



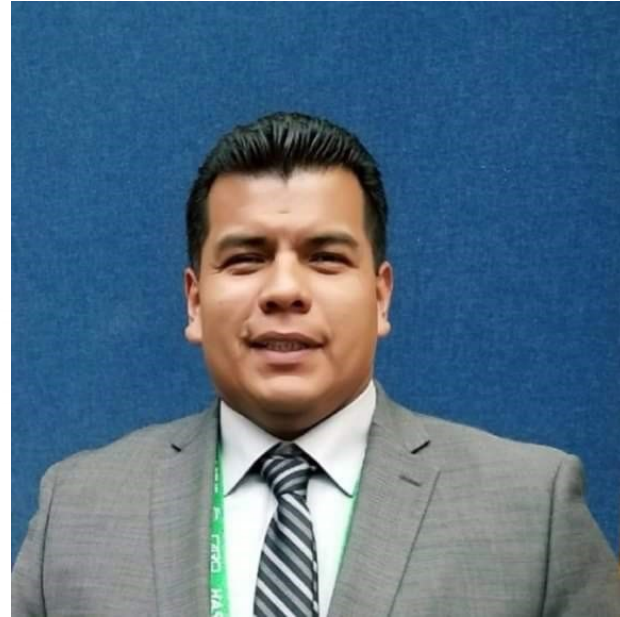
AMERICAN
PUBLIC
TRANSPORTATION
ASSOCIATION

Diesel Aftertreatment Systems

December 03 2019

Moderator

Obed Mejia, Senior Bus Equipment Maintenance Instructor, LA Metro and Vice Chair-Webinars, APTA Bus Technical Maintenance Committee



Presenters



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Cummins Inc.



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Manager of Maintenance
Training
Metropolitan Transit Authority
of Harris County TX



Tim Wallace
Technical Training Instructor
Regional Transportation District
Denver, CO

Objectives

At the completion of this this webinar, you can expect to come away with:

1. *Knowledge of system operation*
2. *Preventive maintenance practices*
3. *System troubleshooting and diagnosis tips*

Cummins Inc



Your Trusted Partner in Transit

11/21/2019

Public

Agenda

01

Cummins Transit Market Overview

02

The Power Of Choice

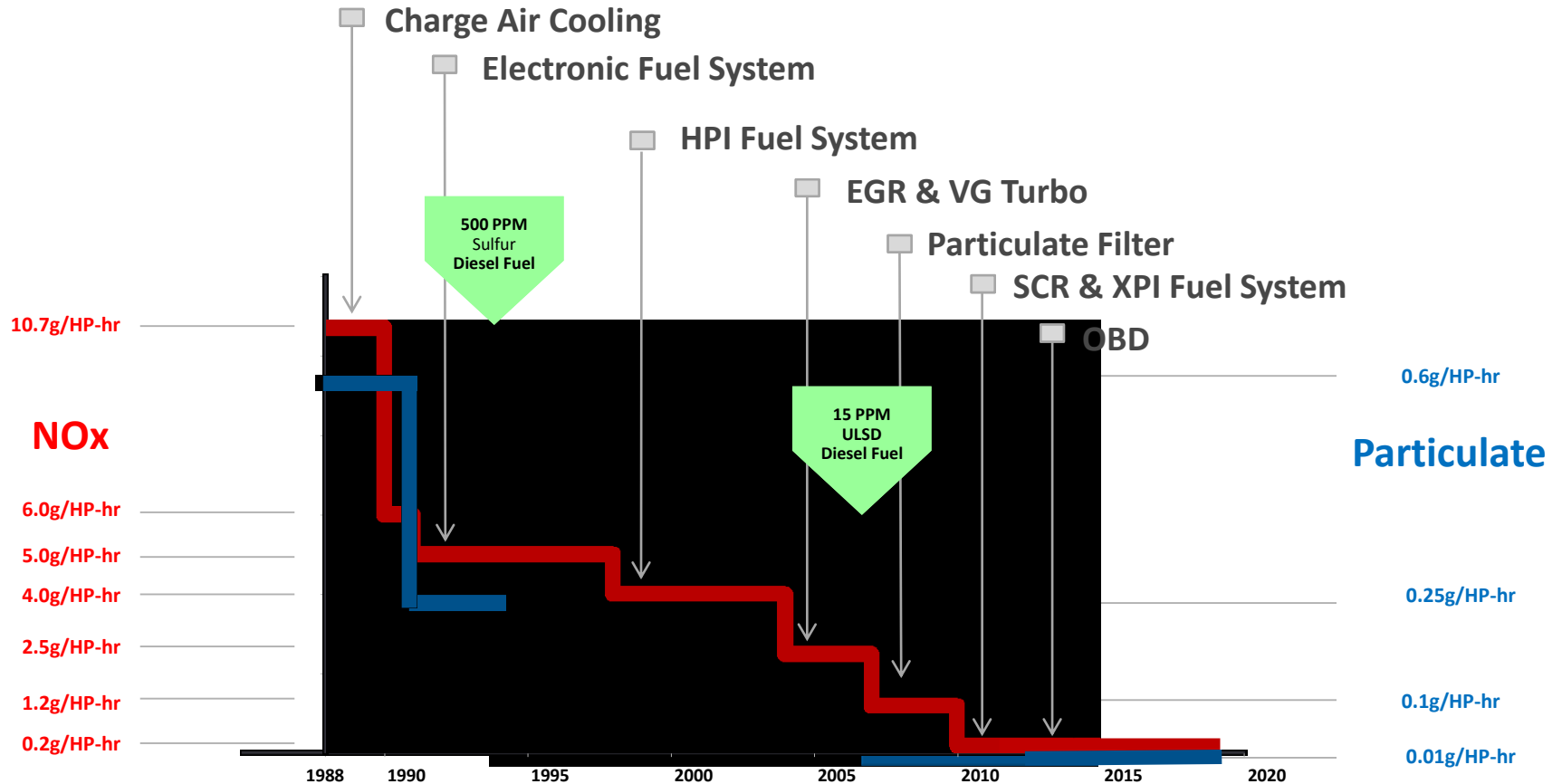
03

Innovation: Our Electrification Story

04

Questions

Where We've Come From



Cummins Portfolio:



