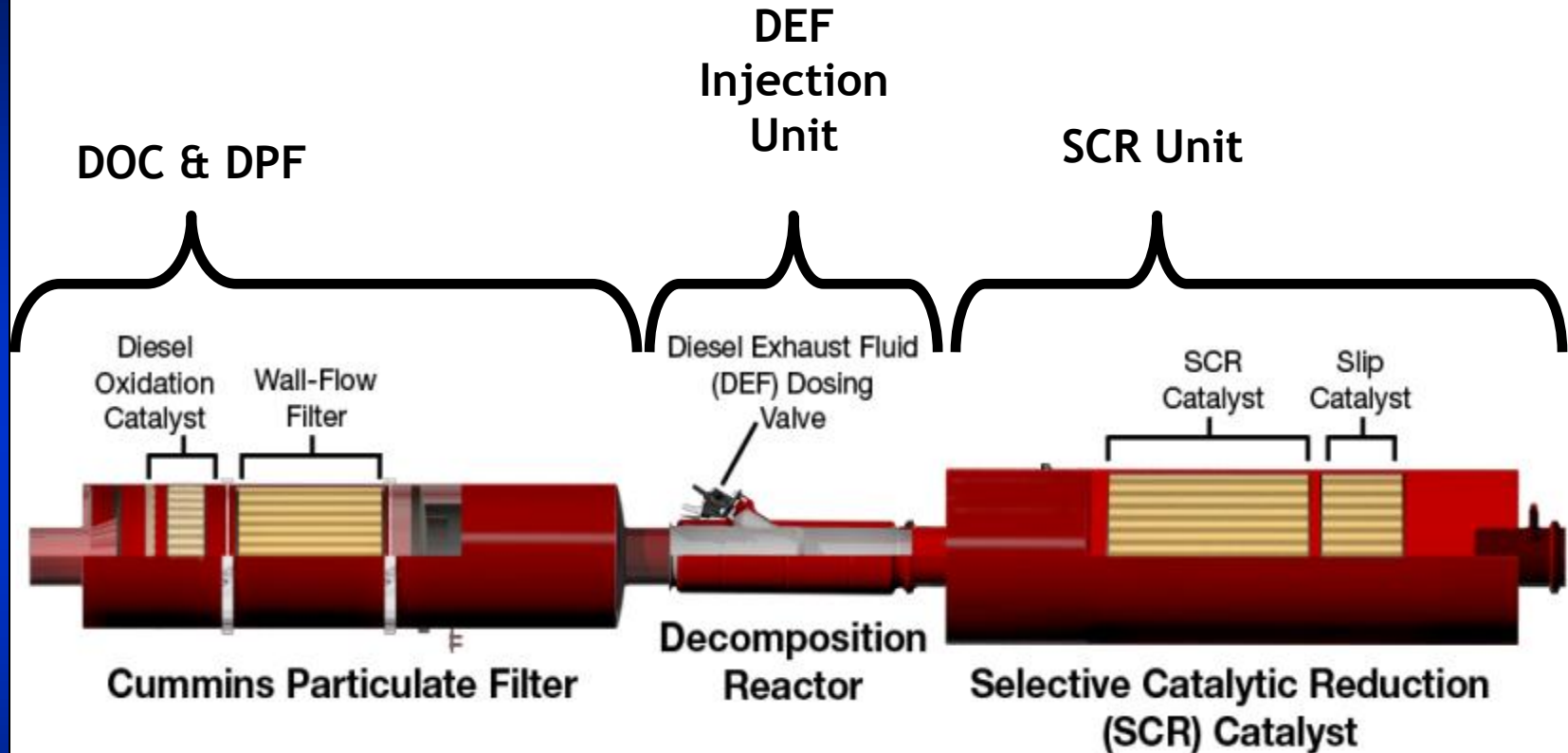
- D.E.F. - Diesel Exhaust Fluid (Urea)
 - Synthetic High Nitrogen Content Fluid
 - Mixed into Exhaust stream
 - Chemical Reaction to break down NOx

- S.C.R. - Selective Catalyst Reduction
 - Additional Catalytic Converter Chamber
 - Uses Urea to break NOx into stable N₂
 - Remaining Hydro-Carbons and 'O' convert to H₂O and CO₂



Components of the Typical ATS (2010)

D.O.C., D.E.F., and S.C.R.



