


Light Vehicle Diesel Engines
First Edition

Light Vehicle Diesel Engines



Chapter 7
Diesel Engine Disassembly, Cleaning, and Crack Detection

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LEARNING OBJECTIVES (1 of 2)

7.1 Prepare for the Light Vehicle Diesel Engine (A9) ASE certification test content area “B” (Cylinder Head Diagnosis and Repair) and content area “C” (Engine Block Diagnosis and Repair).

7.2 Explain the engine removal procedure.

7.3 Explain the disassembly of the short block, rotating engine assembly, and cylinder head.

7.4 Explain the mechanical cleaning procedure of engines.

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LEARNING OBJECTIVES (2 of 2)

7.5 Discuss chemical cleaners.

7.6 Compare spray, steam cleaning, thermal cleaning, tank, vapor cleaning, ultrasonic and vibratory cleaning.

7.7 Explain crack detection.

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PREPARING THE ENGINE FOR REMOVAL (1 of 4)

- **Check Service Information**
 - **Usual Engine Removal Procedures**
 - Remove the hood
 - Clean the engine area
 - Disconnect the negative (-) battery cable
 - Remove the air cleaner assembly
 - Remove all accessories
 - Drain the coolant
 - Remove the radiator
 - Disconnect the exhaust system
 - Recover the air-conditioning refrigerant

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PREPARING THE ENGINE FOR REMOVAL (2 of 4)

- **Usual Engine Removal Procedures**
 - Remove the power steering pump
 - Drain the engine oil
 - Disconnect fuel lines
 - Disconnect wiring

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PREPARING THE ENGINE FOR REMOVAL (3 of 4)

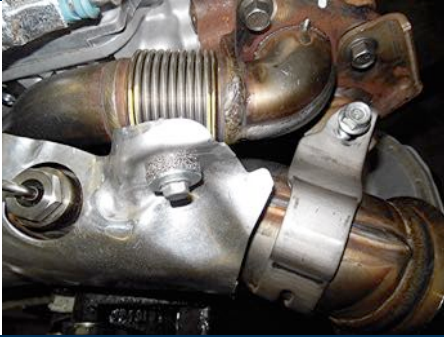
- **Procedure For Engine Removal**
 - **Rear-wheel-drive vehicle Page 83**

NOTE: For the best results, use the factory installed lifting hooks that are attached to the engine. These hooks are used in the assembly plant to install the engine and are usually in best location to remove the engine.

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FIGURE 7-1 Several sections of the exhaust system to the turbocharger on a Duramax diesel engine need to be disconnected before the engine can be easily removed.



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FIGURE 7-2 Cummins 6.7 liter inline six-cylinder diesel engine is so long that it is best to use an engine stand that supports the engine from the side rather than from the bell housing section of the block..



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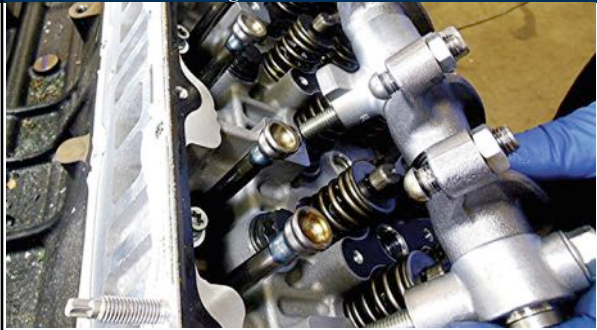
PREPARING THE ENGINE FOR REMOVAL (3 of 4)

- Mounting Engine On Stand **Page 83**
- Disassembling Engine **Page 83**
- Cylinder Head Removal **Page 84**
- Piston Removal **Page 84**

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FIGURE 7-3 Rocker arm shaft being removed from a Duramax V-8 diesel engine.



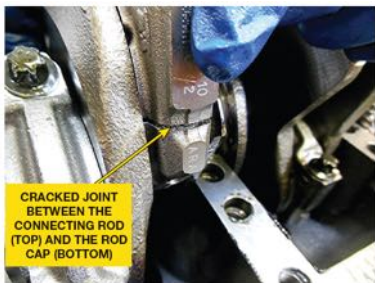
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FIGURE 7-4 Cylinder head bolts being loosened on a Cummins 6.7-liter diesel engine, starting at the ends of the head and working toward the center.



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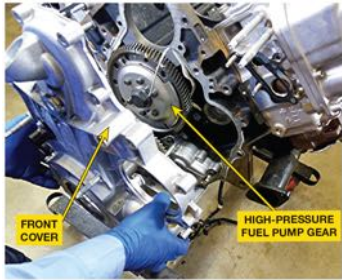
FIGURE 7-5 Removing the rod cap from a Fiat Chrysler 3.0 liter V-6 diesel engine shows that the rod uses a fracture rod cap design.