B6.7™
HYBRID

NOVABUS

EIDorado
NEW FLYER National

GILLIG



L9N™

NOVABUS

EIDorado
NEW FLYER National

GILLIG



L9™

NOVABUS

EIDorado
NEW FLYER National

GILLIG



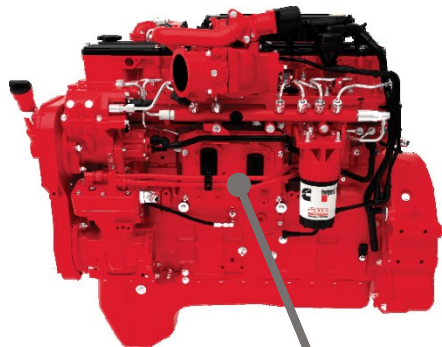
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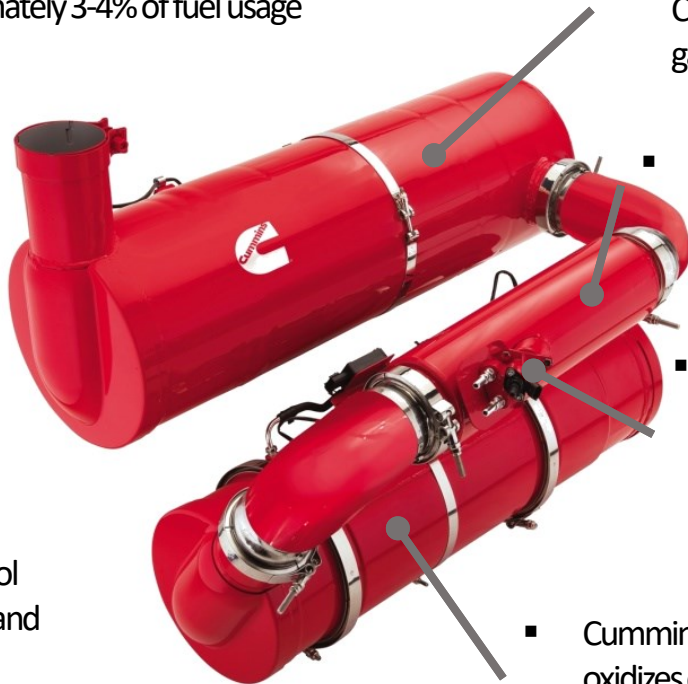
Cummins Aftertreatment System Review

2013 Multi-Module Aftertreatment

- Reduces oxides of nitrogen (NOx) and particulate matter (PM)
- Achieves near-zero emissions; maintains industry-leading fuel economy
- Diesel Exhaust Fluid (DEF) usage approximately 3-4% of fuel usage



- Electronic Controls Single Electronic Control Module (ECM) constantly adjusts engine and aftertreatment operations for peak performance and emissions control.



- Cummins Selective Catalytic Reduction (SCR) Catalyst Converts NOx into harmless nitrogen gas and water vapor.

- Decomposition Reactor converts DEF into ammonia (NH₃) through hydrolysis.

- Diesel Exhaust Fluid (DEF) Dosing Valve Allows a fine mist of DEF to be sprayed into the exhaust stream of the Decomposition Reactor.

- Cummins Particulate Filter Collects and oxidizes carbon to remove PM from the exhaust.



System Component Responsibilities

Cummins Supplied

- Standard Cummins Particulate Filter assembly
- Catalyzed filter, DOC elements
- V-band clamps on 3 modular sections
- ¼" insulated housing
- Standard SCR Catalyst Assembly
- SCR, AMOX catalyst elements
- ¼" insulated housing
- Inlet / Outlet Subassembly
- Decomposition Pipe w/ 2 Gasketed Marmon Flanges
- Aftertreatment DEF Controller and Line Heater Controls (CES to integrate w/ OEM)
- Aftertreatment DEF Dosing Valve
- Delta Pressure Sensor, Mounting, Tube
- NOx Sensor
- Temperature Sensors (DPF and SCR)
- Wiring harness with Common Vehicle Connectic
- Insulated Platform for Sensor Mounting
- Aftertreatment DEF Dosing Unit

