Vehicle engine overhauling

Level-III

Based on NOV 2016, Version 2 Occupational standard

Module Title: - Overhaul Engine and Its Associated Components

LG Code: EIS VEO3 M06 1220 (1-5) LG (22-26)

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Table of Contents

LG #22 LO #1- Prepare to carry out engine overhaul

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying and confirming nature and scope of the work requirements
- Observing OHS requirements and personal protection
- Observing applicable national environmental protection measures
- Identifying and supporting technical and tooling requirements for overhaul
- Cleaning engine prior to disassembling
- Dismantling engine in a logical sequence
- Completing dismantling of engine and relevant components without causing damage
- cleaning components ready for inspection

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify and confirm nature and scope of the work requirements
- Observe OHS requirements and personal protection
- Observe applicable national environmental protection measures
- Identify and support technical and tooling requirements for overhaul
- Clean engine prior to disassembling
- Dismantle engine in a logical sequence
- Complete dismantling of engine and relevant components without causing damage
- clean components ready for inspection

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
   Perform “the Learning activity performance test” which is placed following “Operation sheets”
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1	Identify and confirm nature and scope of the work

1. scope of the work

We have below guide for the scope of a general major overhaul. This will be tailored to suit your individual requirements and expectations.

- Main bearing alignment (auto log) before and after the overhaul.
- Cylinder heads to be overhauled.
- Rocker arms and bearings to be inspected.
- Cylinder liners to be measured and honed.
- Pistons to be inspected and measured. Reused with new piston rings if ok.
- Connecting rod big-end bearings to be measured and inspected by microscope.
- Connecting rod big-end to be measured and recorded for ovality.
- Connecting rod small-end bearings to be measured and reused if within tolerance.
- Main bearings to be measured and inspected by microscope, reused if ok.
- Fuel pumps to be overhauled.
- Fuel injectors to be overhauled.
- Inspection of operation gear for inlet valves, exhaust valves and fuel injection pumps.
- Camshaft bearings clearance to be measured and recorded.
- Check anti-vibration mountings.
- Charge air cooler to be dismantled and cleaned in ultrasonic cleaner.
- Engine sump drained and cleaned.
- Lubricating oil pump to be inspected and overhauled if found necessary.
- Cooling water pumps to be inspected and overhauled if found necessary.
- Governor replacement.
- TC cartridge and nozzle ring to be replaced with reconditioned.
- Engine performance reported after the overhaul.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (2pts)

1 What is the purpose of knowing scope cleaning?

A. To know the range
B. To identify starting and ending of the course
C. To improve life span
D. All except C

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided or on the separate answer sheet (2 pts)

1 Is Engine performance reported after the overhaul is in the range of the overhaul?

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____

1_____

Information Sheet-2 Observing OHS requirements and personal protection

1. Automobile Safety

1.1. What is Safety and Accidents?

- Safety is the state of being free from accidents or Safety means protecting yourself, colleagues, equipment and working environment from possible danger.
- Accidents that are caused by improper use of a machine or tool, by wearing inappropriate clothes, carelessness of the technician, etc.

1.2. Types of Safety:

- Work shop safety
- Personal safety
- Hand tool safety
- Engine and power tool safety

1.2.1 Automotive Maintenance Safety: Automobiles are big and heavy with lots of mechanical moving parts. In the right environment a vehicle can be maintained and repaired safely and effectively. However, in the wrong environment repairing a vehicle can be dangerous.

1.2.2 Basic Automobile Safety:

- Keep an emergency kit in your vehicle for roadside emergencies or repairs.
- Consult your vehicle owner's manual for specific safety rules regarding your vehicle.
- Keep an emergency response number handy and posted clearly where others can see it.

MOTION:

- When the forces on an object do not cancel each other out, they will change the object's speed or direction of motion, or both. The greater the object's mass, the greater the force must be to change its motion.
- When a force overcomes static inertia and moves an object, the object gains momentum. Momentum is the product of an object's weight and speed

2. Core OHS principles

Occupational safety and health is an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine – including physiology and toxicology – ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities. Despite this variety of concerns and interests, certain basic principles can be identified, including the following: -

- All workers have rights. Workers, as well as employers and governments, must ensure that these rights are protected and must strive to establish and maintain decent working conditions and a decent working environment.

  More specifically: -

  - ✓ Work should take place in a safe and healthy working environment;
  - ✓ Conditions of work should be consistent with workers' well-being and human dignity;
  - ✓ Work should offer real possibilities for personal achievement, self-fulfillment and service to society (ILO, 1984).
- Occupational safety and health policies must be established. Such policies must be implemented at both the national (governmental) and enterprise levels. They must be effectively communicated to all parties concerned.
- A national system for occupational safety and health must be established.

  Such a system must include all the mechanisms and elements necessary to build and maintain a preventive safety and health culture. The national system must be maintained, progressively developed and periodically reviewed.
- A national programmer on occupational safety and health must be formulated. Once formulated, it must be implemented, monitored, evaluated and periodically reviewed.
- Social partners (that is, employers and workers) and other stakeholders must be consulted. This should be done during formulation, implementation and review of all policies, systems and programmers.
- Occupational safety and health programmers and policies must aim at both prevention and protection. Efforts must be focused above all on primary prevention at the workplace

level. Workplaces and working environments should be planned and designed to be safe and healthy.

- Continuous improvement of occupational safety and health must be promoted. This is necessary to ensure that national laws, regulations and technical standards to prevent occupational injuries, diseases and deaths are adapted periodically to social, technical and scientific progress and other changes in the world of work. It is best done by the development and implementation of a national policy, national system and national programmer.
- Information is vital for the development and implementation of effective programmer and policies. The collection and dissemination of accurate information on hazards and hazardous materials, surveillance of workplaces, monitoring of compliance with policies and good practice, and other related activities are central to the establishment and enforcement of effective policies.
- Health promotion is a central element of occupational health practice. Efforts must be made to enhance workers' physical, mental and social well-being.
- Occupational health services covering all workers should be established.

  Ideally, all workers in all categories of economic activity should have access to such services, which aim to protect and promote workers' health and improve working conditions.
- Compensation, rehabilitation and curative services must be made available to workers who suffer occupational injuries, accidents and work-related diseases. Action must be taken to minimize the consequences of occupational hazards.

Self-Check 2	Written Test

Instruction I: - chose and write the letter of the correct answer On the space provided below (2 pts each)

1. What is the purpose of component parts cleaning?
   A. To make suit on service
   B. To identify defective area on parts
   C. To improve life span
   D. All of the above
2. What are the hazards in the work place?
   A. Faulty work habit
   B. Misuses of hand tools
   C. Misuses of equipment
   D. All of the above
3. Which of the following is **correct** about fire prevention in the workplace?
   A. Store fuel properly
   B. Keep the shop doors open
   C. Do not smoke in the workplace
   D. All
   E. All except B
4. What do you mean, misuses of hand tools?
   A. Keeping hand tools in dirty and poor condition
   B. Keeping sharp tools in the pocket
   C. Avoid defective hand tools
   D. All of the above
   E. All except C

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet-3	Observe applicable national environmental protection measures

1. Environmental aspects of the automotive industry

Protection of the environment and improvement of air quality is an important objective of the European Commission. In the automotive industry, EU legislation and standards aim to reduce the emission of CO2, NO2 and particulate matter. The Commission also works on noise reduction and the elimination of fluorinated greenhouse gases used in mobile air-conditioning systems.

2. Emissions

Road transport is a major source of greenhouse gas emissions, producing around 15% of the EU's CO2emissions. The Commission focuses on the reduction of emissions from the following vehicle categories in particular:

- light-duty vehicles (cars and vans)
- heavy duty vehicles (coaches, buses, trucks)
- non-road mobile machinery (excavators, bulldozers, front loaders)

Binding emission limits were already introduced for light and heavy-duty vehicles. Environmental requirements for agricultural and forestry tractors, and two or three-wheeled vehicles will be included in future regulations. More on emissions.

3. Noise reduction

Reducing the noise of vehicles is another priority for the Commission. The new Regulation adopted in 2014 will significantly contribute to reducing vehicle noise. More on noise.

4. the environmental factors that affect the automobile industry

The term "environmental factors" refers to elements outside the industry which nonetheless are crucial to the profitability of the industry.

First, the automobile industry is dependent on massive infrastructure, including investment in roads and the existence of a network of fuel stations. If countries decide to invest more in public transit and disinvest in road networks, then people will buy fewer cars.

Next, the most profitable cars tend to be inefficient, large luxury vehicles. Sales of these types of cars are highly dependent on fuel prices. When fuel prices skyrocket, the desire for fuel-inefficient cars decreases dramatically.

Also, the general business environment affects car sales. Rises in interest rates or economic downturns can reduce sales. Currency fluctuations can also affect costs and sales.

Additionally, car companies have attempted to reduce the cost of labor and manufacturing through the use of global supply chains. However, these supply chains leave companies vulnerable to rising wages in the developing world, political unrest, tariffs, and fluctuations in global shipping costs.

Finally, car companies are vulnerable to lifestyle changes, including the sharing economy, which leads to people buying fewer cars. There seems to be a generational shift in progress, in which people are foregoing car ownership and are instead using forms of technologically mediated on-demand access to transportation, such as ride-sharing apps.

Self-Check 3	**Written Test**

Instruction: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (2 pts)

1. what are the environmental factors that affect the automobile industry?

A. buy fewer cars
B. costs and sales.
C. fluctuations in global shipping costs.
D. All of the above

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____

Information Sheet-4 Identify and apply tools, equipment and safety

1. General safety

Safety in automotive work shop is every one responsibility. It means protecting yourself and others from injuries at all time. Working in automotive work shop requires the use of a variety of tools and equipment that can injure others if not handled properly.

The most common injuries are to the hands and fingers. Using the correct tools is an important way to avoid injuries.

1.1. Housekeeping

A clean, well-ordered, attractive work environment sets the tone of your establishment. It encourages tidy work habits in employees. It helps reduce fatigue. It promotes good worker-management relations. It also gives a lift to morale, which is reflected in the quality of production and overall efficiency. Good housekeeping is also a good advertisement for your company. Customers and clients have more confidence in an organization when they we work being carried out efficiently in clean, pleasant, well ordered surroundings. There's an even more important reason why good housekeeping matters — it makes the undertaking a safer place to work in.

1.2. Safety and Safety of Equipment

No matter how small the job, safety must be practiced at all times. A tool may be efficient, essential, time-saving or even convenient; but it is also dangerous.

When using any hand tool you must use it correctly, following the methods prescribed in this manual. You must also be alert for any conditions that might endanger yourself or fellow workers.

Take the time necessary to acquaint yourself with the safety guidelines in this information material. Remember, you are the most important part of safety procedures.

2. Identified and selected tools and equipment

Professional auto technicians invest thousands of dollars (birr) on tools, and for good reason. It is almost impossible to do even the simplest auto repair without using some type of tool. Tools serve as extensions to parts of the human body. They increase the physical

abilities of fingers, hands, arms, legs, eyes, ears, and back. A well-selected set of tools speeds up repairs, improves work quality, and increases profits.

Keep tools organized a technician has hundreds of different tools. For the tools to be located quickly, they should be neatly arranged. There should be a place for every tool, and every tool should be in its place. If tools are just thrown into the toolbox, time and effort are wasted "digging and searching" instead of fixing the vehicle. Keep tools clean—Wipe tools clean and dry after each use. A greasy or oily tool can be dangerous! It is very easy to lose a grip on a dirty tool, cutting or breaking a finger or hand.

Use the right tool for the job—Even though several different tools may be used to loosen a bolt, usually one will do a better job.

- **Hand tools**
  - Such as; open-end Wrench, Box-end Wrench/Spanner, Combination Wrench and Ferrule Nut/Flare Nut Wrenches
- **Screwdrivers**
- **Pliers**
- **Hammer**
- **Cleaning tools/equipment**
  - Such as; Wire brush, Scrapper, Putty knives and Washing gun
- **Power Tools**
  - Such as; Pneumatic wrench, Pneumatic hammer, Pneumatic chisel, Electrical drill and Bench grinder.
- **Special tool**
    - Pullers Bearing, splitters and magnetic pick up tools

3. SAFE REPAIR AND MAINTENANCE OF ENGINES

Several types of injury risks are associated with repairing and maintaining small engines. Types of injury risks include inhalation of toxic fumes, hand

and finger fractures, cuts, and bruises from mechanical impacts, back injuries from improper lifting technique or lifting excessive weight, entanglement injuries from rotating parts, burns from contact with hot surfaces, and electrical shocks from energized systems or components.

Most injuries experienced during small engine repair or maintenance are avoidable and frequently due to the mechanic's inexperience or improper or inattentive work practices.

4. Safe Work Practices for the Repair and Maintenance of Engines

- Thoroughly review and understand information provided in the small engine operator's manual with particular attention given to descriptions of safety procedures.
- Never wear a tie, loose clothing, jewelry, or earphones when performing repair or maintenance on a small engine. Tie long hair back or secure under a cap.
- Only use the proper tools for the type of small engine repair or maintenance task.
- Drain the fuel before performing mechanical work indoors.
- Use gasoline-resistant gloves, such as nitrile, polyurethane, Viton, or chlorinated polyethylene, and wear safety glasses when handling gasoline to prevent skin and eye exposure to gasoline.
- Regularly inspect small engine fuel lines and fittings and fuel tank and cap for cracks or leaks.
- Disconnect the spark plug wire and remove the spark plug before initiating small engine repair or maintenance work. Use an approved spark plug tester when checking the spark.
- For a small engine with an electric start, disconnect the battery before beginning the repair or maintenance task.
- To hand start a small engine, pull the starter cord back slowly until resistance is encountered. Then pull the cord rapidly to start the small engine.
- Use hearing protection whenever a small engine is running.
- Always operate small engines with all guards in place. Be particularly aware of rotating parts.
- Do not start or run a small engine in an enclosed space. Breathing engine exhaust can be deadly.
- Never refuel a small engine when the engine or other parts such as the muffler are hot.
- Use a rag to wipe off fuel spills or rinse fuel spills off with water before starting a small engine.
- Never dump used oil on the ground or pour down any drain. Properly dispose of used engine oil at a recycling facility.

- Store gasoline in an approved red container that has a spark arrester cap. Do not store gasoline in an enclosed space where vapors could accumulate.
- If you suffer an injury while performing small engine repair or maintenance, tell your group leader, parent, or guardian. Seek medical attention if the injury is serious.
- When finished with the repair or maintenance of a small engine, put all tools away and clean the work area.
- Always wash your hands with soap and water after completing the small engine repair or maintenance task.

Self-Check 4	Written Test

Instruction I: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (__ pts)

1. Which one of the following is not power tool?
    a. Pneumatic hammer,
    b. Pneumatic chisel,
    c. Electrical drill
    d. Hammer
2. Which one of the following is not hand tool?
    a. Screw driver,
    b. Combination plyer,
    c. Electrical drill
    d. Hammer

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet- 5 Cleaning engine prior to disassembling

1. Engine Cleaning

- Now that all openings are covered, the second procedure is to clean the engine thoroughly to prevent foreign matter from entering the engine and causing internal damage during disassembly.
- First, take a high-pressure cleaning unit and steam clean the entire outer surface of the engine.
- If a cleaning unit is not available, use a high-pressure water hose to remove the dirt and loose matter.
- Next, with cleaning solvent and a stiff brush, remove any grease or oil that may be on the engine.
- The third procedure is to drain the engine. Using two separate containers, one for oil and the other for the coolant, remove the oil pan drain plug and open the cylinder block drain cock and drain the engine completely (Fig 4-2).
- While the engine is draining, you might use this time to make sure that your working area is thoroughly clean to prevent any chance of getting the internal parts of the engine contaminated with dirt.