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ROTATING ENGINE ASSEMBLIES REMOVAL (1 of 1)

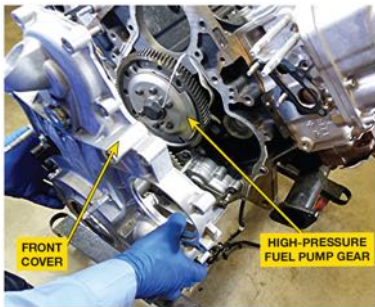
- Harmonic Balancer Removal
- Camshaft Removal
- Crankshaft and Main Bearing Removal
- Block Inspection



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FIGURE 7-6 front cover covering gears for camshaft and high-pressure pump is being removed from a Duramax diesel engine.



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FIGURE 7-7 Main bearing cap being removed from a Cummins 6.7-liter diesel engine. The caps are marked so there was no need to mark their location or direction.



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Mark it to Be Safe



TECH TIP

When you disassemble anything, it is always wise to mark location of parts, bolts, hoses, and other items that could be incorrectly assembled. Remember, the first part removed will be the last part that is assembled. If you think you will remember where everything goes—forget it! It just does not happen in the real world. One popular trick is to use correction fluid to mark location of parts before they are removed. Most of these products are alcohol or water based, dry quickly, and usually contain a brush in cap for easy use. Another way is to take a series of pictures as parts are removed.

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CYLINDER HEAD DISASSEMBLY (1 of 4)

• PROCEDURE

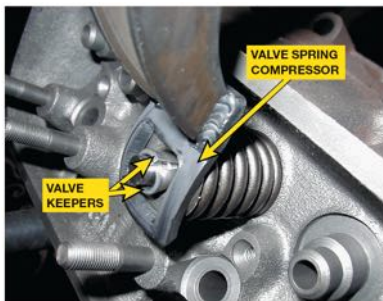
- After heads are removed
- Placed on bench, valves can be removed
- Procedure **Pages 85-86 of text**

• **CAUTION:** Always wear safety glasses when working on a cylinder head. Valve springs can release quickly, causing valve parts to fly.

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FIGURE 7-8 valve spring compressor is used to compress the valve spring before removing the keepers (locks).



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MECHANICAL CLEANING (1 of 4)

• Mechanical Cleaning Involves:

- Scraping
- Abrasive Brushing
- Abrasive Blasting
- ABRASIVE PADS/DISCS
 - White — finest grit size, used for cleaning aluminum parts.
 - Yellow —coarse grit, used on aluminum
 - Green — use on cast-iron components

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Use a Plastic Ice Scraper



TECH TIP

Using a steel scraper can damage aluminum head deck surfaces. To prevent damage, try using a file to sharpen a plastic ice scraper and then use this to scrape gaskets from aluminum engine parts. This method works very well and will not harm the Aluminum parts.

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FIGURE 7-9 Abrasive disc commonly called by its trade name, Scotch Brite™ pad.



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MECHANICAL CLEANING (2 of 4)

• Media Blasting

- Media blasting with baking soda is
- Cleaning method of choice
 - Baking soda (bicarbonate of soda)
 - Works well because it is
 - Nontoxic
 - Nonflammable
 - Nonhazardous
 - Environmentally safe

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FIGURE 7-10 Smaller engine parts can be blasted clean in a sealed cabinet.

- Some blasting done automatically in airless shot-blasting machine.
- Another method is to hard-blast parts in a sealed cabinet



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MECHANICAL CLEANING (3 of 4)

CAUTION: Glass beads often remain in internal passages of engine parts, can come loose and travel through the cylinders when engine is started. Among other places, these small, but destructive, beads can easily be trapped under oil baffles of rocker covers and in oil pans & piston ring grooves. To help prevent glass beads from sticking, be sure the parts being cleaned are free of grease and dirt, and completely dry.

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QUESTION 1: ?

What does mechanical cleaning involve?

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ANSWER 1:

Mechanical cleaning involves:
Scraping
Abrasive brushing
Abrasive blasting

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CHEMICAL CLEANERS (1 of 1)

- pH: **Page 87 of text**
- Solvent-based Cleaning **Page 87 of text**
- Water-based Chemical Cleaning

CAUTION: When cleaning aluminum cylinder heads, blocks, or other engine components, make sure that chemicals used are "aluminum safe." Always test solvent or cleaning chemical first by using a small aluminum part or scrap aluminum. Many chemicals that are not aluminum safe may turn aluminum metal black. Try explaining that to a customer!

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SPRAY & STEAM WASHING

- **Spray Washing**
 - Spray washing is faster than soaking
- **Steam Cleaning**
 - Steam vapor is mixed with high-pressure water and sprayed on the parts



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FIGURE 7–11 A pressure jet washer is similar to a large industrial-sized dishwasher. Each part is then rinsed with water to remove chemicals or debris that may remain there while it is still in the tank.