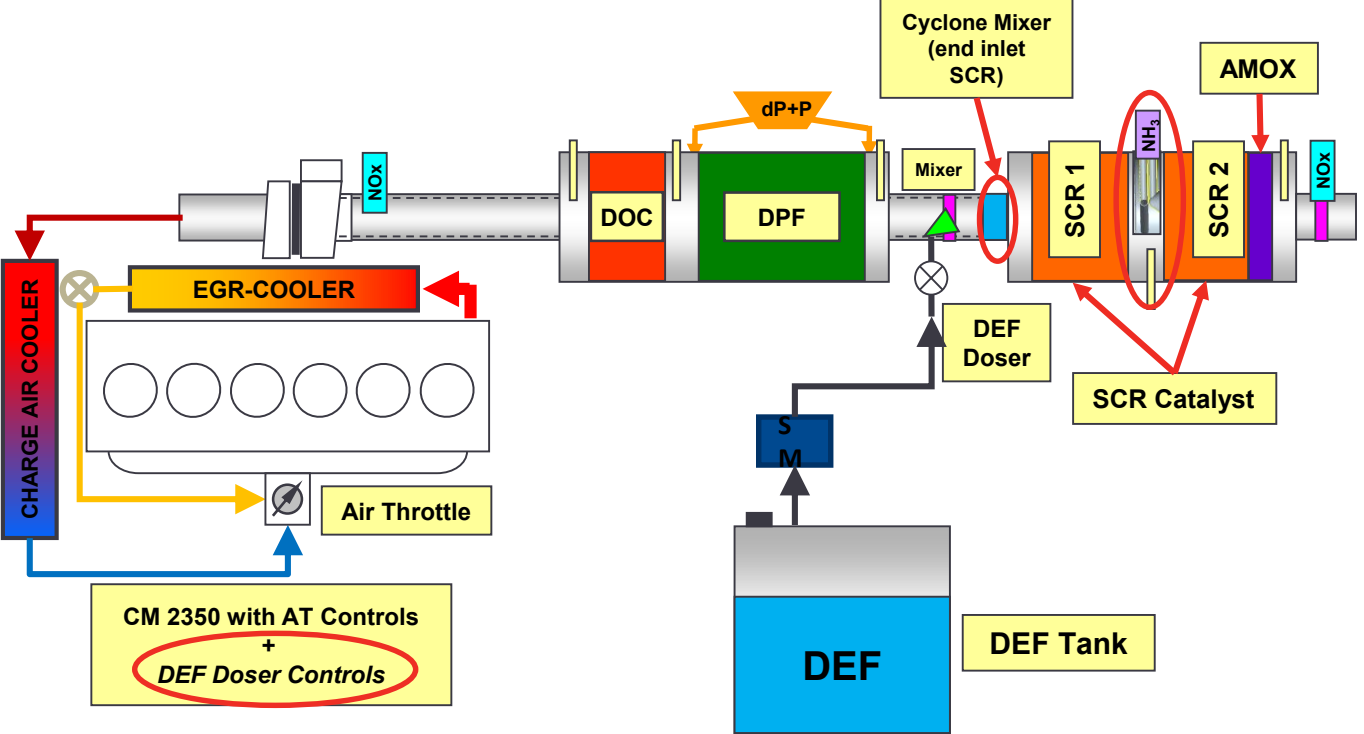


OEM Supplied

- Turbo to CPF Assembly Downpipe
- DEF Tank
- DEF Tank Filter
- DEF Level Sensor
- DEF Temperature Sensor
- DEF Tank Heater (CES to integrate w/OEM)
- DEF Tank Heater Relay/Valve
- DEF Line Heaters
- DEF Lines to/from DEF tank to Aftertreatment DEF Dosing Unit
- DEF Line from Aftertreatment DEF Dosing Unit to Aftertreatment DEF Dosing Valve
- Coolant Lines to/from DEF Tank
- Coolant Lines to/from Doser Nozzle
- Vehicle to Aftertreatment Wiring
- Tailpipe Assembly
- Mounting Brackets/Fasteners