In-Depth Operation Will Be Discussed Later in this Presentation



MOTOR COACH
INDUSTRIES

After Treatment System Operation

2010 Engines DEF and SCR Operation



MOTOR COACH
INDUSTRIES

Best Practices Guide for DEF (Urea) Handling

- What is Urea?
 - Urea is a compound of nitrogen that turns to ammonia when heated. It can be produced synthetically and is used in a variety of industries to make plastics, fertilizer, adhesives, etc.
- What is DEF?
 - Diesel Exhaust Fluid is a solution 32.5 % synthetically pure urea and 67.5% de-ionized water with high purity requirements.
- Properties
 - Non-toxic
 - Poses no serious risk to humans if properly handled
 - Non flammable
 - Safe to handle and store
 - Colorless
 - Storage temperature - 11F to 90 F
 - Freezing of DEF begins at about 11 F
 - Once DEF has melted, it can be used without problem





Best Practices Guide for DEF (Urea) Handling Cont'd

DEF Usage with MCI Coaches

- DEF consumption is expected to be approximately 2.5% of fuel consumption, depending on vehicle operation, duty cycle, geography, load ratings, driving habits, etc.
- See below chart showing DEF average consumption per MCI model.
- Estimated information based on theoretical calculations

MODEL	FUEL TANK CAPACITY (GALLONS)	DEF TANK CAPACITY (GALLONS)	FUEL ECONOMY ESTIMATED MPG	DEF CONSUMPTION ESTIMATED %	ESTIMATED MILES PER FUEL TANK	ESTIMATED MILES PER DEF TANK	DEF CONSUMPTION PER FUEL TANK (GALLONS)
J4500	183	15	7	2.5	1281	4205	4.57
D4500	164	15	6.7	2.5	1099	4020	4.1



MOTOR COACH
INDUSTRIES

Best Practices Guide for DEF (Urea) Handling Cont'd

DEF Availability and Accessibility

A coalition of industries including truck manufacturers, engine manufacturers, fuel distributors, and DEF providers is developing a network. Depending on manufacturer, you could find 330 gallon plastic totes, 275 gallon disposable totes, 55 gallon plastic drums, 5 gallon, 2.5 gallon, and 1 gallon containers.

