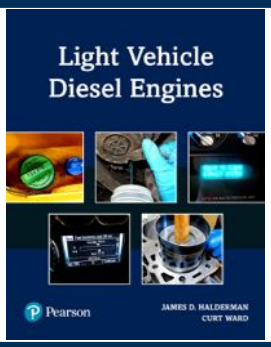
Light Vehicle Diesel Engines

First Edition



Chapter 25
FIAT CHRYSLER
Diesel Engines

LEARNING OBJECTIVES (1 of 2)

25.1. Identify the major engine components on the 3.0-liter VM V-6 diesel engine.

25.2 Explain the cooling system, air intake system, and the lubrication system service on the VM 3.0-liter V-6 diesel.

25.3 Explain the unique features of the upper engine, lower engine, and the engine timing system.

25.4 Perform component identification; verify the location and function of the major engine inputs and outputs of the VM 3.0-liter V-6 diesel engine.

LEARNING OBJECTIVES (2 of 2)

25.5 Explain the location, function and diagnosis of the low-pressure fuel system.

25.6 Identify the components, location, and function of the high-pressure fuel system.

25.7 Identify the components, function and operation of the exhaust aftertreatment system.

OVERVIEW

- **VM 3.0-liter V-6 diesel engine**
  - 2015 Jeep Grand Cherokee & 2015 Ram 1500 pickup
  - Chrysler group refereed EcoDiesel
    - Manufactured by Vancini Martilli Motori (VM)
    - Subsidiary of Fiat Chrysler Automobiles
    - Aftertreatment system consisting
    - Diesel oxidation catalyst
    - Selective catalyst reduction
    - Particulate filter
    - 50 state emissions compliant when using up to 5% biodiesel

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ENGINE IDENTIFICATION

- **2-piece block**
  - 6 cylinders arranged in a 60° O
  - Compacted graphite iron cylind block
  - Aluminum cross flow cylinder heads
  - 4 valves per cylinder DOHC
  - Oil jet cooled pistons, swirl intal ports
  - Timing chain-driven valve train
  - Water-to-oil engine oil cooler
  - Water-cooled EGR system
  - Non-freewheeling (Interference)-

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FIGURE 25–1 VM Diesel 3.0-liter V-6 engine.

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CHART 25-1 specifications for 3.0-liter VM diesel engine.

Cylinder Configuration	60-degree V-Block
Number of cylinders	6
Displacement	2987cc (183 CID)
Bore	3.268 in.(83mm)
Stroke	3.622 in.(92mm)
Compression ratio	16.5:1
Valves per cylinder	4
Dry weight	494 lbs.(224 kg)
Maximum power	230 HP (172 kW) @3600 rpm
Maximum torque	405 lbs./ft.(550 Nm) @1800-2600 RPM
Block configuration	Bedplate (compacted graphite iron)
Cylinder head	Aluminum DOHC
Valvetrain	DOHC with chain drive
Fuel system	High-pressure common rail with a CP 4.2 pump
Engine preheat	7 volt ceramic glow plug
Engine rotation	Clockwise, viewed from front cover
Target idle	700 RPM
Turbocharger	Single variable geometry turbocharger
Aftertreatment	DOC + DPF + SCR
Emissions	TIER 2 BIN 5

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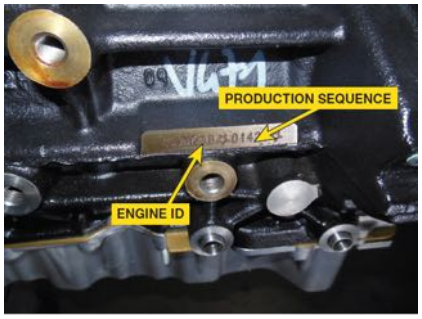
FIGURE 25–2 identification tag on lower right side of engine provides data on engine build.



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SERVICE INFORMATION

- **Engine Oil**
  - Full synthetic 5W-40 low ash diesel oil
    - Per Technical Service Bulletin #-18-078-16 –
    - Use Rotella Full Synthetic Engine Oil
- **Coolant**
  - Uses organic additive technology (OAT) coolant
  - Meets Chrysler material standard MS 12106
  - Premixed antifreeze with 50% with deionized water

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FIGURE 25–3 Engine oil specified in VM 3.0-liter engine per TSB #-18-078-16.