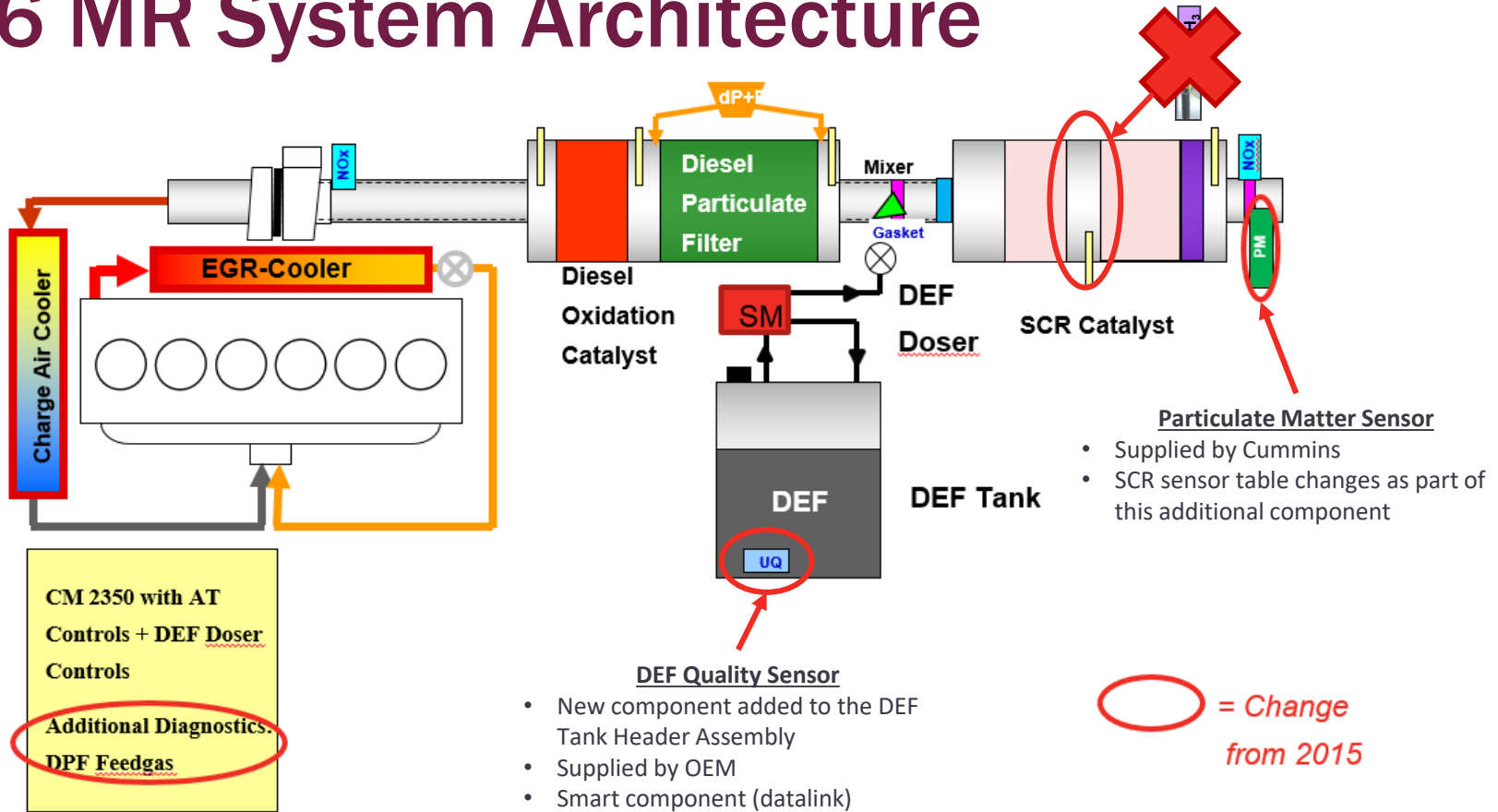


2013 MR System Architecture

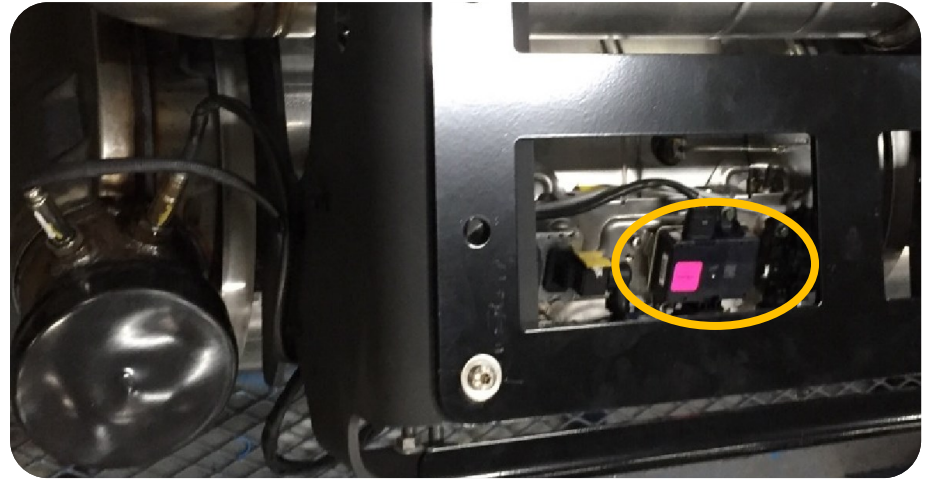
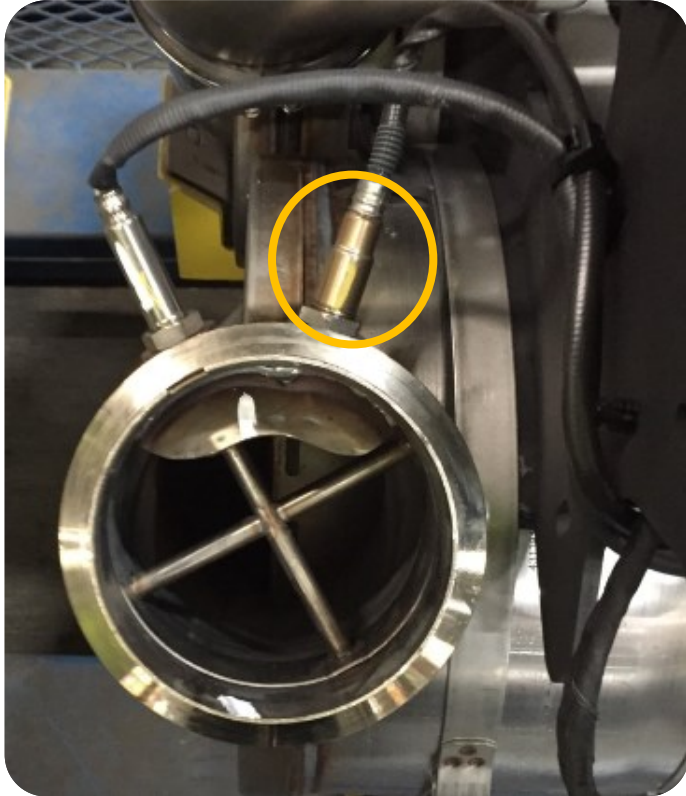