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THERMAL CLEANING

- **Text Pages 87-88**
 - Temperatures Involved
 - Advantages
 - Microbial Cleaning
 - Pyrolytic Oven



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FIGURE 7-12 A microbial cleaning tank uses microbes to clean grease and oil from parts.



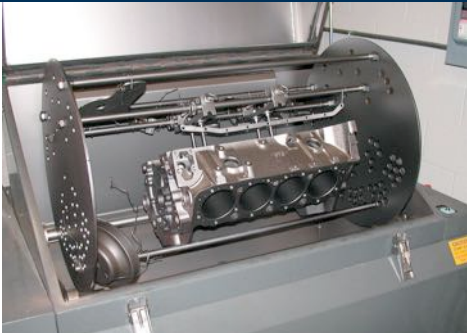
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FIGURE 7-13 (a) A pyrolytic (high-temperature) oven cleans by baking engine parts. After parts have been cleaned, they are then placed into an airless blaster. This unit uses a paddle to scoop stainless steel shot from a reservoir and forces it against the engine part. The parts must be free of grease and oil to function correctly.



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FIGURE 7-13 (b) This cleaned engine block has been baked and shot blasted.



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TANK & VAPOR CLEANING

- **Text Page 88-89**
 - Cold Tank Cleaning
 - Hot Tank Cleaning
 - Vapor Cleaning

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ULTRASONIC AND VIBRATORY CLEANING

- **Ultrasonic Cleaning**
 - To clean small parts that must be absolutely clean
- **Vibratory Cleaning**
 - Best on small parts
 - The movement of the vibrating solution and the scrubbing action of the media do an excellent job of cleaning metal.



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FIGURE 7-14 ultrasonic cleaner is used to clean fuel injectors.



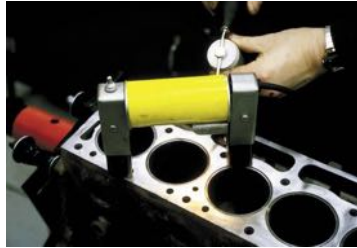
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CRACK DETECTION

• **Pages 90-91 of text**

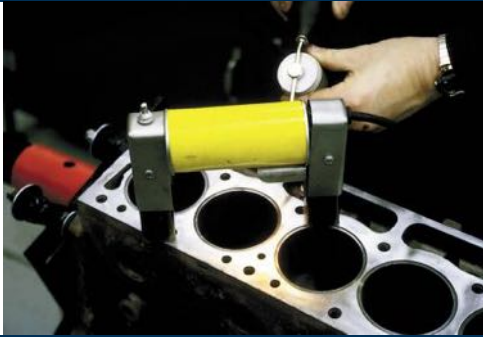
- Visual Inspection
- Magnetic Crack Detection
- Dye-penetrant Testing
- Fluorescent-penetrant Testing
- Pressure Testing



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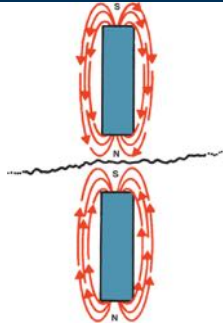
FIGURE 7-15 top deck surface of a block is being tested using magnetic crack inspection equipment.



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Figure 7-16 If the lines of force are interrupted by a break (crack) in the casting, then two magnetic fields are created and the powder will lodge in the crack.



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Figure 7-17 cylinder head is under water and being pressure tested using compressed air. Note that the air bubbles indicate a crack.



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QUESTION 2: ?

What methods are used for engine crack detection?

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ANSWER 2:

- Visual Inspection
- Magnetic Crack Detection
- Dye-penetrant Testing
- Fluorescent-penetrant Testing
- Pressure Testing

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Summary (1 of 3)

- Factory lifting hooks should be used when hoisting an engine.
- Cylinder heads should only be removed when the engine is cold. Also, always follow the torque table backwards, starting with highest-number head bolt and working toward the lowest number. This procedure helps prevent cylinder head warpage.
- Connecting rod and main bearing caps should be marked before being removed to ensure that they can be reinstalled in the exact same location when the engine is reassembled.
- The tip of the valve stem should be filed before removing valves from the cylinder head to help prevent damage to the valve guide.

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Summary (2 of 3)

- Mechanical cleaning with scrapers or wire brushes is used to remove deposits.
- Steel wire brushes should never be used to clean aluminum parts.
- Most chemical cleaners are strong soaps called caustic materials.
- Always use aluminum-safe chemicals when cleaning aluminum parts or components.
- Thermal cleaning is done in a pyrolytic oven in temperatures as high as 800°F (425°C) to turn grease and dirt into harmless ash deposits.

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Summary (3 of 3)

- Blasters use metal shot or glass beads to clean parts.
- All of the metal shot or glass beads must be thoroughly cleaned from the part so as not to cause engine problems.
- All parts should be checked for cracks using magnetic, dye-penetrant, fluorescent-penetrant, or pressure testing methods.

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