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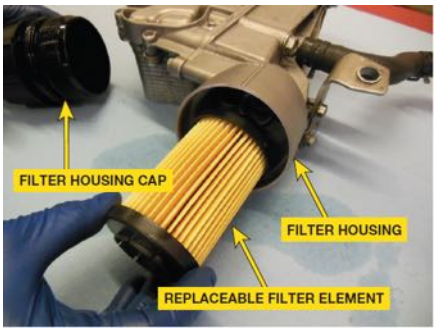
FIGURE 25–4 engine oil filter is a cartridge type to reduce landfill waste.



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Why Does This Engine Use an Oil Cooler?

FREQUENTLY ASKED QUESTION

The engine uses a coolant-to-oil cooler. The cooled and filtered oil helps to reduce engine operating temperature, which helps to reduce the level of oxides of nitrogen (NOx). The engine oil temperature can be viewed with a scan tool.

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FIGURE 25–5 Mopar coolant meets material standard MS 12106.

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ENGINE MECHANICAL (1 of 5)

- **Diesel Engine Block 2 Piece Design**
  - Main casting – houses cylinders & pistons
  - **Bedplate** – provides lower crankshaft bearing journal
    - Adds to strength and stiffness of engine

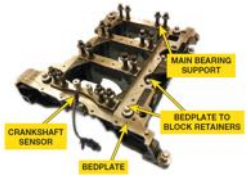

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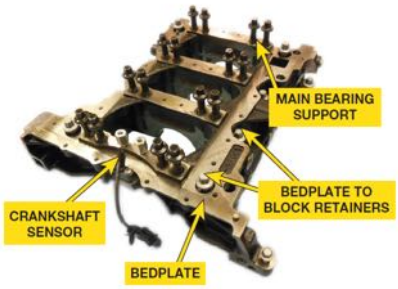
FIGURE 25–6 bedplate is attached to block that adds strength and prevents torsional twist.



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ENGINE MECHANICAL (2 of 5)

- **Oil Pan** is a 2-piece design W/windage tray
- **Oil Pump** is crank gear-driven gerotor-style pump
  - At idle produces 14.5 PSI (1 BAR).
  - 4,000 engine RPM produces 65 PSI (4.5 BAR)
- **Crankshaft** forged steel design
  - 4 main bearings & 4 counterweights
- **NOTE: dampener bolt is left-hand threaded and is angle torqued**

ENGINE MECHANICAL (3 of 5)

- **Pistons** are oil jet cooled with full-floating design.
- **Rods** trapezoidal in design with fractured caps
- **Bores** are classified by size
- **NOTE: According to Fiat/Chrysler, connecting rod bolts must be replaced anytime they are removed**.
- **CAUTION: When servicing cylinder head, always replace cylinder head bolts as they are one-time use-type of angle-torque bolt.**

ENGINE MECHANICAL (4 of 5)

- **Timing System**
  - Two timing chains
  - Driven by crankshaft & attached to exhaust cam
  - Timing chains move along 2 chain guides
  - Hydraulically tensioned & lubricated by oil jets

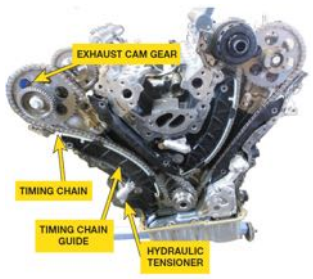
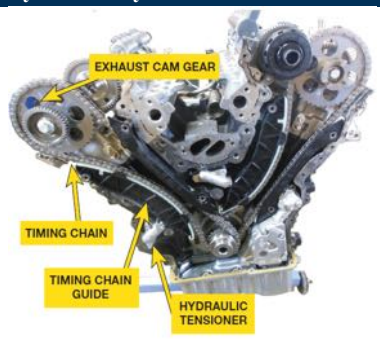


FIGURE 25–7 timing chains move along two guides and are hydraulically tensioned.



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ENGINE MECHANICAL (5 of 5)

CAUTION: When timing engine/replacing high pressure fuel pump, VERY IMPORTANT proper tools and procedures used or internal damage to engine caused by valve to piston interference will result.