Figure 1 Drain the engine.

- With the engine thoroughly cleaned and drained, the fourth procedure is to conduct a good visual inspection of its outer surfaces for cracks and broken parts as you begin removing the accessories.
- If these conditions exist, you must get a decision from a machinist on the feasibility of repairing the defects.

- New or rebuilt parts are of no value if the engine block is damaged beyond repair.
- At this point, you are ready to disassemble the engine. Mount the engine on the repair stand and begin the actual disassembly.
- Remember to lay the parts out in an orderly manner as you disassemble the engine. Doing so will make assembly easier.
- Note: The removal and installation of the intake and exhaust manifolds are not covered in this course. It is essential, however, that these components be inspected and properly aligned for the engine to operate correctly.
- As you disassemble the engine, check each part to make sure it can be used in the repair of the engine.
- If you wait until reassembly, it will cause extra work and unnecessary time if you have to remove a part you earlier assumed was good without checking.
- The three most common cylinder head engine types will be taught. Let's begin with the L-head engine.
- Removing cylinder head requires a little more effort. First, remove the rocker arm cover and discard the gasket and retaining seals. At this time, check the retainer seal surface of the cover for dents. Check for any other dents. Some mechanics have a tendency to over-torque the retaining nuts and bolts; this bends the retainer seal surface of the cover. If a dent exists, you may straighten it at this time or record the defect so that it is not forgotten
- With the cover removed, back off (loosen) the valve adjustment at least one complete turn to relieve the pressure on the rocker arms If the pressure is not relieved, damage to the rocker arm shaft could result when it is being removed.
- The removal of the cylinder head from an L-head engine is very simple. Remove the cylinder head bolts from the head, lift the cylinder head from the engine, and lay it flat on a flat surface.
- To stand it on end or lean it against another object would result in the head warping which in many cases could require repairs that would not have been necessary. At this time, also remove the cylinder head gasket, inspect it for signs of leakage, and discard it. Any signs of leakage should be recorded so that you may concentrate on the cause during your cylinder head and cylinder block gasket surface inspection

- When the pressure is relieved, remove the rocker arm attaching bolts and nuts and lift the rocker arm shaft from the engine. If the engine does not have a rocker arm shaft, simply remove the rocker arm.
- To prevent damage to the pushrods when the cylinder head is removed, take them out of their holes (before removing the cylinder head) and lay them in order on your workbench or in the area you are storing the parts you have removed. You might as well take this opportunity to ensure that all the pushrods are perfectly straight. A bent rod will continue to bend when reinstalled in the engine. Discard any bent rods and make a note of the holes from which they were removed.
- Now, loosen the cylinder head bolts, lift the head from the engine, and lay it on a flat surface.

2. Cleaning and inspecting of component

The first engine component removed is the cylinder head assembly, but before any disassembly is started, you must prepare the engine. A good repair or rebuild job begins with engine preparation. Without good preparation, you may not only fail to locate unknown defects, but you may also cause further damage.

3. Safety for disassembling components

a. Before disassembling engine, place it on ST3.
b. All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
c. Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
d. Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
e. All removed parts, if to be reused, should be reinstalled in the original positions and directions.
f. Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
g. Bolts, nuts and washers should be replaced with new ones as required.
h. Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.

4. Required Tools

Have the necessary tools for this DIY project lined up before you start—you'll save time and frustration.

- Air compressor
- Air hose
- Drip pan
- Flashlight
- Knee pads
- Nylon brush
- Wire brush

5. Engine Preparation

- With the engine removed from the vehicle, you can begin your preparation.
- The first procedure is to cover all openings of the engine with clean, lint free rags indicating typical openings to be covered.
- Now imagine yourself as a surgeon and the engine as your patient.
- If foreign matter enters your patient's body, infection may result, and your operation could be a failure.

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (2 pts each)

5. What is the purpose of component parts cleaning?
   a. To make suit on service
   b. To identify defective area on parts
   c. To improve life span
   d. All of the above
6. What are the hazards in the work place?

A. Faulty work habit
B. Misuses of hand tools
C. Misuses of equipment
D. All of the above

7. Which of the following is **correct** about fire prevention in the workplace?
   A. Store fuel properly
   B. Keep the shop doors open
   C. Do not smoke in the workplace
   D. All
   F. All except B
8. What do you means, misuses of hand tools
   A. Keeping hand tools in dirty and poor condition
   B. Keeping sharp tools in the pocket
   C. Avoid defective hand tools
   D. All of the above
   E. All except C

Short answers

1) Write three main cause of hazard in the work place
2) List at least four purpose of engine cleaning
3) Write three main cause of hazard in the work place
4) Why you prepare engine for overhauling
5) Why you follow safety precaution for engine components

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Choices

1 _____ **2** _____ **3** _____ **4** _____ **5** _____

Short Answer Questions

1. _____

Information sheet – 7 Completing dismantling of engine and relevant components without causing damage

1. Engine overhaul – preliminary information

It is much easier to dismantle and work on the engine if it is mounted on a portable engine stand. These stands can often be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel/drive plate should be removed so that the stand bolt scan be tightened into the end of the cylinder block/crankcase. If a stand is not available, it is possible to dismantle the engine with it suitably supported on a sturdy, workbench or on the floor. Be careful not to tip or drop the engine when working without a stand .If you intend to obtain a reconditioned engine, all ancillaries must be removed first, to be transferred to the replacement engine (just as they will if you are doing a complete engine overhaul yourself). These components include the following:

a. Alternator mounting brackets.
b. Engine mountings and brackets
c. The ignition system and HT components including all sensors, distributor cap and rotor arm, ignition module, HT leads and spark plugs.
d. Power steering pump and air conditioning compressor brackets (where fitted).
e. Thermostat and housing, coolant pump, coolant outlet chamber/elbow.
f. Dipstick tube.
g. Carburetor/fuel system components.
h. All electrical switches and sensors.
i. Inlet and exhaust manifolds.
j. Oil filter
k. Fuel pump - carburetor engines only.
l. Flywheel/drive plate.

Note: When removing the external components from the engine, pay close attention to details that may be helpful or important during refitting. Note the fitting positions of gaskets, seals, washers, bolts and other small items.

If you are obtaining a “short” engine (cylinder block/crankcase, crankshaft, pistons and connecting rods all assembled), then the cylinder head, timing chain/belt (together with

tensioner, tensioner and idler pulleys and covers) sump and oil pump will have to be removed also. If a complete overhaul is planned, the engine can be dismantled in the order given below.

a. Inlet and exhaust manifolds.
b. Timing chain, sprockets, tensioner and oil pump.
c. Timing belt, sprockets and tensioner.
d. Cylinder head.
e. Flywheel/drive plate.
f. Sump.
g. Oil pump .
h. Piston/connecting rod assemblies.
i. Crankshaft.

Self-Check 7	Written Test

Instruction: - chose and write the letter of the correct answer on the space provided below (2 pts each)

1. What is the purpose of component parts cleaning?
   A. To make suit on service
   B. To identify defective area on parts
   C. To improve life span
   D. All of the above
2. What are the hazards in the work place?
   A. Faulty work habit
   B. Misuses of hand tools
   C. Misuses of equipment
   D. All of the above
3. Which of the following is **correct** about fire prevention in the workplace?
   A. Store fuel properly
   B. Keep the shop doors open

C. Do not smoke in the workplace

D. All

E. All except B

4. What do you mean, misuses of hand tools?

A. Keeping hand tools in dirty and poor condition

B. Keeping sharp tools in the pocket

C. Avoid defective hand tools

D. All of the above

E. All except C

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choices

1 _____ **2** _____ **3** _____ **4.**_____

Operation Sheet-1 Dismantling Procedure

1. Dismantling Procedure

1.1. Remove Engine systems

A. Remove Engine Fuel System

B. Remove Engine Cooling System

C. Remove Engine Lubrication System

D. Remove Engine Exhaust System

E. Remove Engine Ignition System

F. Remove Engine Starting System

G. Remove Engine Charging System

H. Remove Engine Wire harness

I. Remove Engine Air intake system

J. Remove Engine Front end component

1.2. Remove Engine from the vehicle

. N. B before start to remove the engine from the vehicle, refer manufacturer's specification. Consider workshop and personal safety procedures Necessary tools and equipment's are selected and organized according to work procedures.

1.2.1. Materials Needed

- Small trolley jack
- Wheels, blocks
- Different types of hand tools
- hydraulic crane
- Chain sling or chain block

1.3. Removal Procedure

a. Secure all wheels with appropriate wheel blocks

b. Disconnect the grounding strap from battery.
c. Drain engine coolant
d. Drain engine oil
e. Remove the alternator/generator wires
f. Disconnect and tag the wiring harness in the engine ignition coil, idle cut-off solenoid, automatic choke, backup lights, oil pressure, etc.
g. Remove engine front parts (radiator, radiator hose cooling fan, etc.).
h. Remove the air cleaner and any emissions hoses
i. Disconnect the throttle linkage, fuel line, and vacuum hoses from carburetor or fuel injection system
j. Depending on the type of engine remove intake and exhaust manifolds
k. Using hydraulic crane and chain sling, hung up the engine.
l. Carefully look around the engine for un detached engine attachments
m. Identify engine fixing bolts and loosen it carefully.
n. Lift the slightly engine up and pull it forward and the take it off the vehicle.

1.4. Dismantle engine on bench

If you are planning a complete overhaul, the engine can be dismantled and the internal components removed in the following order.

- ✓ Inlet and exhaust manifolds.
- ✓ Timing belt, toothed pulleys and tensioner, and timing belt inner cover
- ✓ Cylinder head
- ✓ Removing Cylinder Head

1.4.1. Cylinder head is removed for;

- ✓ valve refinishing
- ✓ Leaking head gasket
- ✓ For resurfacing
- ✓ For gasket replacement
- ✓ For timing chain or timing belt service

N.B While removing cylinder head, consider workshop and personal safety procedures.

Careful: Never remove a cylinder head from a hot engine. Wait until the engines cools. If the head is removed hot, it can warp so that it cannot be used again. Follow the manufacturers or general instruction to remove the cylinder head.

- ✓ Slightly loosen all cylinder head bolts in the sequence shown below to ease the tension on the head.
- ✓ Loosen it completely in 2 to 3 steps
- ✓ If the head sticks, carefully pry to remove
- ✓ Do not insert the pry bar too far between the head and block. This could ruin the mating surfaces and lead to leaks.
- ✓ Lift the head off and place it in a head–holding fixture.
- ✓ As you remove the head, examine the gasket, and mating surface for traces of leakage or cracks

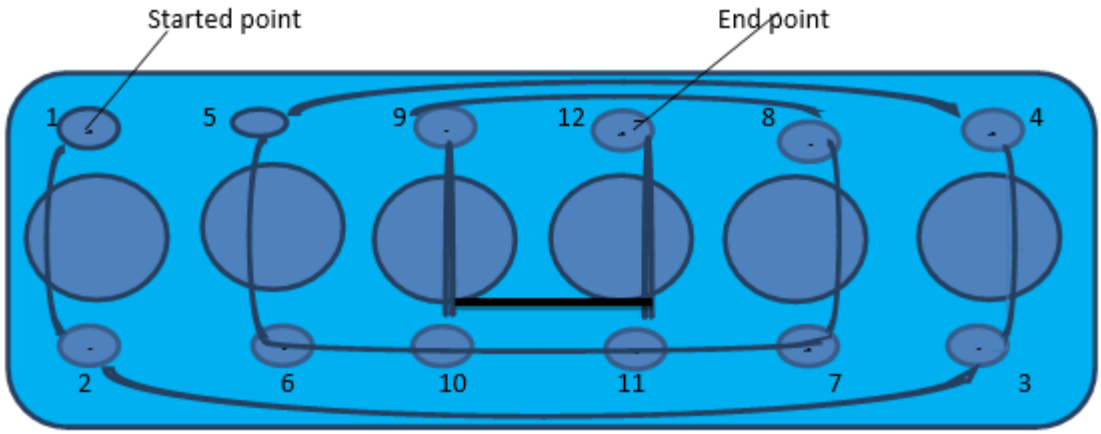


Figure 2 cylinder head bolt loosening procidure

1.4.2. Flywheel/drive plate

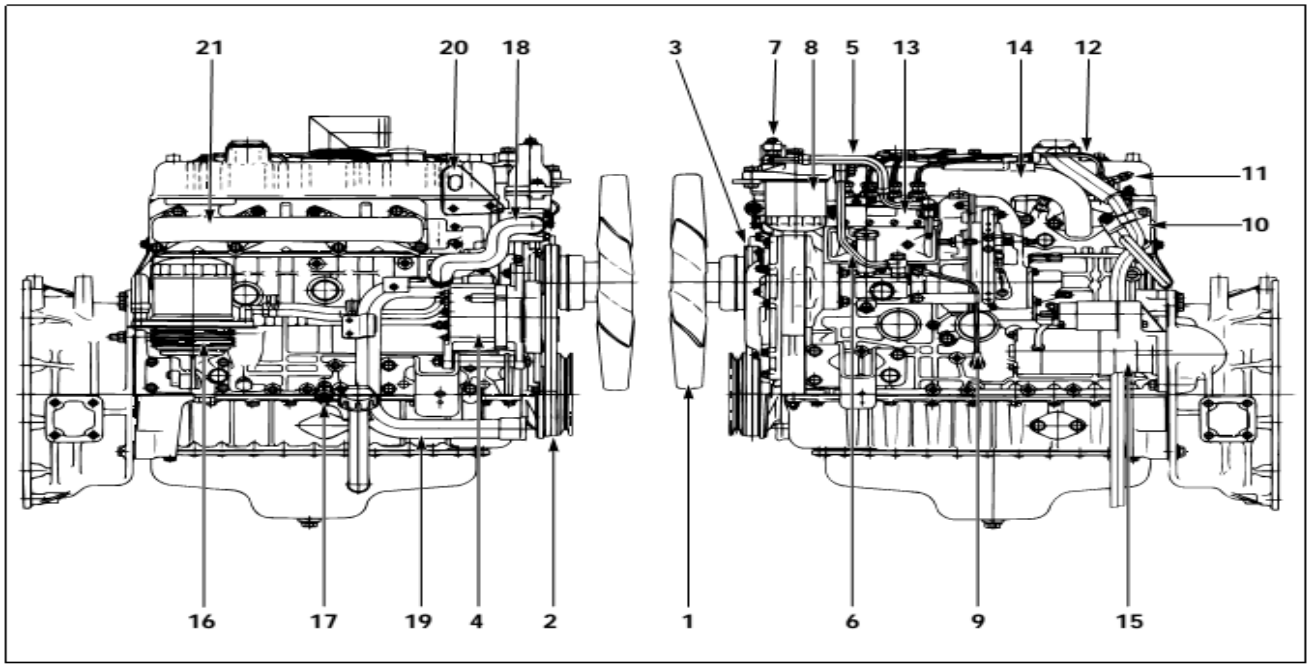
1.4.3. Oil Sump

1.4.4. Oil pump Piston/connecting rod assemblies

1.4.5. Crankshaft

1.5. Cleaning cylinder head, valves and valve springs

- ➢ Remove carbon deposit from cylinder head combustion chamber, valve seats and necks of valves
- ➢ Remove sticky head gasket from head face carefully.