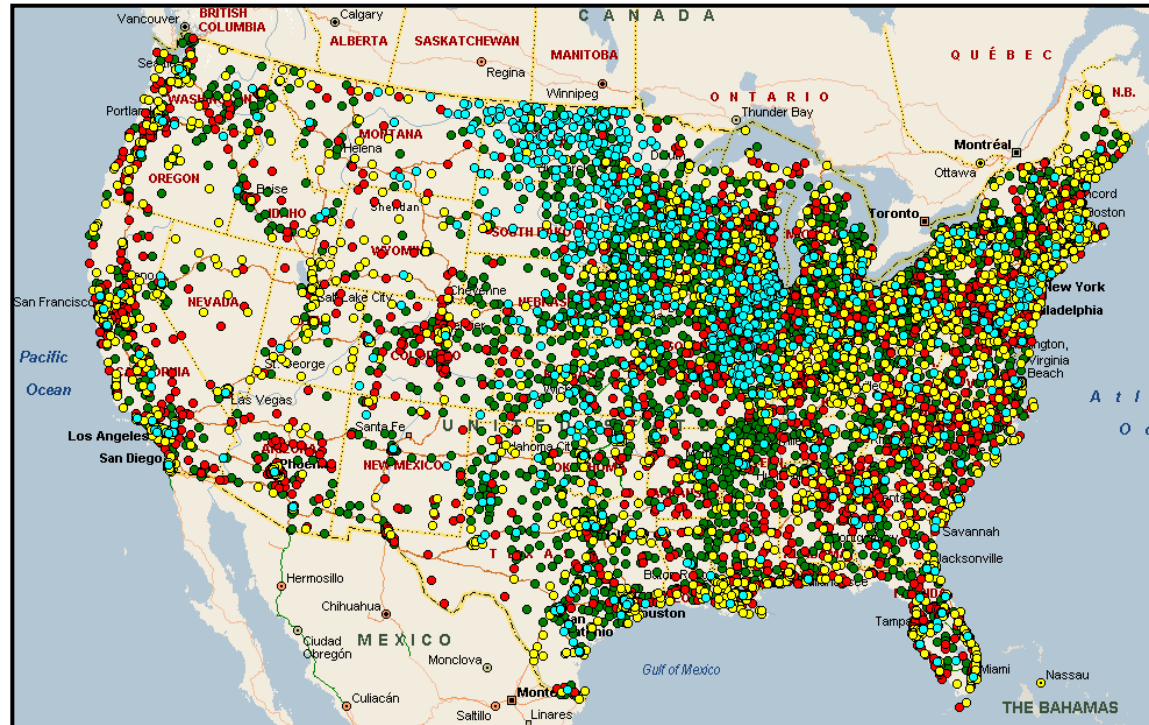




MOTOR COACH
INDUSTRIES

DEF Availability

DEF is sold at over 2500 locations across USA and Canada. These include: Cummins Distributors, Detroit Diesel - Freightliner Distributors, Pilot Travel Centers, Kenworth Distributors and Mack Distributors



US Department of Energy has a DEF locator on line:

<http://www.afdc.energy.gov/afdc/locator/def>

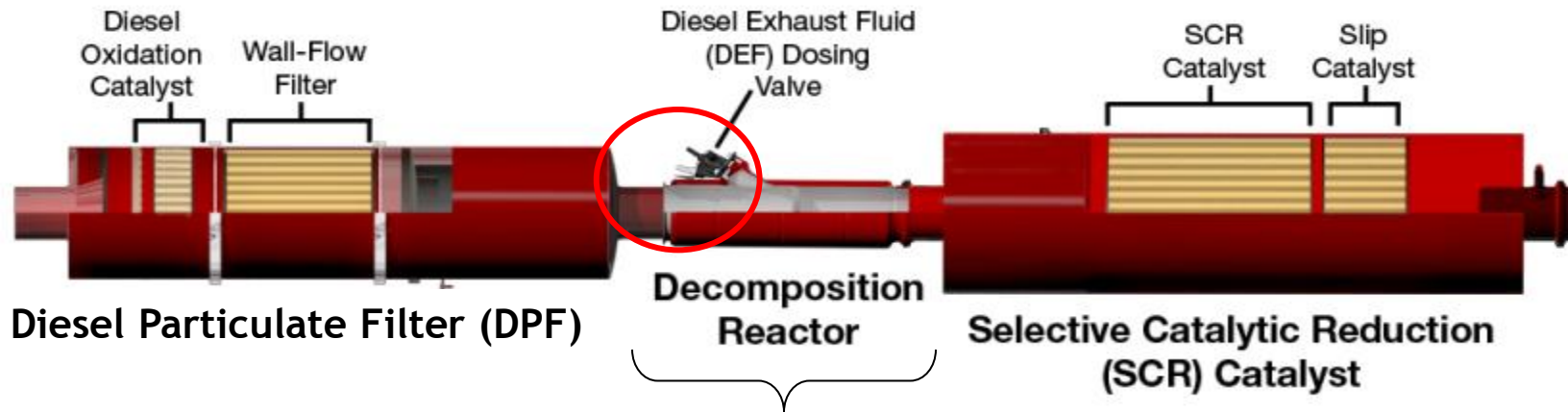


2010 Technology: How it Works

Emission System Components:

Particulate Filter / Decomposition Reactor / SCR Catalyst
Control Module / DEF Pump / DEF Valve / NOx sensor

DEF Dosing Valve sprays a fine mist of DEF into hot exhaust stream



Decomposition of D.E.F. occurs in 3 steps within the **Decomposition Reactor**

Step 1: Evaporation : Liquid DEF vaporizes into exhaust stream

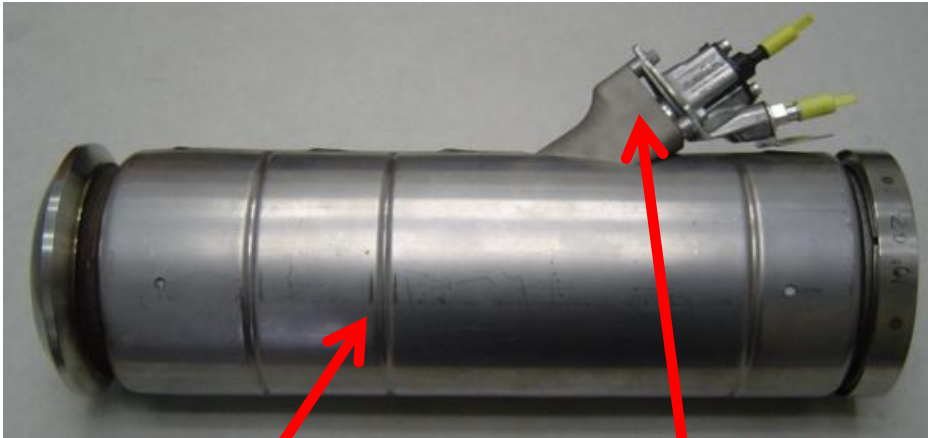
Step 2: Thermolysis : Thermal Breakdown of the NOx into simpler components