- **Intake Air System: Page 312 of text**
- **Variable Geometry Turbocharger: Page 312 of text**

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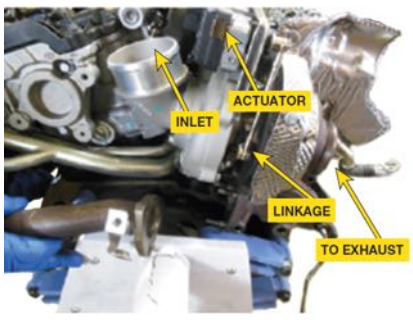
FIGURE 25–8 variable geometry turbocharger provides the needed boost under all operating conditions.



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LOW-PRESSURE FUEL SYSTEM

- **Fuel Tank: Figure 25-9**
- **FUEL PUMP module includes**
  - Internal fuel filter, pressure regulator, electric fuel pump,
  - sending unit
  - Operate between 58–86 PSI
  - Flow rate for pump will be 953 gallons/hour
- **Fuel Filter**
  - Filter/water separator
  - Fuel heater and located near fuel tank

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When Does the Water Need to be Drained?

? FREQUENTLY ASKED QUESTION

There is a water drain in bottom of the fuel filter housing. It is recommended that the drain be opened at each oil service and fuel be inspected for the presence of water. If water-in-fuel light is illuminated, it is recommended that filter be changed.

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FIGURE 25–9 saddle tank configuration used on the Grand Cherokee uses a jet pump and delivery pump.

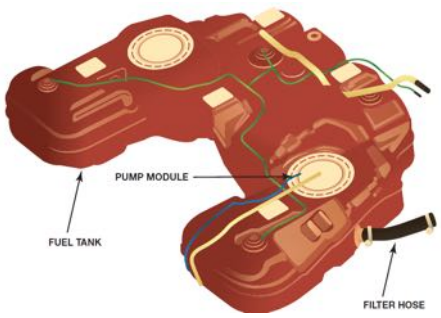

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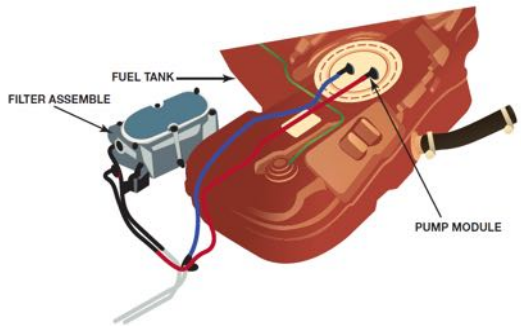
FIGURE 25–10 filter assembly contains the filter, water separator, water drain, and fuel heater.



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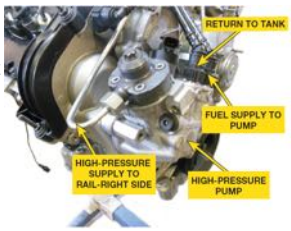
HIGH-PRESSURE FUEL SYSTEM (1 of 2)

- **Two-Cylinder Design Pump**
  - Mounted to the right front cylinder
  - Timed to engine at camshaft gear on right cylinder
  - Delivers between 2,900–29,008 PSI
  - Minimum fuel rail pressure needed to start 1,740 PSI



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WARNING

High-pressure fuel lines deliver fuel under extreme pressures. Use extreme caution when looking for leaks as fuel under pressure may penetrate the skin, causing injury or death.

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FIGURE 25–11 high-pressure pump is a two-cylinder design and has separate outlet for each side of motor.

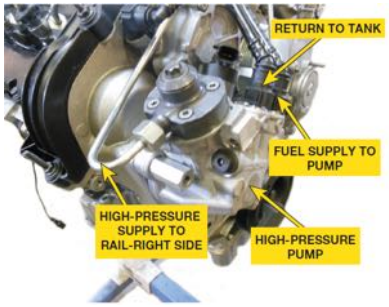

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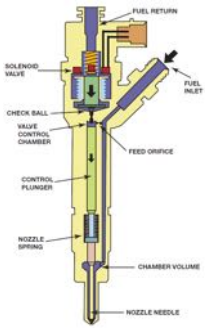
FIGURE 25–12 injector is solenoid controlled and utilizes a control chamber to quickly open and close the nozzle.