Disassembly Steps - 1

1. Cooling fan and spacer
2. Cooling fan drive belt
3. Cooling fan drive pulley
4. Alternator and adjusting plate
5. Fuel pipe (Fuel filter to injection pump)
6. Fuel pipe (Fuel filter to feed pump)
7. Fuel pipe (Fuel filter leak off)
8. Fuel filter
9. Oil pipe (Injection pump to cylinder body)
10. Rear engine hanger
11. Fuel leak off pipe
▲ 12. Fuel injection pipe with clip
▲ 13. Injection pump
14. Intake manifold
15. Starter
16. Oil filter
17. Oil pressure switch
18. Cooling water rubber hose
19. Cooling water intake pipe
20. Front engine hanger
▲ 21. Exhaust manifold

Figure 3 sectioned view of the engine

2. General

A. The procedure outlined in this section covers dismantling of the engine into its major component parts, or subassemblies, and cleaning of these items.

B. For complete disassembling and reconditioning of the engine a number of special tools are necessary.

C. As parts or sub-assemblies are removed from the engine, they should be placed on a portable rack preparatory to being cleaned. Small boxes, tins or other receptacles should be provided in which bolts nuts, washers and other small parts can be placed as they are removed.

D. As each part or sub-assembly is removed from the engine, it should be inspected carefully before cleaning to note any unusual conditions such as sludge deposits or the collection of metallic chips. Samples of the sludge or chips, if present, should be retained for later analysis. In addition, during the various stages of dismantling, close observation must be made of all parts or components for signs of scoring or burning due to undue friction, as it often happens that many valuable indications of defects can be obtained when the oil or the loosened surface of metal is present to indicate them, rather than after all parts have been washed and laid out for examination. The sub-assemblies should be checked for the freedom of movement of all gears, shafts or bearings. After the preliminary inspection all components and sub-assemblies should be thoroughly cleaned.

E. The threads on the front end of the crankshaft should, whenever possible, be covered with a suitable thread protecting cap.

Operation Sheet-2 Safety for disassembling components and Ready engine Components for inspection

1. CLEANING ENGINES BEFORE DISASSEMBLY

A good cleaning job can be done by using the following procedure before disassembly:

- Drain oil out of crankcase.
- If equipped with oil filter, remove cartridge and replace top of filter. If engine has "throw-away" type filter, install new filter. DO NOT USE OLD FILTER.
- Replace oil pan drain plug.
- Pour into crankcase 2 quarts SAE 20 oil and 2 quarts Casita Tune-Up.
- Start engine and let idle, for 30 minutes at 600 to 800 RPM. Drain oil-Casita mixture and clean out oil filter. If equipped with "throw-away" filter, remove filter.
- Proceed with normal overhaul.
- Install new oil filter cartridge.

After the engine has been overhauled, the oil and oil filter cartridge should be changed at about 500 miles to remove any other sludge and abrasives in the engine.

LAP Test	Practical Demonstration

Name: _____ **Date:** _____

Time started: _____ **Time finished:** _____

1 Prepare and Use proper tools to remove the engine from the vehicle
2 Drain engine oil in proper procedure
3 Drain coolant from the radiator
4 Identify engine system components carefully.
5 Remove Engine from the vehicle.
6 Dismantle engine on bench
7 remove Cylinder head

LG #23	LO #2- Overhauling engine components

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Accessing and interpreting information
- Analyzing engine failure using appropriate tools and equipment
- Measuring and comparing components against manufacturer specifications
- Making decisions to serviceability and repair method
- Ordering/sourcing replacement parts
- Carrying out rebuild or replacement of engine components
- Carrying out overhaul activities

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Access and interpreting information
- Analyze engine failure using appropriate tools and equipment
- Measure and comparing components against manufacturer specifications
- Making decisions to serviceability and repair method
- Ordering/sourcing replacement parts
- Carry out rebuild or replacement of engine components
- Carry out overhaul activities

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets

7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1 Accessing and interpreting information

1. Interpret Information

The information given ranges from advice concerning preparation for an overhaul and the purchase of replacement parts, to detailed step-by-step procedures covering removal, inspection, renovation and refitting of engine internal components

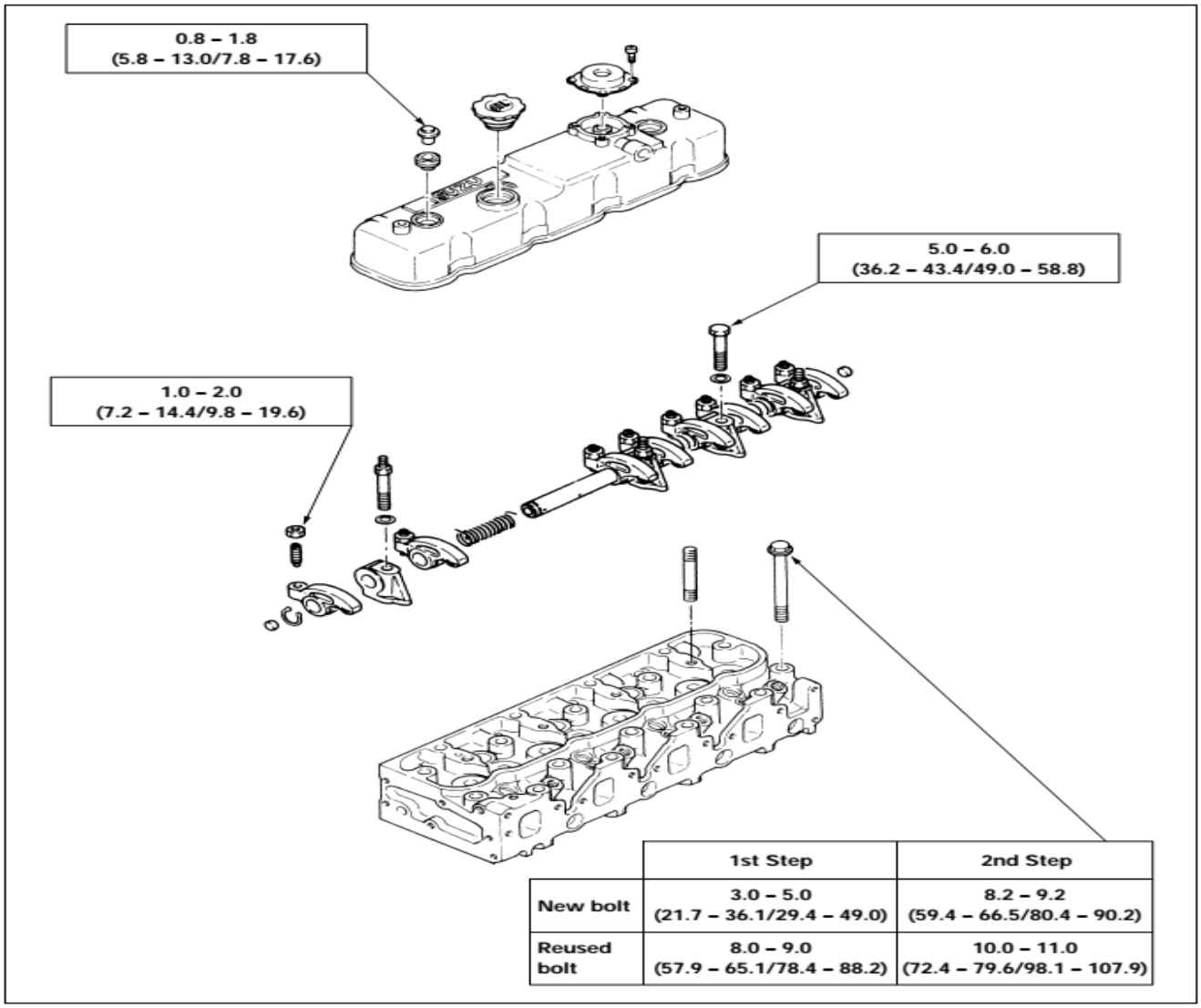
Plan the operation ahead of time. Before starting work, obtain (or arrange for the hire of) all of the tools and equipment you will need. Access to the following items will allow the task of removing and refitting the engine/transmission to be completed safely and with relative ease: an engine hoist – rated in excess of the combined weight of the engine/transmission, a heavy-duty trolley jack, complete sets of spanners and sockets as described at the rear this manual, wooden blocks, and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and fuel. A selection of different sized plastic storage bins will also prove useful for keeping dismantled components grouped together. If any of the equipment must be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand; this may save you time and money.

Plan on the vehicle being out of use for quite, while especially if you intend to carry out an engine overhaul. Read through the whole of this section and work out a strategy based on your own experience and the tools, time and workspace available to you. Some of the overhaul processes may have to be carried out by a Peugeot dealer or an engineering works - these establishments often have busy schedules, so it would be prudent to consult them before removing or dismantling the engine, to get an idea of the amount of time required to carry out the work.

It is much easier to dismantle and work on the engine if it is mounted on a portable engine stand. These stands can often be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel/drive plate should be removed so that the stand bolts can be tightened into the end of the cylinder block/crankcase.

If a stand is not available, it is possible to dismantle the engine with it suitably supported on a sturdy, workbench or on the floor. Be careful not to tip or drop the engine when working without a stand. If you intend to obtain a reconditioned engine, all ancillaries must be removed first, to be transferred to the replacement engine (just as they will if you are doing a complete engine overhaul yourself).

PART-CYLINDER HEAD



	1st Step	2nd Step
New bolt	3.0 – 5.0 (21.7 – 36.1/29.4 – 49.0)	8.2 – 9.2 (59.4 – 66.5/80.4 – 90.2)
Reused bolt	8.0 – 9.0 (57.9 – 65.1/78.4 – 88.2)	10.0 – 11.0 (72.4 – 79.6/98.1 – 107.9)