 = Change from 2010

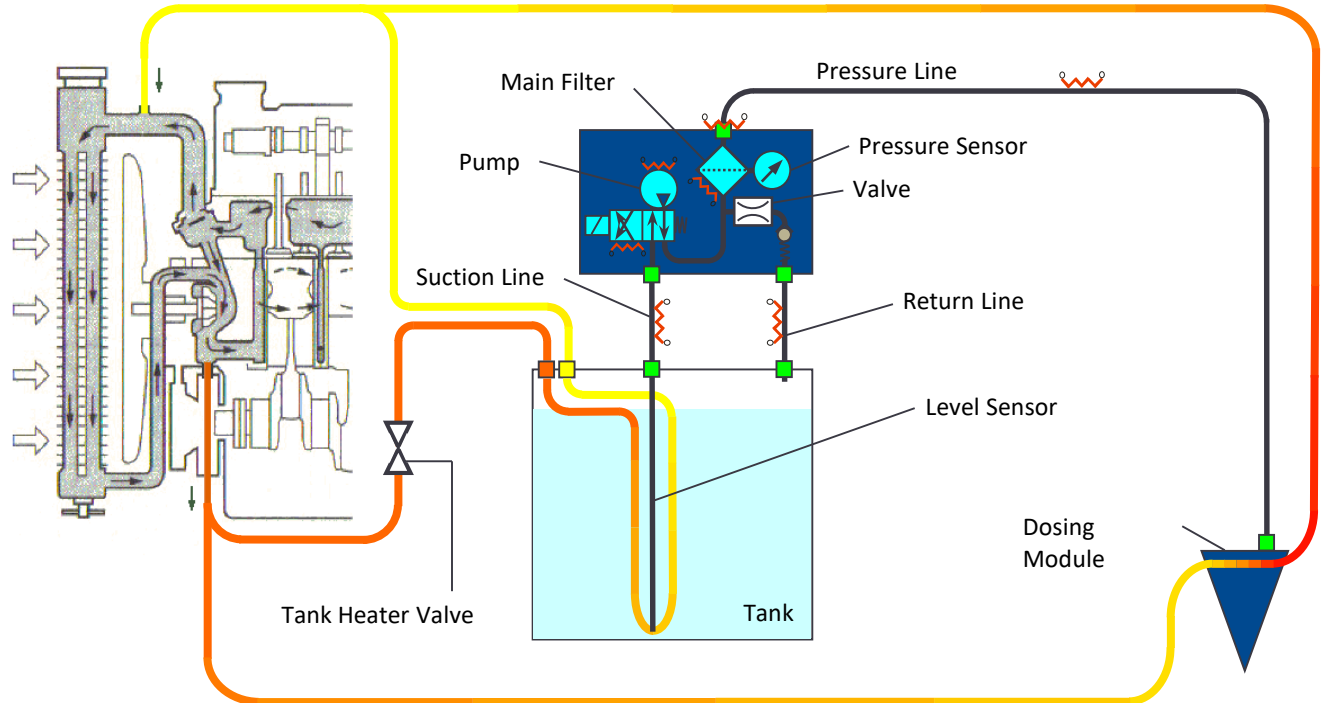
2016 MR System Architecture



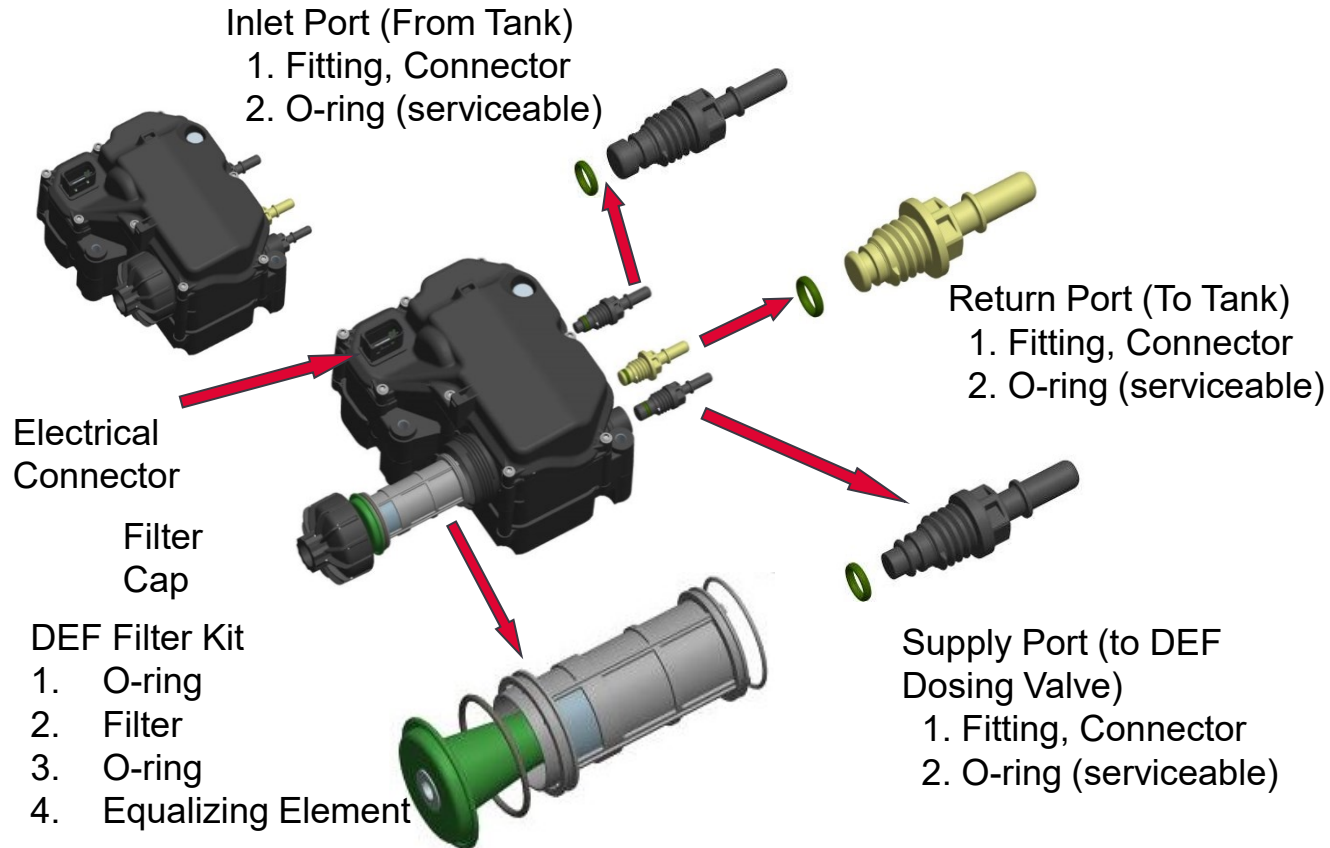
Particulate Matter (PM) Sensor



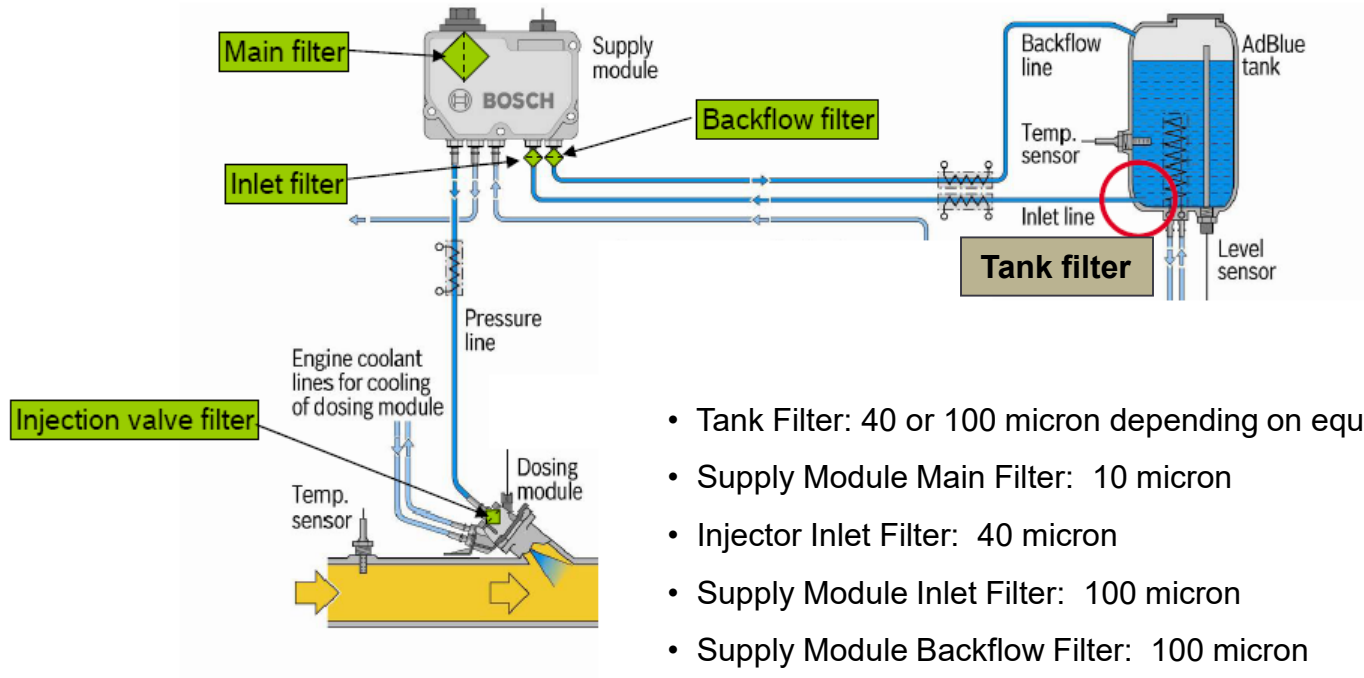
2010 - 2016 DEF System Architecture



2010 - 2016 Bosch DEF Dosing Unit



Filtration Points in DEF Circuit



- Tank Filter: 40 or 100 micron depending on equipment year
- Supply Module Main Filter: 10 micron
- Injector Inlet Filter: 40 micron
- Supply Module Inlet Filter: 100 micron
- Supply Module Backflow Filter: 100 micron

Troubleshooting Steps