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HIGH-PRESSURE FUEL SYSTEM (2 of 2)

- **Page 315 of text**
  - **High-Pressure Common Rail Fuel Injectors**
  - **Operation**
  - **High-Pressure Common Rail**
  - **Fuel System Return**

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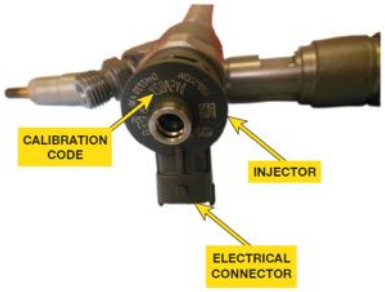
FIGURE 25–13 calibration code for each injector must be programmed into PCM to ensure precise amount of fuel is delivered.



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CONTROL SYSTEM INPUTS

- **Pages 316-317 of text**
  - **Crankshaft Position Sensor Figure 25-14**
  - **Camshaft Position Sensor Figure 25-15**
    - **Camshaft Sensor Fails To Produce A Signal, Vehicle Will Not Start.**
  - **Boost Pressure Sensor: Figure 25-16**
  - **Engine Coolant Température Sensor: Figure 25-17**
  - **Mass Air Flow Sensor: Figure 25-18**
  - **Wide Band Oxygen Sensor: Figure 25-19**

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FIGURE 25–14 crankshaft position sensor is mounted on the bedplate behind the flywheel.

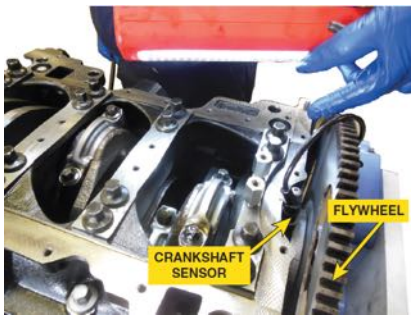

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FIGURE 25–15 camshaft position sensor is mounted on right side of timing cover and is triggered by exhaust camshaft.

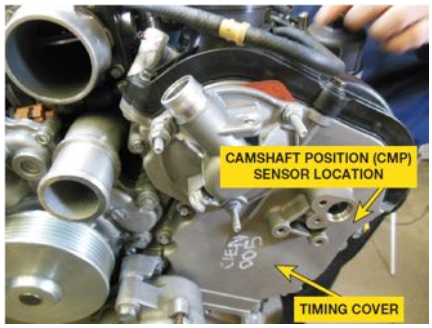

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FIGURE 25–16 boost pressure sensor is mounted on top of intake manifold and it allows PCM to monitor intake air pressure.

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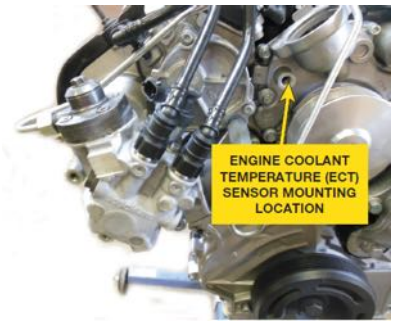
FIGURE 25–17 coolant temperature sensor is mounted on front of engine below upper radiator hose, and provides engine temperature data needed to calculate fuel delivery and target idle.



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"Check for Soot"

TECH TIP

When diagnosing an exhaust gas sensor fault, be sure the tube is not restricted with soot or carbon.

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FIGURE 25–18 mass air low sensor provides PCM with air density information needed to calculate proper EGR flow.

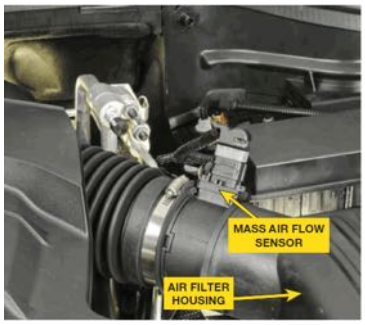

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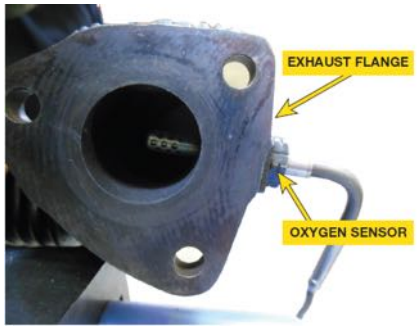
FIGURE 25–19 wide band O2 sensor is used to calculate EGR flow in order to minimize NOx emissions.