Step 3: Hydrolysis : Further molecular breakdown into water components



MOTOR COACH
INDUSTRIES

Decomposition Reaction Chamber



Stainless Steel
Insulated Shell



Dosing Nozzle Assembly





MOTOR COACH
INDUSTRIES

Additional Components

- NOx Sensors (2) relay NOx level information to the DEF ECU
- ECU processes information and determines amount of DEF to be Injected into exhaust stream
- Supply Module receives signals from ECU and performs injection

NOx Sensor Assembly





MOTOR COACH
INDUSTRIES

After Treatment System Operation

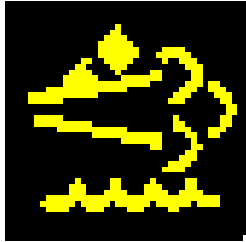
Driver Area Updates for 2010 Engines



MOTOR COACH
INDUSTRIES

Aftertreatment Dash Lamps

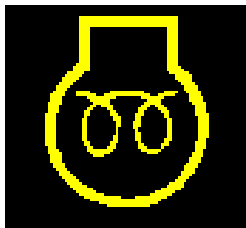
- **New !** DEF Lamp-Diesel Exhaust Fluid Low level warning
 - The DEF lamp alerts the vehicle operator that the reducing agent is low and must soon be replenished. The warning from the DEF lamp would escalate in intensity as the reducing agent level approaches empty and cannot be turned off without replenishment of the reducing agent



- **New !** WIF Lamp- Water In Fuel Indicator Lamp
 - The WIF sensor detects the presence of water in the fuel filter. When the conductivity probe indicates a change consistent with water the warning lamp flashes after the key switch is turned on



- **New !** WTS Lamp- Wait To Start (*DD and ISL Only*)
 - OBD regulations require circuit continuity detection of the Wait to Start Lamp.
 - An intake air heater, or grid heater, comes standard on DD Platform engines.





MOTOR COACH
INDUSTRIES

Aftertreatment Dash Lamps Cont'd

- **New !** MIL Lamp- Malfunction Indicator Lamp Emissions non-compliance indication. OBD (On-board Diagnostics) Requirement 2013 (DD-13 only)



- The Malfunction Indicator Lamp notifies the operator that an emission related system error has occurred which may result in an engine de-rate or engine protection shutdown.



- CEL Lamp- Check Engine Lamp (Updated Illustration)



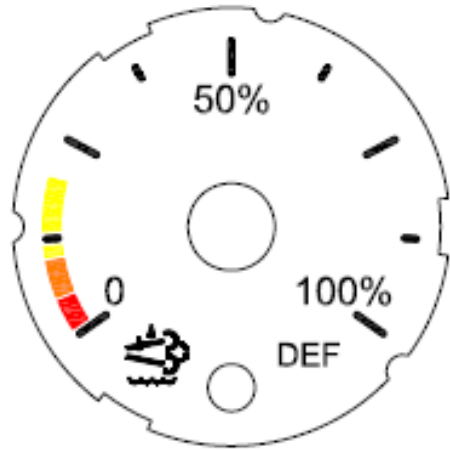
- SEL Lamp- Stop Engine Lamp (Updated Illustration)





MOTOR COACH
INDUSTRIES

DEF Gauge and Tank: E/J Coach



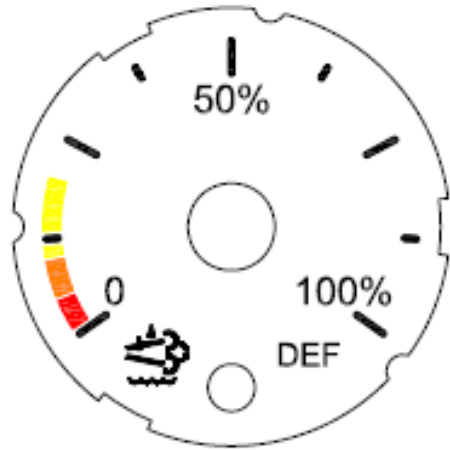
DEF Tank Filler
neck next to
Fuel Filler, Curb
Side Only