DO NOT use INSITE for troubleshooting steps

- Troubleshooting steps within INSITE are not updated as regularly as other sources

DO use QSOL for troubleshooting steps

- Campaign notifications
- Fault Code Analyzer
- Updated regularly





Service and Support

Unmatched Service & Support Network

With 24/7 support in over 225 locations across North America, the Cummins service network is the most extensive in the industry.

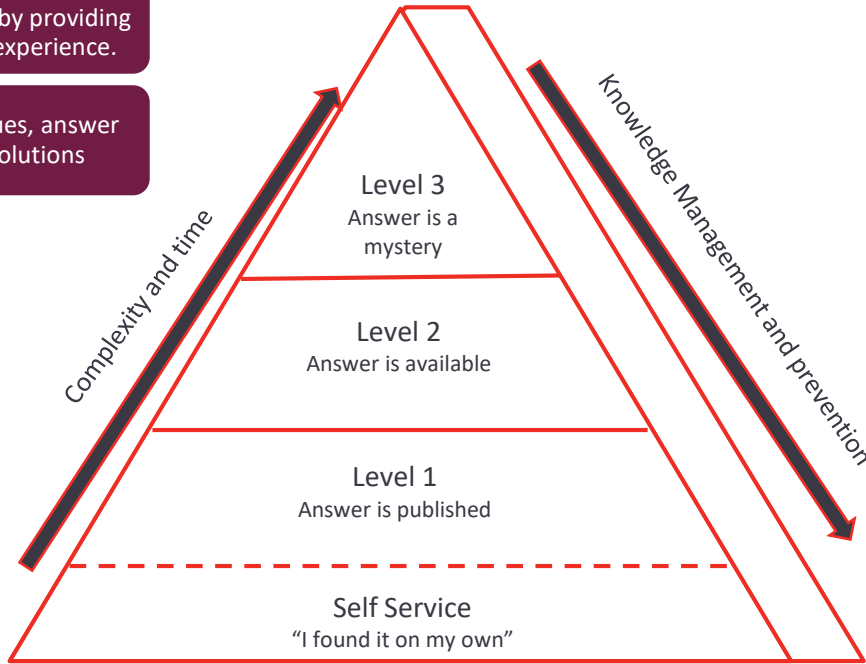


Cummins Care



We are here to make the lives of our customers easier by providing a seamless support experience.