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ENGINE OUTPUTS (1 of 2)

- **Glow Plugs & Glow Plug Module**
  - Module controls glow plugs
  - Battery positive and ground
  - Connected to PCM via local interface bus (LIN)
- **Exhaust Gas Recirculation (EGR) Valve**
  - **See page 318 of text**

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Do Not Test Glow Plugs with 12 Volts

TECH TIP

Applying 12 volts to glow plugs will result in failure of glow plug. Be careful when handling glow plugs. They are sensitive to impact and may fail if dropped.

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ENGINE OUTPUTS (2 of 2)

- **Intake Air Flow Control Valve**
  - Position of valve determines mix
  - Fresh air &exhaust gasses in intake
- **EGR Cooler Bypass Valve**
  - Allows exhaust gasses to bypass EGR cooler
- **Turbocharger Actuator**
  - Controlling boost pressure
  - Controlling position of guide vanes

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FIGURE 25–20 EGR valve is mounted on end of EGR cooler. Together they reduce level of NOx emissions by controlling flow and temperature of EGR gasses.

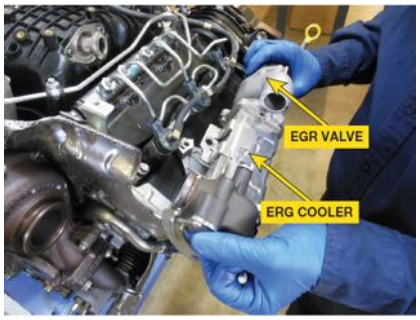

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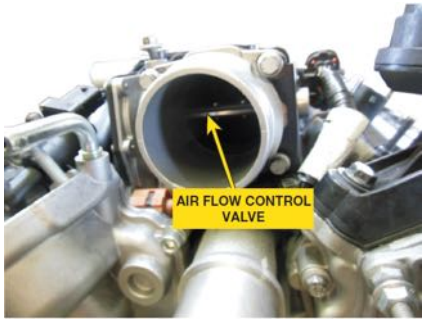
FIGURE 25–21 air flow control valve creates negative intake air pressure that increases flow of EGR gasses.



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VM 3.0-LITER V-6 DIESEL AFTERTREATMENT SYSTEM (1 of 2)

- **Aftertreatment System Conform To Emissions**
  - Non-methane hydrocarbons (NMHC)
  - Carbon monoxide (CO)
  - Oxides of nitrogen (NOx)
  - Particulate matter (PM)

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VM 3.0-LITER V-6 DIESEL AFTERTREATMENT SYSTEM (2 of 2)

- See page 319 of text
  - Diesel Oxidation Catalyst
  - Diesel Particulate Filter
  - Selective Catalytic Reduction System (SCR)
  - Diesel Exhaust Fluid (DEF) Tank & Injector
  - DEF Warning System

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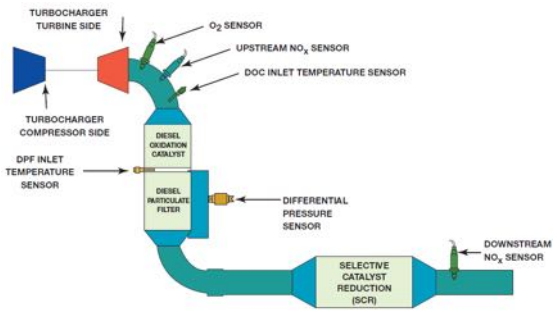
FIGURE 25–22 aftertreatment system is designed to reduce tailpipe emissions to meet current model year requirements.



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QUESTION 1

- What is the purpose of the MAF sensor?

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ANSWER 1

- Mass air flow (MAF) used by the PCM to measure air density. The primary use of this input is to make adjustments to the EGR operation. The sensor is located between the air filter and the inlet to the turbocharger

Summary (1 of 2)

- The VM diesel engine is a 60-degree overhead valve V-6 engine that utilizes a two-piece block. The block is compacted graphite iron and the cylinder head is aluminum.
- The engine is dual overhead camshaft design with two timing chains that are hydraulically tensioned.
- The air induction system utilizes a single variable geometry turbocharger and 7-volt ceramic glow plugs.

Summary (2 of 2)

- The fuel system is a high-pressure common rail design that uses solenoid-style injectors.
- The exhaust aftertreatment system consists of a diesel oxidation catalyst, diesel particulate filter, and a selective catalyst reduction system, which allows it to achieve Tier 2 Bin 5 emission certification.