MOTOR COACH
INDUSTRIES

DEF Gauge and Tank: D Coach








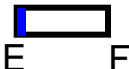


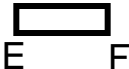


DEF Tank Filler
neck at #3
baggage Bay
Curb Side





MOTOR COACH
INDUSTRIES






Low DEF Warning & Inducement: Cummins

DEF (Urea) Tank Level		Notification*		Inducement
		Lamp	- or - Message	
>20% full		None	None	None
Stage 1 <20% full		DEF lamp solid 	Warning message	None
Stage 2 <10% full		DEF lamp flashing 	Increasing message duration and/or frequency	None
Stage 3 <5% full		DEF lamp flashing Amber warning lamp solid  	Inducement message	Maintenance derate (12 -17% torque derate)
Stage 4 Empty, after the engine has been shut down		DEF lamp flashing Red lamp solid  		Vehicle speed limited to 5 mph



MOTOR COACH
INDUSTRIES

Incorrect DEF/SCR Warning & Inducement

Incorrect DEF Warning & Inducement			
Condition	EMD+ Driver Indication Lamps	J1939 DM1 (SPN-FMI)	Inducement
Correct Reducing Agent	None	None	None
Initial Warning for Incorrect DEF @ detection	Amber Warning 	4094-31	None
Initial Inducement for Incorrect DEF @ detection + 1 hour	Amber Warning 	4094-31 1569-31	25% Torque Derate
Secondary Inducement for Incorrect DEF @ detection + 3 hours	Amber Warning 	4094-31 1569-31	40% Torque Derate ramped in at 1% per minute
Final Inducement for Incorrect DEF @ detection + 3 hours and the engine has been intentionally shutdown or in extended idle for 1 hour	Amber Warning Red Stop  	4094-31 1569-31 5246-0	40% Torque Derate & 5 MPH Vehicle Speed Limit



MOTOR COACH
INDUSTRIES

Additional Notes for Operation

- DO NOT turn batteries OFF for at 2 minutes after Shut down
 - Purge Cycle to empty supply and return lines of DEF
- DO NOT close coolant hand valves (*engine compartment*) during summer operation
- DO observe specific cooling system fill and bleed procedures

Drivers Cards for Your Convenience

• 07-14-7821B (side 1)

Items Driver Will Notice

Aftertreatment System

- Under certain conditions (cold or very dry) condensation, in the form of water vapor, can be seen coming from the vehicle tailpipe. This is normal. It will clear within a few minutes of normal vehicle operation.
- SCR-Specific: **Do not disconnect the vehicle batteries during the initial 60 seconds after turning your keyswitch off to avoid system damage.** During this time, a pumping sound may be heard from underneath the vehicle. This sound is the aftertreatment Diesel Exhaust Fluid (DEF) dosing unit purging any unused DEF from the system and returning it to the tank. This is normal.

Engine Sounds

- The 2010 engines are equipped with a feature to 'Warm Up' the aftertreatment system under various idle conditions. This 'Warm Up' feature can cause slight sound changes during idle. These sounds are perfectly normal.
- The electric-actuated Variable Geometry Turbocharger causes the engine sound to vary at different times. This is normal. A slight turbo whistle may also be observed at idle conditions.
- Compression brakes are quieter on engines with Exhaust Aftertreatment.

Exhaust

- After prolonged idle, you may notice momentary white vapor and an odor. This is normal.
- When the High Exhaust System Temperature Lamp is illuminated, you may notice an odor. This is normal. If the odor is excessive and you also notice white vapor, have the exhaust system inspected for leaks.