We help prevent issues, answer quickly, provide solutions



Cummins Care is not a typical call center. We are a solutions center helping to prevent issues and provide answers quickly.



Cumminsengines.com/urban-bus-shuttle

Cumminsengines.com is your one stop-shop for high level service, product, literature and support information. The On-Highway, Urban Bus & Shuttle section provides more specific information for transit and shuttle bus applications.



Email

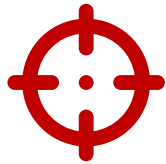
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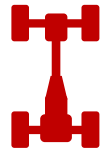
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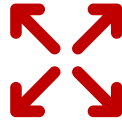
The Cummins difference



ONE CENTURY
OF POWERTRAIN
FOCUS



POWERTRAIN
OF
CHOICE



CAPABILITIES
ACROSS
APPLICATIONS

Houston Metro

Metro Facts

Houston METRO currently operates 1,236 buses. METRO is currently purchasing compressed natural gas (CNG) and clean diesel buses.

Currently, Houston METRO operates 930 Clean Diesel buses.

System Preventive Maintenance

Cummins Clean Diesel Preventive Maintenance:

ISB

- DPF replacement with swing unit – 5000 hours
- EGR components and port cleaning – 5000 hours
- Replace Differential Pressure Sensor – 5000 hours
- Minor Tune Up – 5000 hours / Major Tune Up – 10000 hours (turbo/SCR inspection, & injector replacement)

ISL

- DPF replacement with swing unit – 5000 hours
- EGR components and port cleaning – 5000 hours
- Replace Differential Pressure Sensor – 5000 hours
- Minor Tune Up – 5000 hours / Major Tune Up – 10000 hours (turbo/SCR inspection, & injector replacement)

ISX

- DPF replacement with swing unit – 5000 hours
- EGR components and port cleaning – 5000 hours
- Replace Differential Pressure Sensor – 5000 hours
- Minor Tune Up – 5000 hours / Major Tune Up – 10000 hours (turbo/SCR inspection, & injector replacement)

Current Common Issues

Dosing valve plugging when battery switch is turned off too quickly

Picture of plugged dosing
valve

Resolved Common Issues

Dirty EGR components and ports have been remedied with 5k hour cleaning

Frequent DPF soot loading has been remedied with 5k hour replacement of DPF with cleaned swing units

Frequent DPF soot loading has been addressed with programmed “0” mph regens on non-SCR aftertreatment systems

Service Procedures

5k hour DPF
replacement

5K hour EGR
component / port
cleaning

5k hour dosing unit
filter replacement

5k / 10K hour Tune Up



Service Procedures

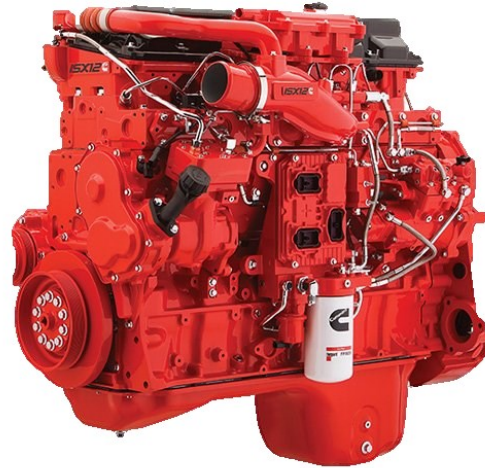
DPF Cleaning Procedures:

Steps of the DPF pneumatic cleaning, vacuum testing, and/or baking and retesting (with pictures)

RTD Denver

RTD Facts

- Cold Side EGR Valve
- Very poor duty cycle
- Frequent Plugging of EGR and DPF
- 96000 mile EGR CCO