Figure 4 overhauling parts of the engine

PART-BLOCK

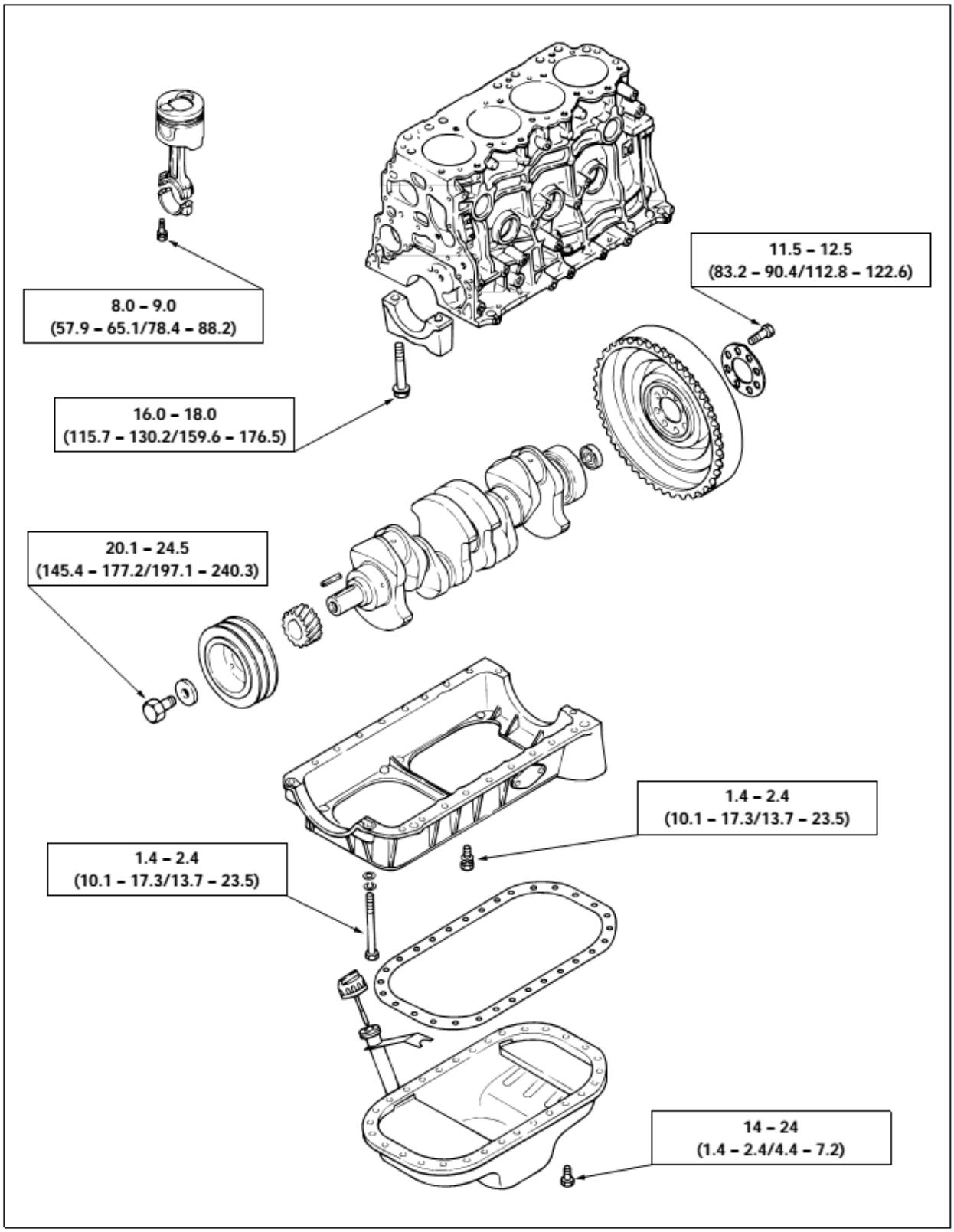


Figure 5 Figure 1 overhauling sump of the engine

PART-TIMING

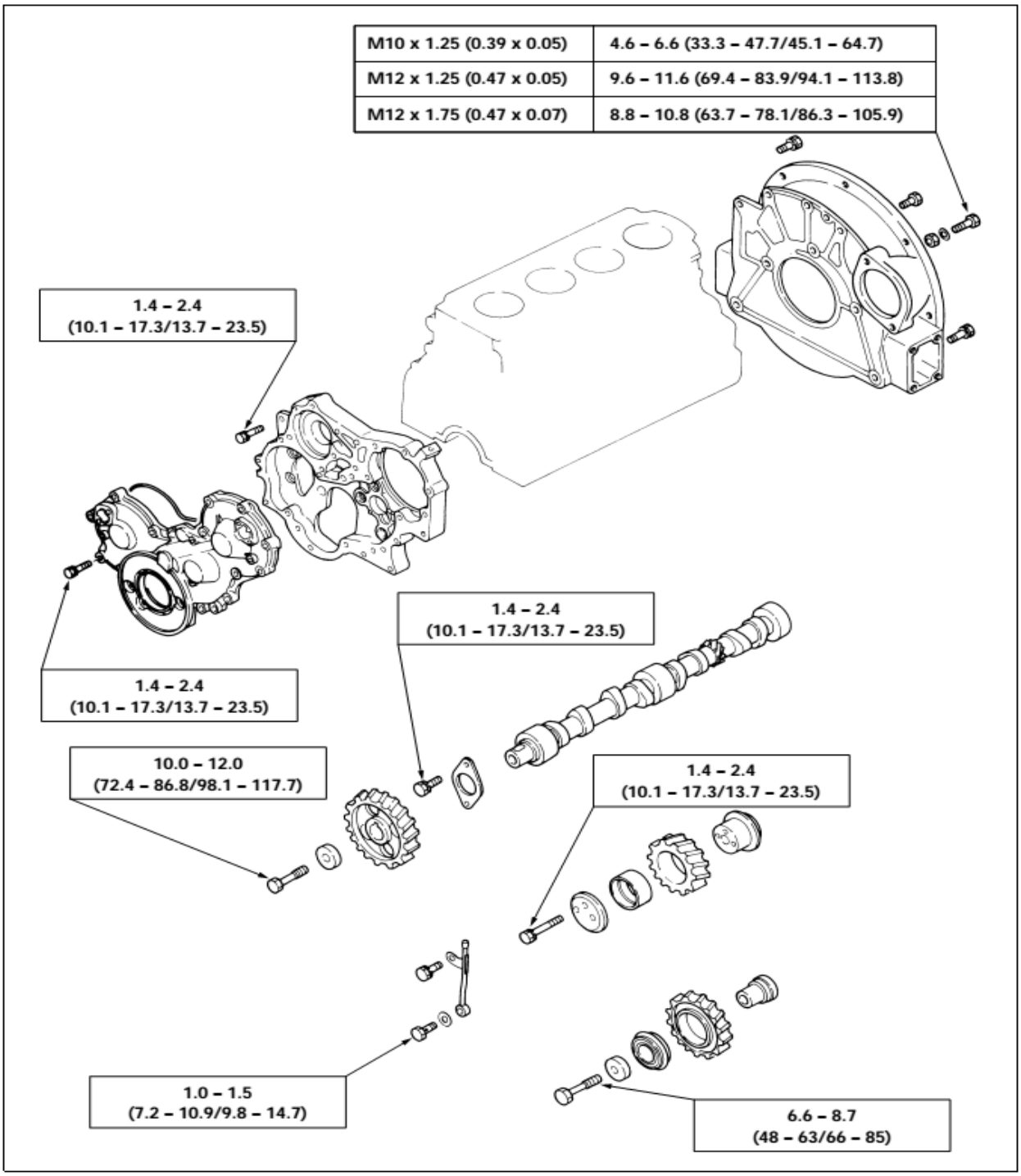
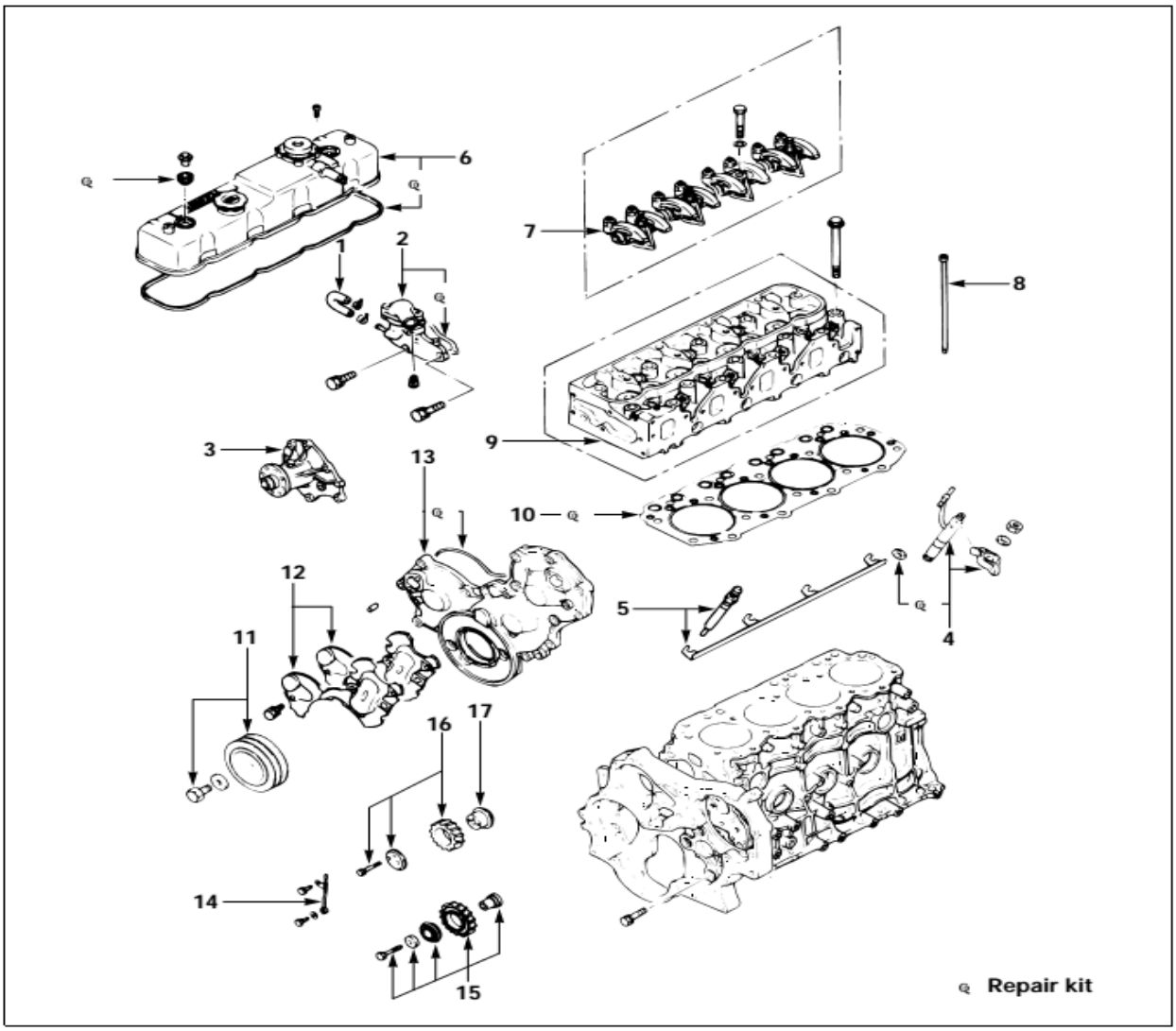


Figure 6 overhauling front and rear part of the engine

DISASSEMBLE-1

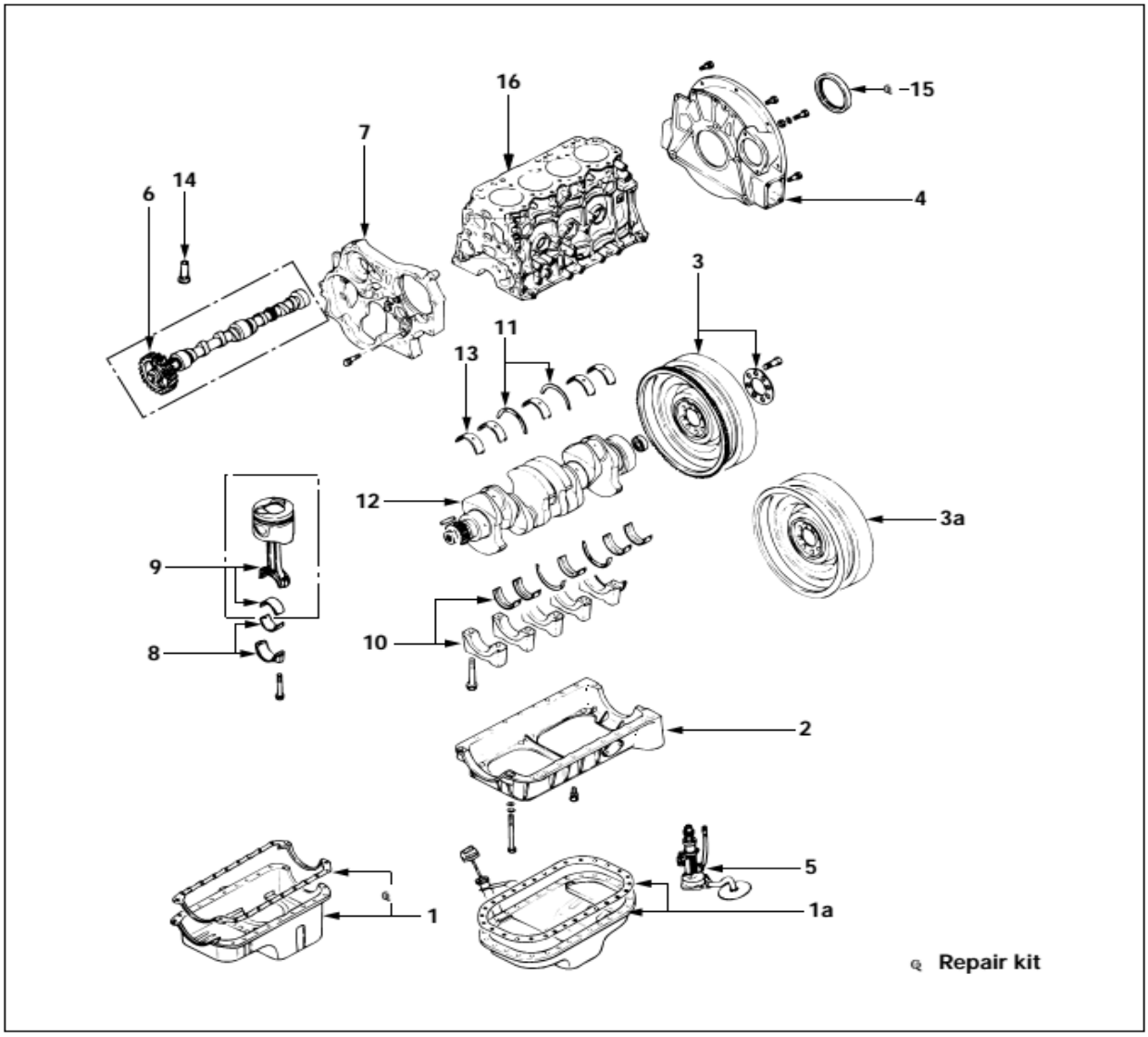


Disassembly Steps - 2

1. Water by-pass hose
2. Thermostat housing
3. Water pump
▲ 4. Injection nozzle holder
5. Glow plug and glow plug connector
6. Cylinder head cover
▲ 7. Rocker arm shaft and rocker arm
8. Push rod
▲ 9. Cylinder head
10. Cylinder head gasket
▲ 11. Crankshaft damper pulley with dust seal
12. Timing gear case cover
13. Timing gear cover
14. Timing gear oil pipe
15. Idler gear "B" and shaft
▲ 16. Idler gear "A"
17. Idler gear shaft

Figure 7 overhauling of cylinder block accessories engine

DISASSEMBLE-3

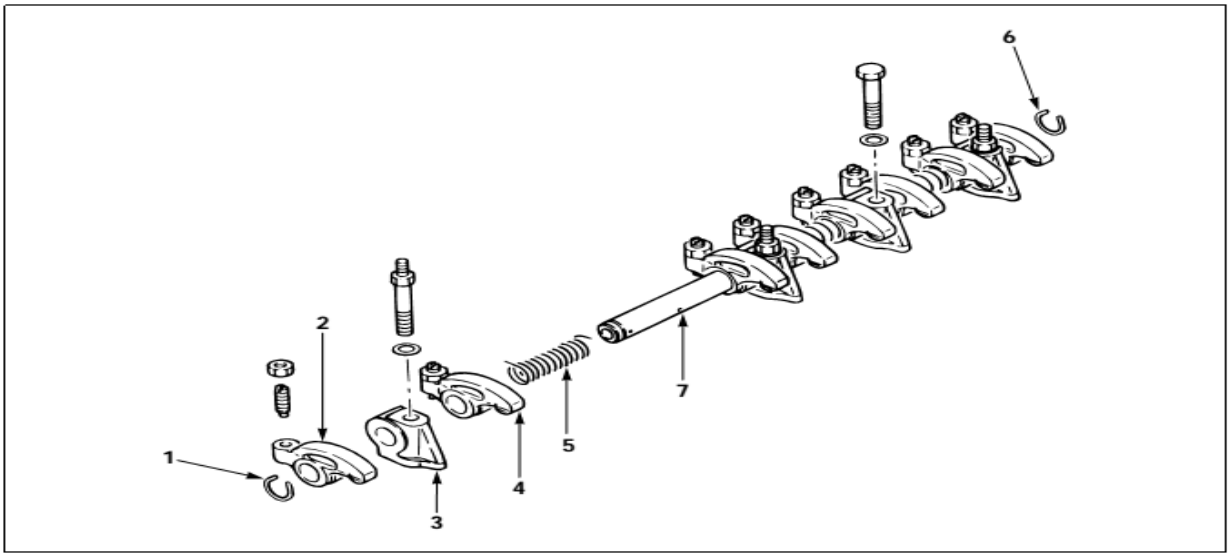


Disassembly Steps - 3

1. Oil pan
1a. Oil pan (If so crankcase equipped)
2. Crankcase (If so equipped)
▲ 3. Flywheel
3a. Rear flywheel (If so equipped)
4. Flywheel housing
5. Oil pump with oil pipe
▲ 6. Camshaft with camshaft timing gear and thrust plate
7. Timing gear case
▲ 8. Connecting rod cap with lower bearing
▲ 9. Piston and connecting rod with upper bearing
▲ 10. Crankshaft bearing cap with lower bearing
11. Crankshaft thrust bearing
12. Crankshaft with crankshaft timing gear
▲ 13. Crankshaft upper bearing
▲ 14. Tappet
15. Crankshaft rear oil seal
16. Cylinder body