Cold Weather Operation

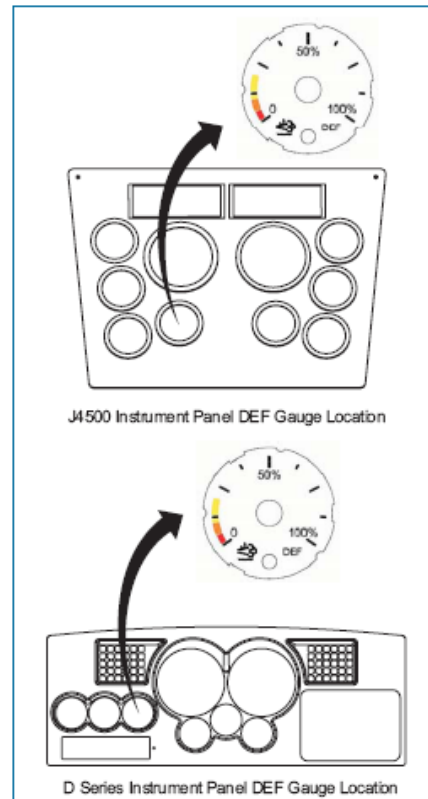
- When a coach is operating at idle, under 140 degrees F coolant temperature for longer than one hour an engine code (Z789) will log and the Check Engine Light will illuminate, this is normal operation for the 2010 EPA engines. To clear this fault, cycle ignition and restart the engine and let it run for 1 minute, the code should go inactive once the engine has performed a self-check.

How to Perform a Parked (Stationary) Regeneration

- Park vehicle in an appropriate location, the regeneration light must be illuminated and just prior to initiate the regeneration, the driver must move the coach(2-3 ft) to cycle the park brake and transmission, set parking brake, and place transmission in Neutral, and ensure fast idle and HVAC switches are disabled, allow at least 60 minutes for the regeneration. Engine must be up to normal operating temperature.
- Set up a safe exhaust area. Confirm that nothing is on or near the exhaust system surfaces.
- Hold the manual Regeneration Switch in the Rear Curbside Service Door in the regen position for at least 5 seconds.
Note: Engine speed will increase and there may be a noticeable change to the sound of the turbocharger during the regeneration process. Once the diesel particulate filter is regenerated the engine will automatically return to normal idle speed.
- Monitor the vehicle and surrounding area during regeneration. If any unsafe condition occurs, shut off the engine immediately. To stop a parked regeneration, depress the service brake or throttle pedal or use the Regeneration Inhibit Switch in the Rear Curbside
- If Regeneration has not started after 60 seconds, move the coach again(2-3 ft) and repeat this procedure.

Once regeneration is complete, exhaust gas and exhaust surface temperatures will remain elevated for 3 to 5 minutes.

Reference your Cummins Owners Manual and Vehicle Owners Manual for complete operating instructions.



Fuel, Oil and Aftertreatment System Maintenance

- Only use Ultra Low Sulfur Diesel (ULSD) fuel.
- CJ-4 (low ash) is the recommended oil.
- Be sure to check DEF gauge at every refueling. DEF meeting
- IsO 22241-1 must be used.
- Never put DEF in anything but the DEF tank (blue cap).**

Road Side and Technical Assistance

- For Engine Manufacturer Technical questions, call:
-Cummins Engine: (800) 343-7357.
- For Motor Coach Industries Assistance, call:
-Emergency Road Side Assistance and Technical support: (800) 241-2947.



EPA 2010 Engine, Driver's Information Card

D and J Coaches with Cummins ISL and ISX Engines



Drivers Cards Cont'd

• 07-14-7821B (side 2)

Mandated Telltale changes for EPA 2010

A storage tank for Diesel Exhaust Fluid (DEF) and the addition of four new dash lamps: Water In Fuel Indicator Lamp (WIF), Wait To Start Lamp (WTS), Diesel Exhaust Fluid Lamp (DEF) and Malfunction Indicator Lamp (MIL). Also, new are the revised graphics for the Check Engine Lamp (CEL) and the Stop-Engine Lamp (SEL). A Diesel Exhaust Fluid Level Gauge has also been added. Please read your vehicle Maintenance and Operators Manuals to familiarize yourself with location, DEF capacity and Aftertreatment

Diesel Exhaust Fluid (DEF) Lamp*

Illuminated

An illuminated DEF lamp is an indication that the DEF level is low. This can be corrected by refilling the DEF tank.

Flashing

A flashing DEF lamp indicates that the DEF level has fallen below a critical level. This can be corrected by refilling the DEF tank.

Flashing with Warning or Check Engine Lamp

A flashing DEF lamp combined with an illuminated amber Warning or Check Engine Lamp indicates that the DEF level is **critically low** and you will experience a **power loss**. Normal engine power will be restored after refilling the DEF tank.