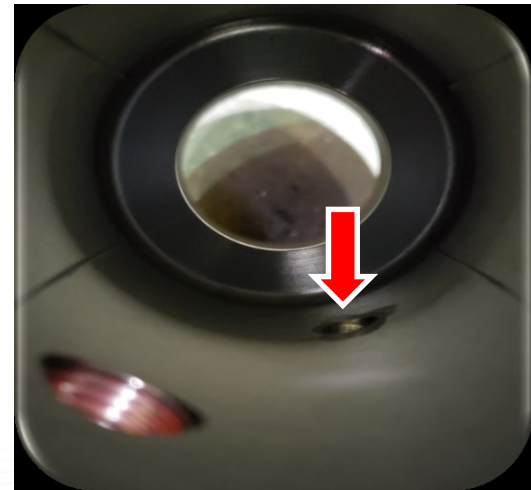
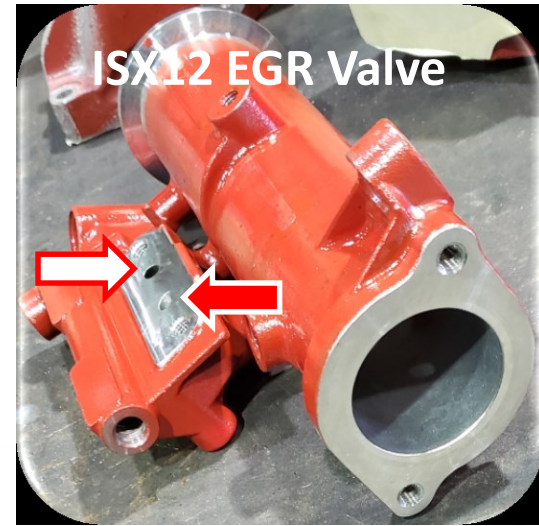
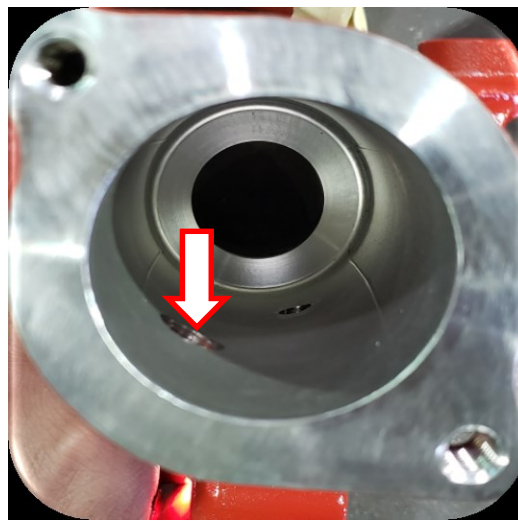
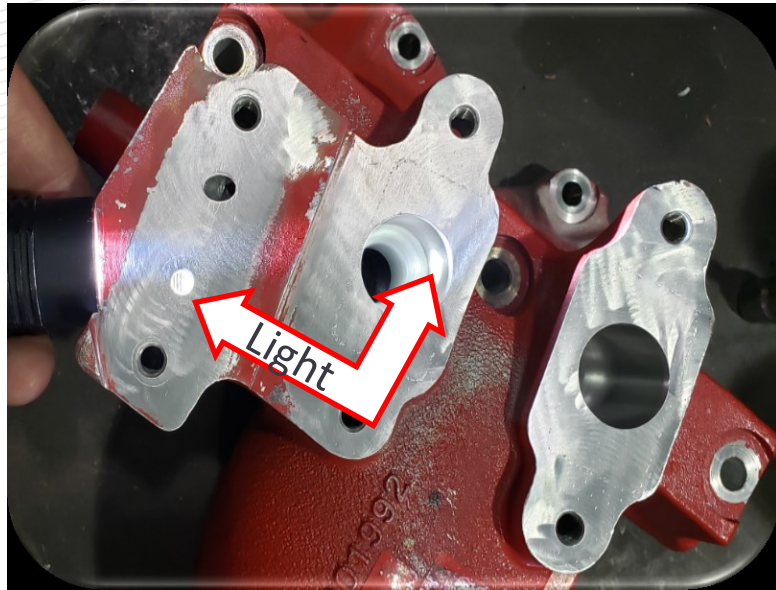
- Hot Side EGR valve
- Highway duty cycle
- Less plugging of EGR & DPF, causes intermittent problems
- 150000 mile EGR CCO

Common Failures



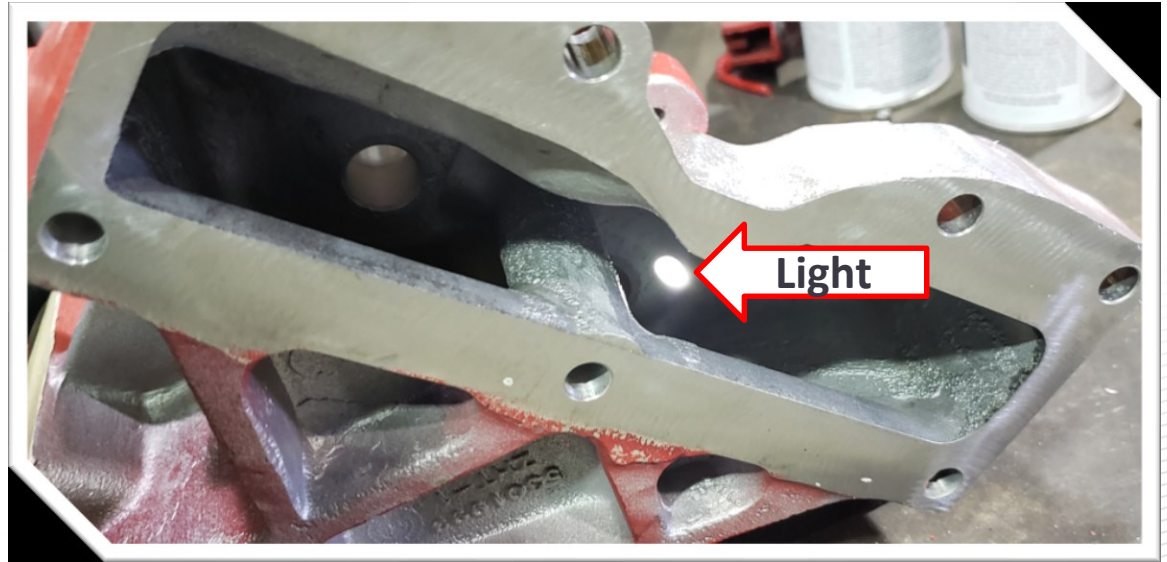
Typical Repairs

ISL9 Intake Horn



Logical Troubleshooting Steps

ISL 9 EGR Valve and Intake Horn Bottom View



Summary