Figure 8 exploded view overhauling of cylinder block

DISASSEMBLE-4

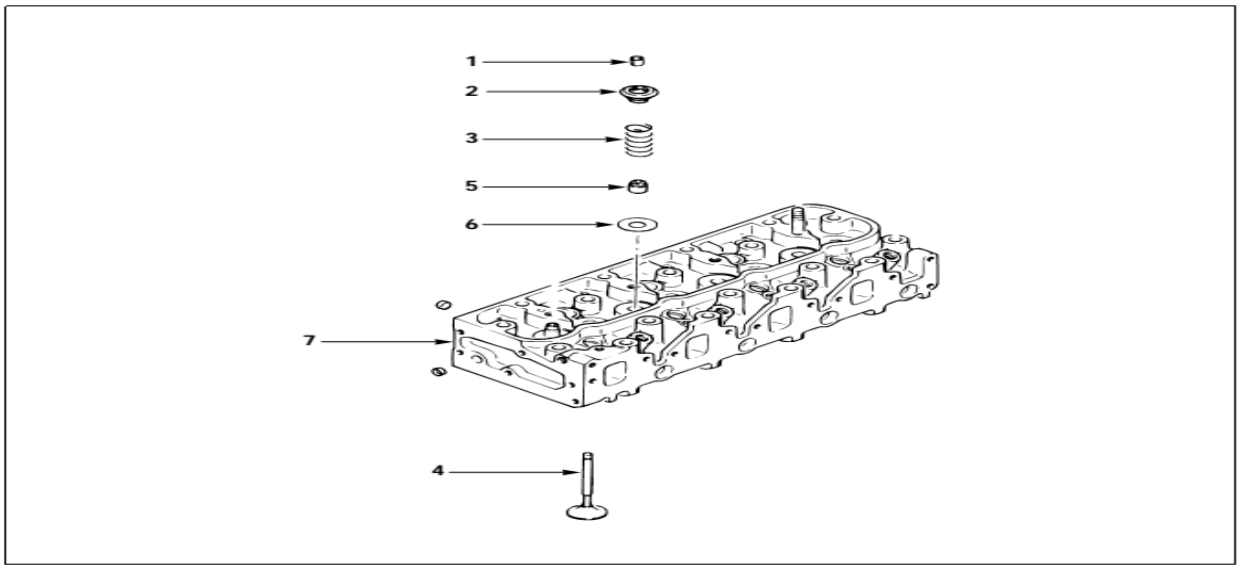


Disassembly Steps

▲ 1. Rocker arm shaft snap ring
▲ 2. Rocker arm
▲ 3. Rocker arm shaft bracket
4. Rocker arm
5. Rocker arm shaft spring
6. Rocker arm shaft snap ring
7. Rocker arm shaft

Figure 9 rocker arm with assemblies engine

DISASSEMBLE-5

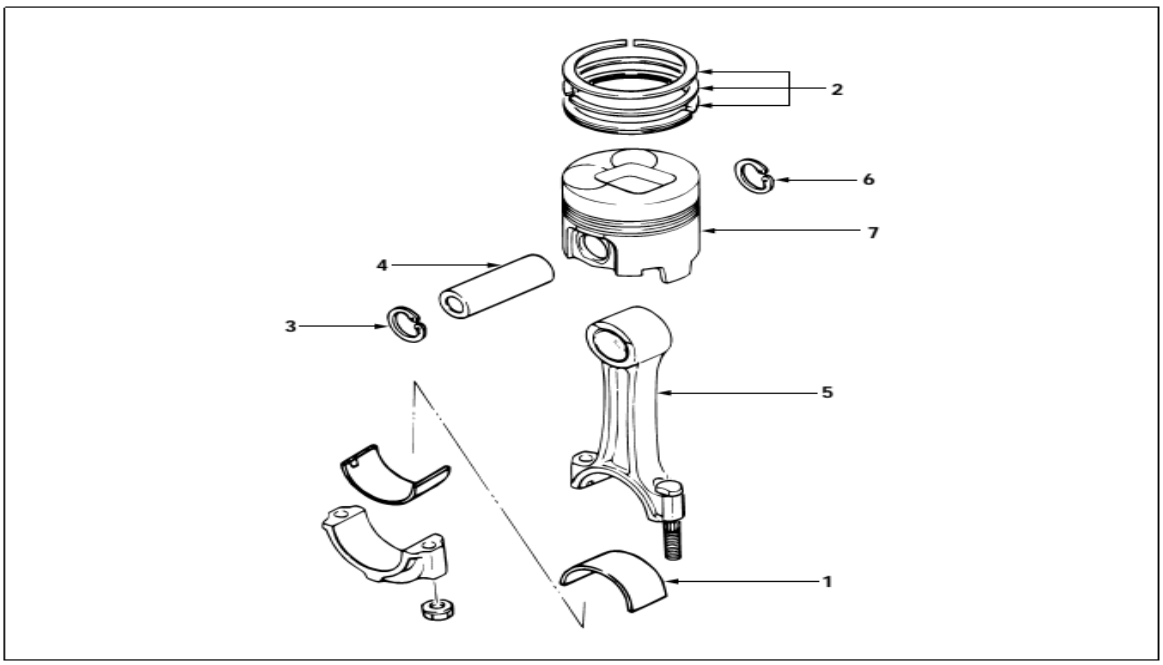


Disassembly Steps

▲ 1. Split collar
2. Valve spring upper seat
3. Valve spring
▲ 4. Intake and exhaust valves
5. Valve stem oil seal
6. Valve spring lower washer
7. Cylinder head

Figure 10 valve with assemblies

DISASSEMBLE-5



Disassembly Steps

▲ 1. Connecting rod bearing
▲ 2. Piston ring
▲ 3. Piston pin snap ring
▲ 4. Piston pin
5. Connecting rod
▲ 6. Piston pin snap ring
▲ 7. Piston

Figure 11 piston and connecting rode with assemblies

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction I: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1) Piston assemblies include ring, pin, connecting rode
2) Cylinder block assemblies include valve, intake manifold

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet-2 Analyze engine failure using appropriate tools and equipment

1. tools and equipment

All tools, equipment, and vehicles must be properly maintained so that workers are not endangered. Construction regulations require inspections of vehicles, tools, machines, and equipment before use.

Preventive maintenance is the systematic care and protection of tools, equipment, machines, and vehicles in order to keep them in a safe, usable condition that limits downtime and extends productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:

- well organized and scheduled
- controls hazards
- defines operational procedures
- Trains key personnel.

The degree of detail to include in your company's program regarding equipment maintenance will depend on the kinds of tools/equipment used. Some construction equipment (e.g., cranes) has very specific inspection and maintenance requirements. Mobile heavy equipment (dozers, loaders, scrapers, etc.) may have different maintenance requirements. Passenger vehicles (company trucks, cars, and vans) may require only basic maintenance. Power tools should be maintained in good working order. This may be limited to ensuring that blades/bits are replaced when needed and those guards or other safety devices are operable and any damaged electrical cords/plugs are repaired or replaced. Damaged or defective equipment/tools should be tagged and removed from service.

Most manufacturers can provide maintenance schedules for their equipment. Large companies with a fleet of vehicles/equipment typically have a comprehensive maintenance program due to the capital investment and/or leasing agreements. Smaller companies may lease equipment and maintenance services may be included in the leasing agreement.

Requirements

2. General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Setting up a system for removal and tagging of damaged or defective tools and equipment.

Self-Check 1	Written Test

Instruction I: - chose and write the letter of the correct answer Use the Answer sheet provided in the next page: (2 pts each)

1. The successful maintenance program is:
   A. well organized and scheduled
   B. controls hazards
   C. defines operational procedures
   D. Trains key personnel.
2. General requirements for equipment maintenance include:
   A. Obtaining a copy of the maintenance schedule recommended by the manufacturer.
   B. Ensuring that maintenance is performed as required.
   C. Ensuring that the person(s) performing the maintenance are competent
   D. All of the above

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-3 Measure and compare components against manufacturer specifications

1. Measuring engine components

Generally, visual inspection to be performed during a removal of each component parts, with the right workshop procedures, and by using recommended tools and equipment.

1.1. Cylinder head

- Inspect cylinder head for carbon deposit due to incomplete combustion.
- Check head for crack by using correct methods. Especially, the tapered region that found between intake and exhaust valves in each cylinders.
  a. Magnetic crack detector method
  b. Water and air pressure method
  c. Dye penetrant method
  d. Ray penetration method (in some case, it's not common)

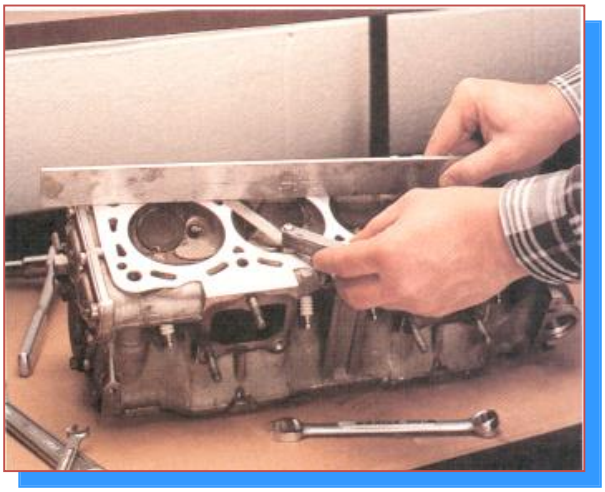


Figure 12 measuring by strata edge with filer gauge

- Check head surface for damage, and likewise for any unusual signs such as scuff, scored, nick, dent, oxidized/corroded, uneven wear, leakage, etc.
- Inspect and check intake and exhaust manifold meeting surface with sealing thin sheet metal gasket on the cylinder head for war page, crack, damage, and likewise for any unusual signs such as scuff, scored, nick, dent, oxidized/corroded, uneven wear, leakage, etc.

1.2. Head gasket:

- Check head gasket sealing surface for leakage (extra-liquid) and for any unusual elements
- Check for deterioration, damage, burnout, worn-out, and soon.

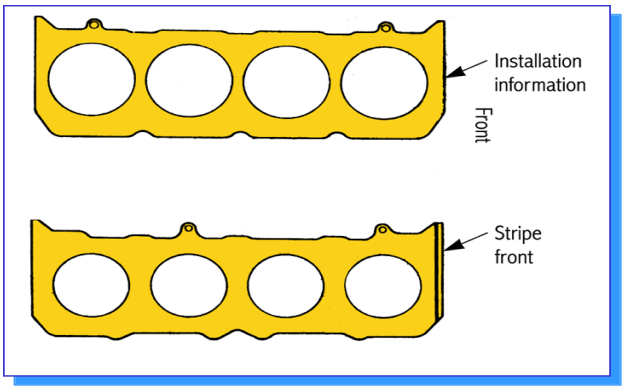


Figure 13 gasket direction

1.3. Head bolts, nuts and studs:

- Check head bolts, nuts and studs for proper thread and fitting surface.
- Check for damage, worn-out, rust-out/corroded, bend, broken-in, and so on.

1.4. Valves (Intake and Exhaust):

- Check both valves head for damage, erosion, fracture or crack, worn-out, burn-out, broken and so on. Especially, exhaust valve may develop erosion, burn-out, broken and fracture, because it's exposed to high temperature and pressure during discharging of burnt gas. Relatively, intake valve can be cooled by air or air/fuel mixture drawn to the cylinder
- Check both valve stem tip for mushroom, it's develop by knocking or clicking of rocker arm during opening the valves.

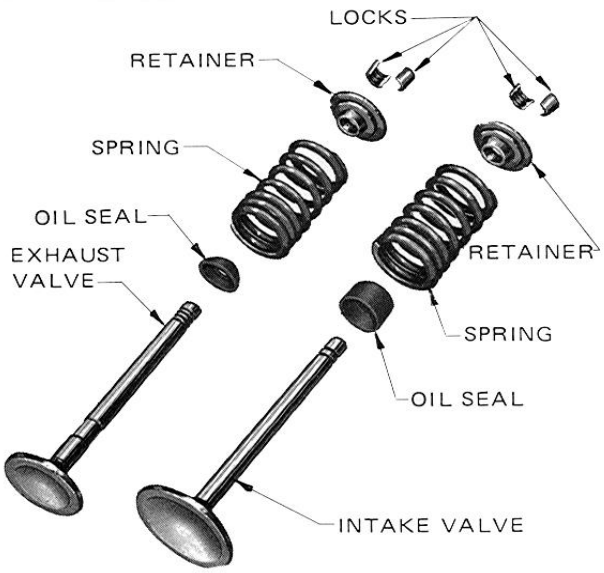


Figure 14 valve assemblies

1.5. Valve guide

- Inspect valve guide bore and guide seal for damage, worn-out, likewise for any unusual signs such as corrosion/oxidized, scuff, scored, nick, dent, crack and uneven wear.

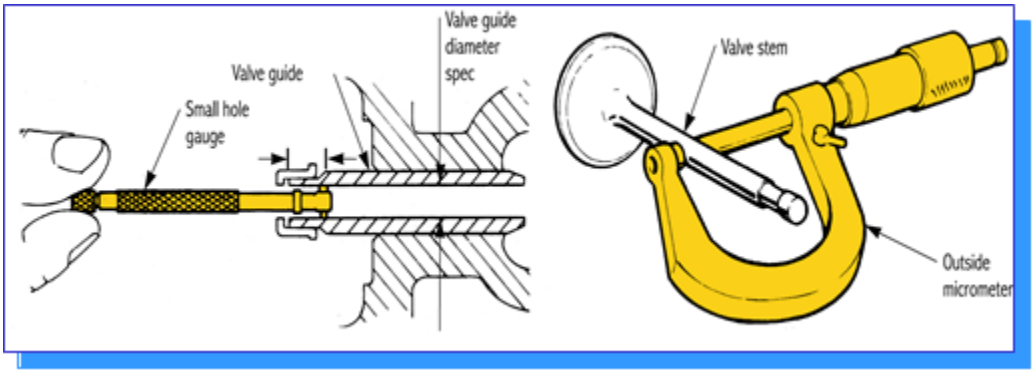


Figure 15 micrometer reading

1.6. Camshaft

- Inspect and check shaft, journal and lobs for damage, worn-out, bend and unusual signs such as scored, nick, dent, crack and uneven wear.

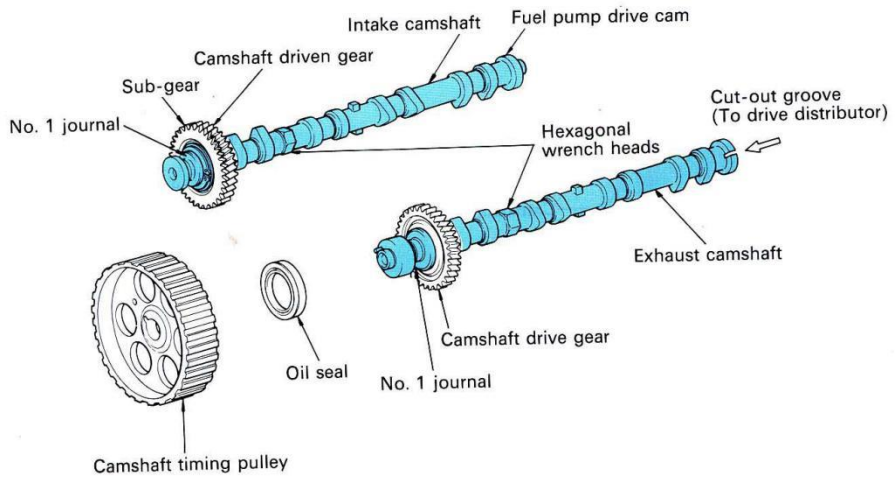


Figure 16 cam shaft assemblies

1.7. Rocker arm assembly:

- Inspect and check rocker shaft, rocker springs and rocker itself for damage, worn-out, likewise for any unusual signs such as scuff, scored, nick, dent, crack and uneven wear.

1.8. Push rod

- Inspect push rod for damage, worn-out, likewise for any unusual signs such as scuff, scored, nick, dent, crack and uneven wear.

1.9. Tappet (valve lifter)

- Inspect valve lifter for damage, worn-out, unusual signs such as scuff, scored, broken, dent, crack and uneven wear.