Stop Engine Lamp with Flashing DEF and Amber Warning or Check Engine Lamp

If the engine has been shut down or has idled for 20 hours after the DEF tank has been run dry, the Stop Engine Lamp will also be illuminated along with the flashing DEF lamp and illuminated Warning or Check Engine lamp.

Engine power will continue to be reduced automatically. The vehicle will also be limited to 5 MPH (8 km/h) speed limit. Normal engine power and vehicle speed will be restored after refilling the DEF tank.

Malfunction Indicator Lamp (MIL)

(this symbol used to be used for checkstop engine and is now dedicated to MIL for emissions controlled components)

Functioning MIL Lamp

The MIL illuminates when the On Board Diagnostics (OBD) detects a malfunction related to the emissions control system. The illuminated MIL indicates that the engine needs to be serviced at the first available opportunity and can be illuminated along with any of the engine indicator lamps. **It is not used to indicate an engine protection or maintenance required condition.**

Aftertreatment Diesel Particulate Filter (DPF) Lamp

Illuminated

The Aftertreatment DPF Lamp indicates, when illuminated or flashing, that the Aftertreatment DPF requires regeneration. This is accomplished by the following:

1. Ensure the Regeneration Inhibit Switch in the Rear Curb Side Service Door is not in the Inhibit position
2. Perform a DPF regeneration by one of the following methods:
 - a. Change to a more challenging duty cycle, such as highway driving for at least 20 minutes.
 - Or
 - b. Perform a Parked Regeneration

Flashing

If a regeneration is not performed in a timely manner after the DPF lamp is illuminated, the DPF lamp will begin to flash. This indicates a higher level of soot in the DPF. In addition, engine power may be reduced automatically.

Flashing with Amber Warning or Check Engine Lamp

A flashing DPF lamp combined with an illuminated amber Warning or Check Engine Lamp indicates that the aftertreatment DPF needs regeneration immediately. Engine power will be reduced automatically. A parked regeneration is required.

Stop Engine Lamp (SEL)

If a parked regeneration is not performed, the red Stop Engine Lamp will illuminate. The vehicle should be stopped as soon as it can safely be done until it can be repaired.

High Exhaust System Temperature (HEST) Lamp

The HEST Lamp illuminates to indicate that high exhaust temperatures may exist due to aftertreatment regeneration. This is normal and does not signify the need for any kind of vehicle or engine service. When this lamp is illuminated, ensure that the exhaust pipe outlet is not directed at any combustible surface or material.

New Telltale Symbols

Low Coolant Indicator

Illuminated

The Low Coolant telltale indicates, when illuminated, that the level of engine coolant is low in the radiator surge tank. Operators need to refill the surge tank up to the specified coolant level, otherwise the engine could self protect to prevent overheating.

Transmission Malfunction

Illuminated

An illuminated Transmission Lamp is an indication of a transmission failure. This condition can be corrected providing immediate service to the transmission.

Water In Fuel Indicator (WIF) Lamp

Illuminated

The WIF lamp indicates the presence of water in the fuel filter. When the conductivity probe indicates a change consistent with water, the Warning lamp flashes after the key is turned on.

Wait To Start (WTS) Lamp

Illuminated

OBD regulations require circuit continuity detection of the Wait to Start Lamp.

Check Engine (CEL) Lamp

Illuminated

An illuminated Check Engine Lamp is an indication that the engine needs service at the first available opportunity.

Stop Engine Lamp (SEL)

The red Stop Engine Lamp will illuminate to alert the driver of the two engine conditions:

- a. Refill the DEF tank
- Or
- b. The coach needs to be **STOPPED** to force a parked regeneration.



MOTOR COACH
INDUSTRIES

Summary

You should now:

- Know important facts about Exhaust Emissions and how they are controlled with After Treatment System (ATS)
- Be able to identify components of the different ATS
- Understand the operation of each stage of the ATS
- How the driver interacts with the ATS
- Learn the maintenance requirements
- Driver Area changes for 2010 engines
- Learn the proper handling of Diesel Exhaust Fluid (DEF)



MOTOR COACH
INDUSTRIES

Questions and Answers

Click on the hand



to ask your question with your voice



MOTOR COACH
INDUSTRIES

Thank you for your business