1.10. Intake and Exhaust manifold mounting surface

- Inspect and check intake manifold mounting surface for damage, warp page, worn-out, likewise for any unusual signs such as broken, erosion, scored, burn, bend, crack and uneven wear.
- Inspect and check intake manifold mounting surface for damage, warp page, worn-out, erosion, scored, burn, bend, crack and uneven wear.

1.11. Cylinder block

- Inspect cylinder head for carbon deposit due to incomplete combustion.

- Check head for crack by using correct methods. Especially, the tapered region that found between intake and exhaust valves in each cylinders.

A. Magnetic crack detector method
B. Water and air pressure method
C. Dye penetrant method
D. Ray penetration method (in some case, it's not common)

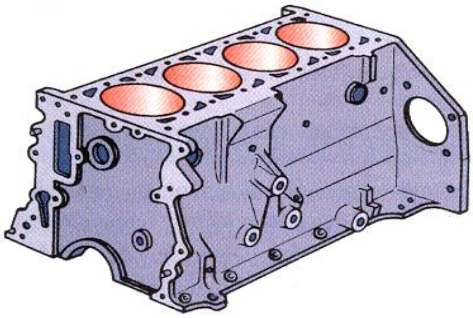


Figure 17 cylinder block

- Check head surface for damage, and likewise for any unusual signs such as scuff, scored, nick, dent, oxidized/corroded, uneven wear, leakage, etc.
- Inspect and check intake and exhaust manifold meeting surface with sealing thin sheet metal gasket on the cylinder head for war page, crack, damage, and likewise for any unusual signs such as scuff, scored, nick, dent, oxidized/corroded, uneven wear, leakage, etc.

1.12. Crankshaft and bearing

- Inspect and check shaft, journal, webs and pins for damage, worn-out, bend and unusual signs such as scored, nick, dent, crack and uneven wear.

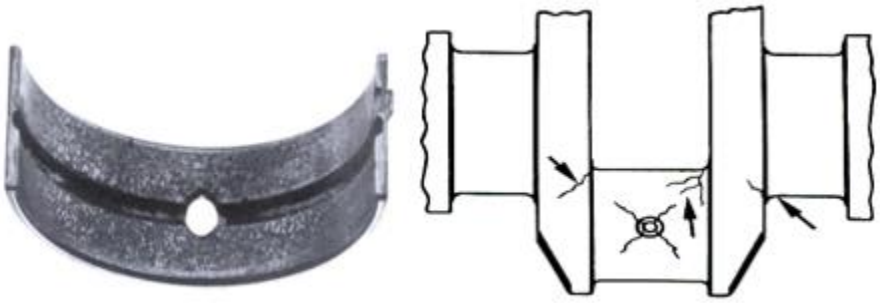


Figure 18 connecting road journal with Bering

1.13. Piston assembly

- Inspect and check piston rings, piston pin and piston itself for damage, worn-out, likewise for any unusual signs such as scuff, scored, nick, dent, crack and uneven wear.

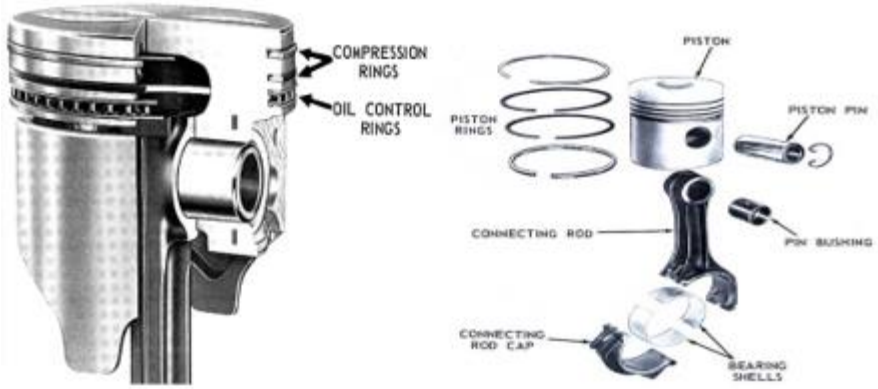


Figure 19 piston assemblies

1.14. Connecting rod with cups

- Inspect and check rods, for damage, worn-out, twist, bend and unusual signs such as scored, nick, dent, crack and uneven wear. Also check the cups for any uneven sign.

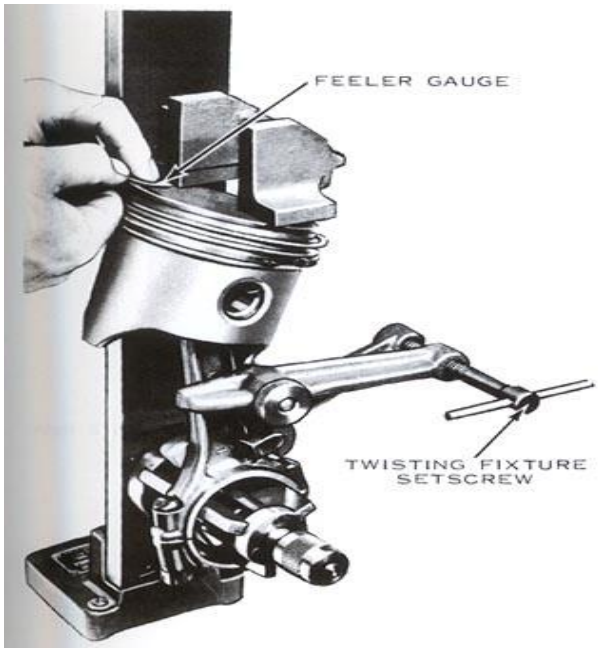


Figure 20 measuring piston connecting road bending

When completing visual inspection and measurement of engine top-end component parts please define possible causes of poor operation (low power output), noise, damage and defective of parts.

Hence, write your justify your conclusions depend on the results that have been obtained through visual inspection and measurement that may be enable you to give possible recommendation.

Finally, forward your recommendation as per manufacturer specification or/and service/repair manual in order to improve power output, increase lifespan of parts and make smooth operation of device.

1.15. Fly Wheel

Check cranking gear for damage, and likewise for any unusual signs such as worn, damage, defect, uneven wear, etc.

Inspect and check fly wheel meeting surface with pressure plate for war page, crack, damage, smoothness and likewise for any unusual signs such as scuff, scored, nick, dent, oxidized/corroded, uneven wear, leakage, etc.

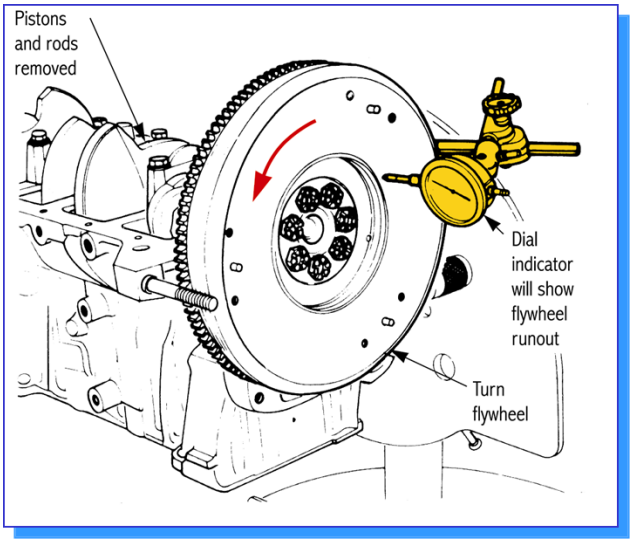


Figure 21 fly wheel ware page

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Write the answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1. Visual inspection can only perform before cleaning of component parts
2. Shop manual is useful to avoid mistake
3. Inspection is not part of engine service

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____

Information Sheet-4 Making decisions to serviceability and repair method

1. Understanding the Service Due/Service Engine Light

If you're driving around and discover this light staring back at you, it could mean a couple of different things, depending on the make and model of your car. Most often, this light serves as a reminder to bring your own car in for regular/scheduled service. Several manufacturers include a mileage countdown, which will trigger the light to alert you.

Some of the routine maintenance items that it could be calling for include:

- Air Filter
- Cabin Filter
- Oil Service

2. How often should you service your car?

According to Halfords, you should service your car every 12,000 miles or every 12 months, whichever comes first.

2.1. Dashboard warning lights

Dashboard warning lights are the most obvious sign that something isn't working. Don't ignore them!

If a yellow "check engine" light appears on your dashboard, you should get your car to the garage for a service ASAP. There are a range of engine problems that this light could indicate.

A lot of cars also have a service light – usually in the shape of a spanner – that will come on when your next service is due.

Your car's manual will show you what each of your dashboard lights mean.

2.2. Strange noises

If you hear any unusual noises coming from your car then you should get them checked out.

- Squealing noises like a high-pitched squeal when turning the ignition on could indicate a problem with the cam belt. It might be worn, or loose.
- Squealing brakes could be down to worn brake pads.

- Whining from under the bonnet is usually caused by a loose cam belt, which can cause all sorts of issues from overheating to battery problems.
- Scraping noises or sounds coming from your car needs to be checked out.
- This could be a broken part of your car scraping on something else, causing extra damage to both. This could also cause a reduced ride comfort, e.g. If your tires are scraping on the wheel arches.
- Uneven engine noise could be an easy fix but could also indicate a more serious problem with your engine.
- Louder-than-usual exhaust noise tends to be easy to fix but should be looked at because there's a risk your exhaust pipe could fall off.
- Crunching gears make a huge noise when there's an issue. If you hear a crunching noise as you change gear, get your car checked.

2.3. Loss in power or stalling

Difficulty getting up to speed, or not being able reach the same distance with a full tank of petrol could mean something is wrong.

Also stalling even though you're in the right gear can be a tell-tale sign.

2.4. Unusual brake activity

Vibrating or pulling under braking could be due to worn brake discs or pads, a suspension problem, or an issue with your steering.

If you notice oversensitivity or resistance you should get your car checked.

It's not safe to drive like this so get your car serviced as soon as possible.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer (2 pts each)

1. Loss in power or stalling one of the symptom vehicle need to service
2. Dashboard warning lights is not indicating the problem in the vehicle

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-5 Ordering/sourcing replacement parts

Ordering/sourcing

Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarize yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed. A suitable tube of liquid sealant will also be required for the joint faces that are fitted without gaskets. It is recommended that Peugeot's own product(s) are used, which are specially formulated for this purpose.

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Answer on the space provided below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer (2 pts each)

1) Ordering/sourcing the process of finding replacing material
2) Ordering is not including preparing tools

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-6 Carrying out rebuild or replacement of engine components

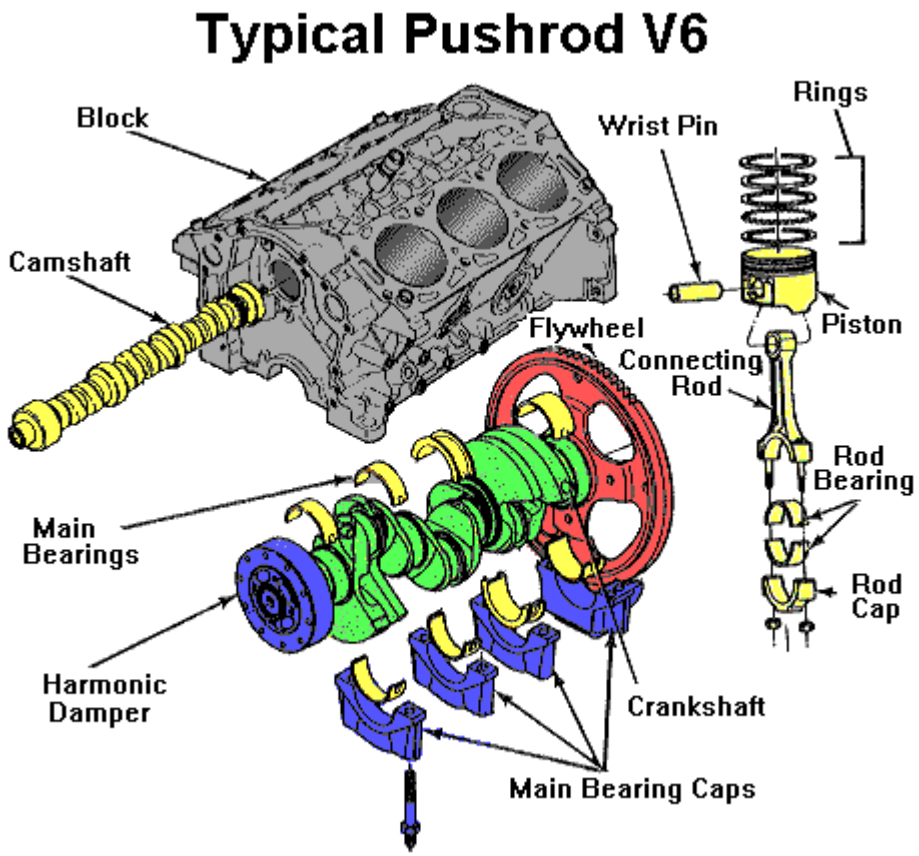


Figure 22 all block part exploded view

1. How to Rebuild an Engine?

When an engine has accumulated a lot of miles, the internal parts inside the engine may be worn or damaged and have to be replaced. Which engine parts you replace when you rebuild your engine will depend on their condition and whether you are overhauling the engine or just fixing something that is wrong with it.

The first step in rebuilding an engine is to correctly identify the engine. Auto makers are making constant changes from one model year to the next, and may even make mid-year changes, so to find the correct replacement parts for your engine you will need the year, make and model of your vehicle, and probably its VIN number. The VIN number can be

found on a metal plate at the base of the windshield on the driver's side, or on the vehicle title or registration.

1.1. REPLACE ENGINE BEARINGS

Let's start with bearings. Common reasons for replacement include noise and low oil pressure. If a bearing has seized or spun, it will take more than a new set of bearings to fix the problem. The crankshaft journal will likely have suffered damage so turning the crank to undersize will probably be necessary. The big end of the connecting road may also be damaged or out-of-round which will require reconditioning the rod or replacing it.

Figure 23 REPLACE ENGINE BEARINGS

1.2. REPLACE PISTONS & PISTON RINGS

Pistons and rings may have to be replaced if a compression test reveals the rings are not holding a good seal. Taper, distortion or damage in the cylinder bores can be factors, too. Worn rings and/or cylinders will allow a lot of blow by into the crankcase. This reduces power, increases fuel consumption and emissions, and contributes to sludge formation as well as oil dilution (both of which are bad for the bearings).

1.3. REPLACE CAM DRIVES, TIMING CHAINS & BELTS

Another wear component in the block is the cam drive, be it a set of gears or a timing chain. Chains stretch with age, which retards valve and ignition timing to adversely affect engine performance. If the chain jumps one or more teeth, it may be hard to start or run poorly. If it breaks, the engine won't run at all and may suffer valve damage if there is insufficient valve-to-piston clearance for the engine to freewheel. Timing gears with nylon coated teeth may become brittle with age and disintegrate.

1.4. REPLACE CAMSHAFT & LIFTERS

Moving on to the cam and lifters, failures here are fairly common, too. Sometimes a cam will wipe out a lobe because of a lubrication problem. The result is a dead cylinder because the affected valve is not opening. Cams can also break or seize, as is the case in many overhead cam engines that lose their coolant and overheat. If an Overhead cam head warps, it may bend, break or seize the cam.

1.5. REPLACE ENGINE VALVES

New valve springs are also recommended for a new cam, particularly a performance cam. Weak valve springs can allow valve float at higher rpms, limiting the power potential of the engine. Any valve spring that does not meet specs (height or pressure) should be replaced.

Figure 24 replace engine valves

Heavy carbon deposits like these are usually due to worn valve guides and seals

1.6. REPLACE OTHER ENGINE PARTS

Other engine parts that may be needed include a new oil pump (always recommended for high mileage engines), a new oil pressure sending unit, a new thermostat, oil, oil filter, antifreeze, gaskets and fasteners. Head bolts that are the torque-to-yield type should not be reused because they stretch when tightened and may break if reused.

Self-Check 6	Written Test

Instruction: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (__ pts)

1. What is the Couse of replacing valve?
   a. Carbon deposit c. above maximum prefacing
   b. Damage d. all
2. Replacing the engine bearing conduct by the Couse of _____
   a. Over wearied c. lack of oil
   b. Broken d. all

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-7 Carrying out overhaul activities

1. Overhauling activity

An engine overhaul is a major diesel and gasoline engine repair that involves the removal, disassembly, inspection and repair of an engine. During the overhaul, small parts and components, like bolts, might be replaced with new factory parts. During disassembly, the engine is cleaned thoroughly to remove built-up grime and debris. Since your entire engine is being taken apart, it's much easier for the mechanic to identify problems and replace malfunctioning parts. Once everything has been cleaned and the necessary replacements have been made, the engine will be put back together and set back into the vehicle.

1.1. Benefits of an engine overhaul

An engine overhaul is an excellent option for engines that aren't old or excessively worn but are still experiencing issues. In many cases, an engine overhaul can effectively fix any issues with your engine and save you a significant amount of money over having your engine replaced completely. Since all of your parts and components are thoroughly cleaned and inspected during an engine overhaul, your mechanic will be able to spot minor issues that you might not have even noticed yet. The thorough cleaning of the engine gets it into the best condition possible for peak performance and efficiency.

You can also choose to have your engine rebuilt to add new features or upgrade it. Lots of people choose to rebuild their engines on a routine basis every few years to improve their speed, performance, efficiency and power. Regardless of why you want your engine rebuilt, it's important that you find a mechanic who specializes in engine repair, to handle the job. An experienced professional will be able to figure out what's going on with your engine and address issues during a rebuild.

Self-Check 7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1. Benefits of an engine overhaul is repair an engine
2. Inspection is one of the pat of an engine overhauling

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____ **4** _____

Operation Sheet-1 Service or repair method of components, Order/source and recycle parts of replacement

Disassembly procedure:

- ❑ **During disassembly, move slowly, inspecting each part carefully.**

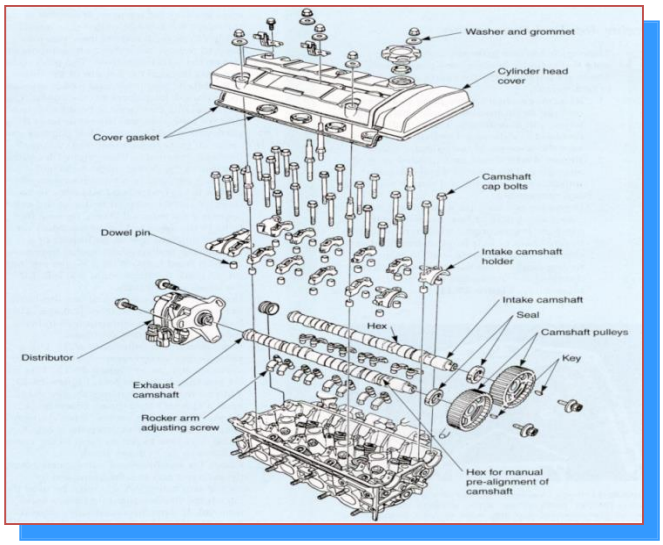
A. Mount the engine on a stand to perform the following:

1. Remove the fuel system, intake and exhaust manifolds.
2. Remove the oil pan, rocker covers, accessories, etc.
3. Mark the direction that components were originally mounted to the engine.
4. Position crankshaft in TDC #1 compression stroke.
5. Mark the position of the distributor's housing and the rotor before removing it.
   NB: Make GOOD marks!!!! Distributor pump on diesel applications!!
6. Remove front cover, timing chai n/belt, etc. Note how the marks on the cam, crankshaft balance shaft, etc. line up.
7. Draw how these gears/sprockets are arranged on page 2 of this booklet.

General Procedure

A. Top end

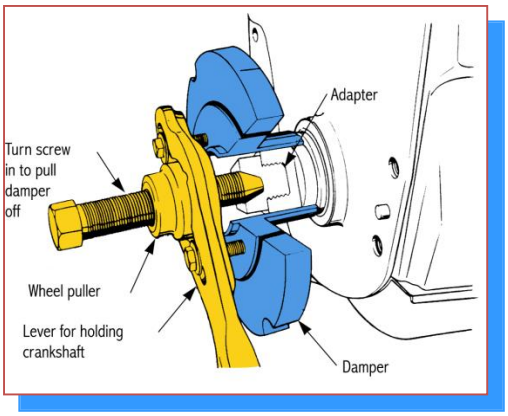
- The top end includes the valve train and cylinder head–related components
- Keep the lifters, push rods, and rocker arms in exact order
- Remove the head bolts in the specified sequence
- Inspect the head-to-block mating surfaces for signs of leakage



- Valve Train Timing
    - Aligning timing marks before disassembly
- Cylinder Head Disassembly
    - With the valve springs compressed, the keepers can be removed

B. Front End

- Remove the water pump and any parts in front of the timing cover
- Do not rotate the crankshaft with the timing belt removed (pistons might contact valves)
- Remove the harmonic balancer or damper
- Remove the timing cover
- Remove the oil slinger and the timing gears or sprockets



- Damper Removal
    - A wheel puller is used to force the damper off the crankshaft

C. Bottom End

- Bottom end components:

a. pistons
b. rods
c. crankshaft
d. camshaft
e. bearings
f. cylinder block

Operation Sheet-2 Overhaul activities

A. CYLINDER HEAD ASSEMBLY

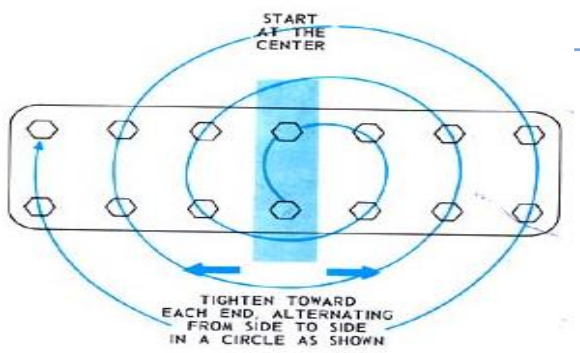
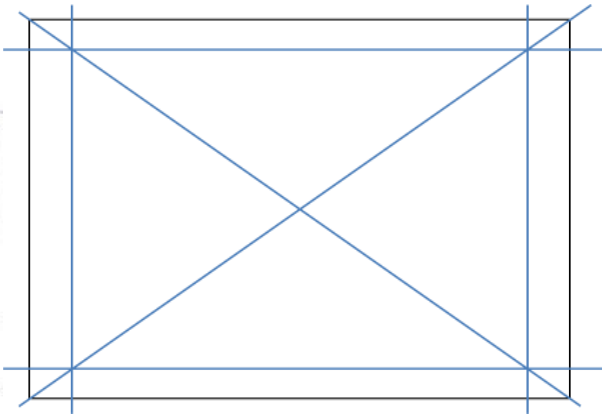


Fig. 9—Guide To Proper Sequence For Tightening Cylinder Heads—Older Engines



Cylinder head war page

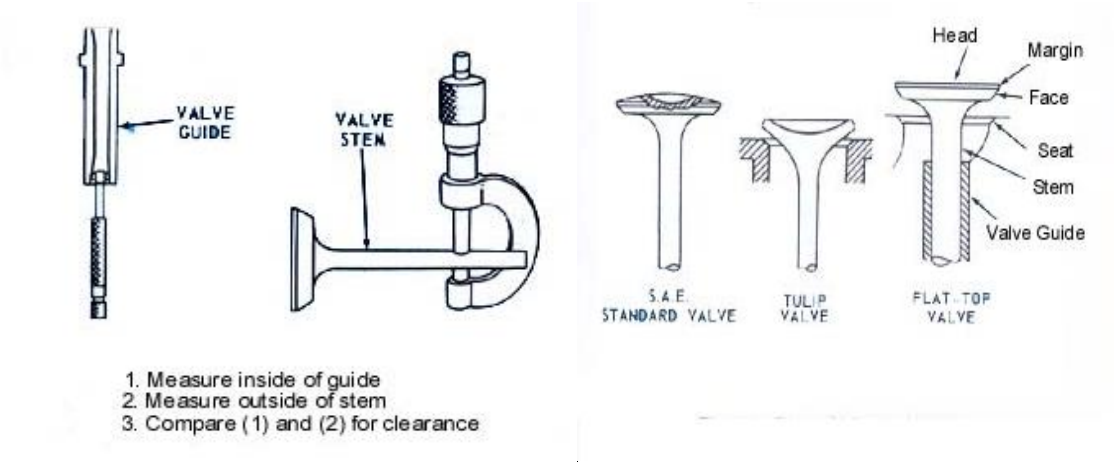
Measure cylinder head warp age with apposite measuring tool such feeler gauge and straight edge.

1	2	3	4	5	6

Valve guide

Measure valve guide inner Ø with correct measuring device such telescopic gauge and micrometer

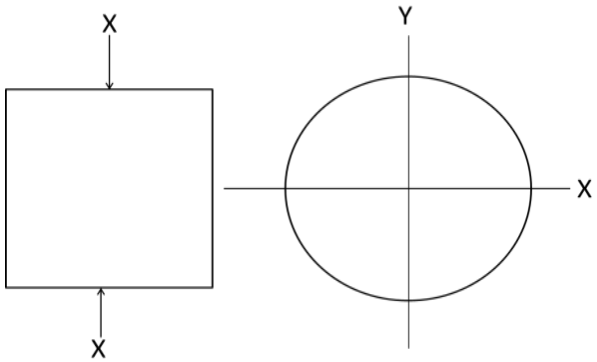
Direction	1		2		3		4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
X								
Y								
Max.								



Valve stem and head

Measure valve stem Ø, length, and Face angle with suitable measuring device like micrometer vernier caliper, steel rule and protractor. Note: you have to measure stem Ø in to three parts, and then take the minimum reading.	1		2		3		4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
Stem Diameter								
Valve Length								
Margin thickness								
Valve Seat angle								

Note: Valve Guide Oil Clearance = Max. Valve guide Ø -- Min. Valve stem Ø



Valve spring

Measure valve spring length, Squareness and stiffness (load) with right measuring device and tools such micrometer, vernier caliper, try square, and spring load tester.

	1		2		3		4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
Length								
Squareness								
Load								

Camshaft lobe height

Measure Camshaft lobe height or length with precise measuring device such micrometer.

	1		2		3		4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
Lobe height								

Camshaft journal

Measure camshaft journal Ø with proper measuring device such outside micrometer

Direction	1	2	3	4	5	6
X						
Y						
Min.						

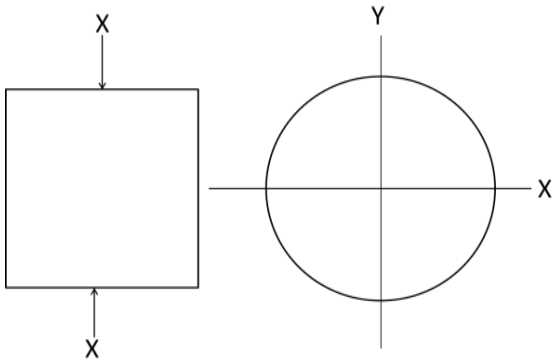
Camshaft bearing

Measure camshaft bearing Ø with proper measuring device such telescopic gauge or in-micrometer

Direction	1	2	3	4	5	6
X						
Y						
Max.						

Camshaft Oil Clearance

- ***Oil Clearance*** *= Max. Camshaft bearing Ø - Min. Camshaft journal Ø*



Camshaft bending and Run-Out

- *Measure camshaft bending with dial indicator. Carefully, put the camshaft on the v-block, and then obtain maximum reading by rotating the camshaft over the v-block gently.*
- *Check Run-out, when bending divided by two its gives run-out.* **Run-out = B/2**

Rocker shaft bending and Run-Out

- *Measure rocker shaft bending with dial indicator by fixing the shaft on the v-block, and then obtain maximum reading by rotating the rocker shaft over the v-block slowly.*
- *Check Run-out, when bending divided by two its gives run-out.* **Run-out = B/2**

Rocker Arm oil clearance

- ***Oil Clearance*** *= Max. Inner Ø of Rocker arm - Min. Outer Ø of Rocker shaft*

Rocker Arm Springs

Measure rocker spring length, Squareness and stiffness (load) with right measuring device and tools such micrometer, vernier caliper, try square, and spring load tester.

	Spring -1	Spring -2	Spring -3	Spring -4	Spring -5	Spring -6
Length						
Squareness						
Load						

Push rod bending and Run-Out

- *Measure push rod bending with dial indicator. Carefully, put the push rod on the v-block, and then obtain maximum reading by rotating the push rod over the v-block gently.*
- *Check Run-out, when bending divided by two its gives run-out.* **Run-out = B/2**

Tappet (valve lifter)

Measure Tappet length and diameter with right measuring device and tools such micrometer and vernier caliper.

	1	2	3	4	5	6
Length						
Diameter						

B. CYLINDER BLOCK ASSEMBLY

Cylinder block war page

Dimensionally, measure cylinder block surface warps age with proper measuring tool such feeler gauge and straight edge.

1	2	3	4	5	6	7

Crankshaft end-play

- *Measure crankshaft end-play before take-off the crankshaft from the original place such crank case. Follow the right procedures, and use correct tools such as flat crew drivers and dial indicator.*

Crankshaft main journal

Measure crankshaft main journal Ø with appropriate measuring device such outside micrometer

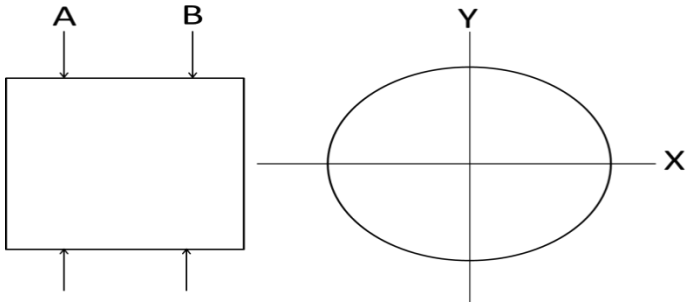
Direction	1	2	3	4	5	6
A-X						

A-Y						
B-X						
B-Y						
Min.						

Crankshaft main bearing

Measure crankshaft main bearing diameter with appropriate measuring device such telescopic gauge and inside micrometer. Note: it's measured by re-assembling main cap into crankshaft seat.

Direction	1	2	3	4	5	6
A-X						
A-Y						
B-X						
B-Y						
Max.						



Crankshaft main journal Oil clearance

- ***Oil clearance*** *= Max. Crankshaft main bearing Ø - Min. Crankshaft main journal Ø*

Crank-pin

Measure crank-pin diameter with appropriate measuring device such outside micrometer

Direction	1	2	3	4	5	6
A-X						
A-Y						
B-X						

B-Y						
Min.						

Crank-pin cap (bearing)

Measure crank-pin cap (bearing) diameter with appropriate measuring device such telescopic gauge and inside micrometer. Note: it's measured by installing/assembling the cap into connecting rod.

Direction	1	2	3	4	5	6
A-X						
A-Y						
B-X						
B-Y						
Max.						

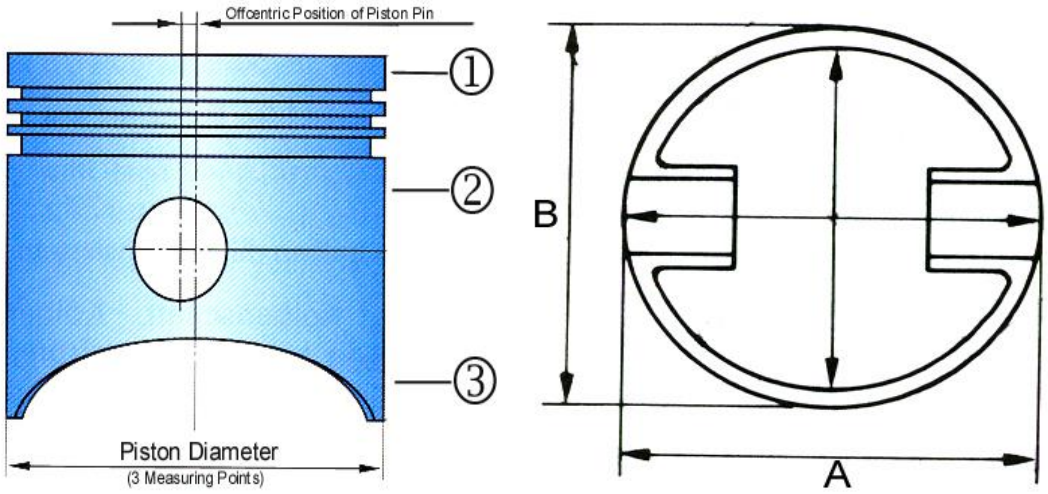
Crank-pin and bearing Oil clearance

- ***Oil clearance*** = *Max.* Crank-pin cap (*bearing) Ø - Min.* Crank-pin *Ø*

C. PISTON ASSEMBLY

Piston diameter

- Pistons shall be measured at Top, Center and Bottom!
- Pistons shall be measured in "A" and "B" direction!



Measure Piston diameter by using correct measuring device like outside micrometer

Portion	Direction	1	2	3	4	5	6
Top	A						
	B						
	Min.						
Center	A						
	B						
	Min.						
Bottom	A						
	B						
	Min.						

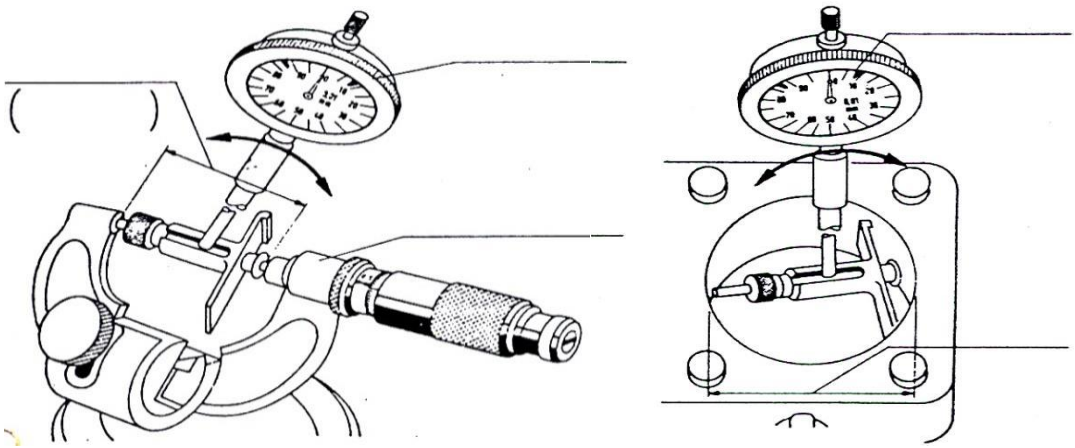
Piston Ring

Measure Piston ring end-gap and thickness with recommended measuring device such feeler gauge and outside micrometer

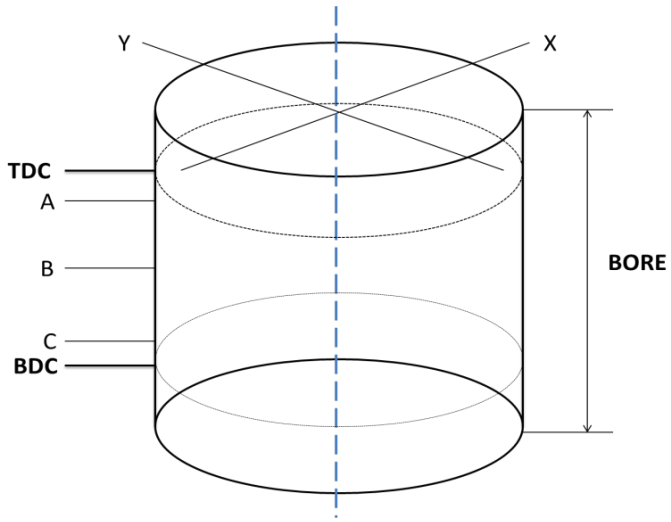
	Rings	**Cylinder - 1**	**Cylinder - 2**	**Cylinder - 3**	**Cylinder - 4**	**Cylinder - 5**
End-gap	Comp. 1					
	Comp. 2					
	Oil ring					
Thickness	Comp. 1					
	Comp. 2					
	Oil ring					

Cylinder bore

I. <u>Adjustment of the Bore Gage</u>



II. Measuring the Bore



Measuring Point	Cylinder - 1		Cylinder - 2		Cylinder - 3		Cylinder - 4		Cylinder - 5	
	X	Y	X	Y	X	Y	X	Y	X	Y
At point "A" near TDC										
At point "B" center										
At point "C" near BDC										
Max. reading										

Cylinder bore oil clearance

- *Measure cylinder bore oil clearance by following the right procedures.*

*Hence, **Oil clearance** = Max. Ø of cylinder bore - Min. Ø of piston*

Piston pin

- *Check piston pin clearance with connecting rod bushing or bearing by using proper measuring device like inside micrometer, if it's necessary.*
- *Check piston pin bending and run-out by using dial indicator.*

Parts	Measurement	**Cylinder - 1**	**Cylinder - 2**	**Cylinder - 3**	**Cylinder - 4**
Piston pin	*Pin clearance*				
	Bending				
	Run-out				

***Note:** Please refer service manual for manufacturer limit.*

Connecting rod

- *Check Connecting rod bending, twist and misalignment by using recommended measuring device and tools dial indicator. And then compere the obtained results with manufacturer specification from service manual*

Parts	Measurement	**Cylinder - 1**	**Cylinder - 2**	**Cylinder - 3**	**Cylinder - 4**
Connecting rod	*Run-out*				
	Misalignment				
	Bending				

***Note:** Please permanently refer service manual or shop manual to compare your obtained results of measurement with manufacturer limit. This enables you to identify whether the component parts in specification or not. Likewise help you to provide recommendation about service of each component parts as well.*

LAP Test-1	Practical Demonstration

Name: _____ **Date:** _____

Time started: _____ **Time finished:** _____

1 Identify measuring device in accordance with service manual procedure
2 Take measurement of engine component parts with proper measuring tools and devices
3 Compare the obtained result with manufacturer specification
4 Write your conclusion as per manufacturer specification
4. Set components in-order on the selected place
5. Use service manual to avoid misleading
6. Check the deflection of timing belt and/or chain
7. Measure timing gear back-lash with proper tools

LG #24 | LO #3- Assembling engine and components

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Assembling engine following manufacturer procedures
- Measuring running clearances against manufacturer specifications
- Completing assembly of engine
- Completing assembly without causing damage

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Assemble engine following manufacturer procedures
- Measure running clearances against manufacturer specifications
- Complete assembly of engine
- Complete assembly without causing damage

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1 Assembling engine following manufacturer procedures

1. Preparation for reassembling the engine

- Prepare and set in order component parts that has been cleaned
- Prepare and interpret shop/service manual, that enables you to follow correct procedure of engine reassembly
- Cleaning parts cannot be included replaceable parts

1.1. Cleaning component parts

Again, before being start assembling process, cleaning engine component parts with recommended cleaning agents, follow service/shop manual recommendation.

- Before any assembly is started, you must prepare the engine parts. A good repair or rebuild job begins with engine preparation. Without good preparation, you may not only fail to locate unknown defects, but you may also cause further damage

Now that all openings are covered, the second procedure is to clean the engine thoroughly to prevent foreign matter from entering the engine and causing internal damage during a assembly. First, take a high-pressure cleaning unit and steam clean the entire outer surface of the engine. If a cleaning unit is not available, use a high-pressure water hose to remove the dirt and loose matter.

- Next, with cleaning solvent and a stiff brush, remove any grease or oil that may be on the engine.
- The third procedure is to drain the engine. Using two separate containers, one for oil and the other for the coolant, remove the oil pan drain plug and open the cylinder block drain cock and drain the engine completely
- While the engine is draining, you might use this time to make sure that your working area is thoroughly clean to prevent any chance of getting the internal parts of the engine contaminated with dirt.

- With the engine thoroughly cleaned and drained, the fourth procedure is to conduct a good visual inspection of its outer surfaces for cracks and broken parts as you begin removing the accessories.

- New or rebuilt parts are of no value if the engine block is damaged beyond repair.

- At this point, you are ready to assemble the engine. Mount the engine on the repair stand and begin the actual assembly.

2. Engine overhaul – reassembly sequence

Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarize yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed. A suitable tube of liquid sealant will also be required for the joint faces that are fitted without gaskets. It is recommended that Peugeot's own product(s) are used, which are specially formulated for this purpose.2 In order to save time and avoid problems, engine reassembly can be carried out in the following order:

A. Crankshaft
B. Piston/connecting rod assemblies.
C. Oil pump -.
D. Sump
E. Flywheel
F. Cylinder head
G. Timing chain/belt, sprockets and tensioner
H. I). Engine external components.

the piston connecting rod assemblies must be fitted before the crankshaft due to the arrangement of the split crankcase.3 At this stage, all engine components should be absolutely clean and dry, with all faults repaired. The components should be laid out(or in individual containers) on a completely clean work surface.

Self-Check 1	Written Test

Instruction: - write true if the statement is correct or write false if the statement is incorrect and write the answer Write the Answer on the space provided below: (2 pts each)

3) Damage parts should be replacing by new one
4) Service manual must be available during engine reassemble
5) Reassembling procedure is not reverse procedure of disassemble

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____

Information Sheet-2 Measuring running clearances against manufacturer specifications

1. Main bearing running clearance check

- ✓ On early engines, if the modified bearing shells are to be fitted, obtain a set of new (Yellow) upper bearing shells and new Blue (Class A) lower bearing shells. On later (mid-1994 on) engines where the modified bearing shells are already fitted, the running clearance check can be carried out using the original bearing shells, although it is preferable to use a new set, since the results obtained wile a lot more conclusive.
- ✓ Clean the backs of the bearing shells, and the bearing locations, in both the cylinder block/crankcase and the main bearing caps.

2. Inspection of oil pump

Measure body clearance using a feeler gauge, measure the clearance between the driven rotor pup body

3. Measure tip clearance / gear backlash

Using a feeler gauge, measure the clearance between both rotors tips/ between two meshing teeth.

4. Measure side clearance

Using a feeler gauge and flat block, measure the side clearance

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Write answer on the space provided below:

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer (2 pts each)

1 Measure the side movements of the crank shaft is called end gap

2 Side clearance measured using micro meter

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____ **3** _____

Information Sheet-3 Completing assembly engine without causing damage

1. Completing assembly engine

Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarize you with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed.

2. Engine reassembly sequence

A. Crankshaft
B. Piston/connecting rod assemblies
C. Oil pump
D. Flywheel
E. Cylinder head
F. Timing chain/belt, sprockets and tensioner
G. Engine external components.

3. Engine - initial start-up after overhaul

- With the engine refitted in the vehicle, double-check the engine oil and coolant levels. Make a final check that everything has been reconnected, and that there are no tools or rags left in the engine compartment.
- Remove the spark plugs. On models with a distributor, disable the ignition system by disconnecting the ignition HT coil lead from the distributor cap, and ear thing it on the cylinder block. Use a jumper lead or similar wire to make a good connection. On models with a static (distributor less) ignition system, disable the ignition system by disconnecting the LT wiring connector from the ignition module.
- Turn the engine on the starter until the oil pressure warning light goes out. Refit the spark plugs, and reconnect the spark plug(HT) leads, for further information. Reconnect any HT leads or wiring which was disconnected.
- Start the engine, noting that this may take a little longer than usual, due to the fuel system components having been disturbed.

- While the engine is idling, check for fuel, water and oil leaks. Don’t be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.
- Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose, then switch off the engine.
- Check the ignition timing and the idle speed settings (as appropriate), then switch the engine off.
- After a few minutes, recheck the oil and coolant levels and top-up as necessary.
- with hexagon type cylinder head bolts, it will be necessary to re-tighten the head bolts after the engine has been run up to normal working temperature then switched off and allowed to cool .On all other engines, if they were tightened as described, there is no need to re-tighten the cylinder head bolts once the engine has firs turn after reassembly.
- If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 500miles (800 km). Do not operate the engine at full-throttle, or allow it to labor at low engine speeds in any gear. It is recommended that the oil and filter be changed at the end of this period.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Write answer on the space provided below:

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer (2 pts each)

1 Damage parts should be replacing by new one

2 When completing the assembling no need to clean the engine

3 Oil level check is one of the re installing step

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____

Operation Sheet 1 assembly engine without causing damage

1. Engine assembling procedure

1.1. wash all components.

1.2. Always wash the bores with hot soapy water. (test cleanliness with white oiled rag rubbed up and down the bores)

1.3. Check all threads, bolts, studs and washers.

1.4. Assemble in dust free, well lit area.

1.5. Set up engine components methodically.

1.6. Check all new parts for quality and compatibility.

1.7. Inspect and measure all machined surfaces.

1.8. Check quality of all reusable parts.

1.9. Measure and record piston/bore clearance, big-end and main vertical oil clearance.

1.10. Tighten all series of bolts evenly in a crisscross pattern, in 2 or 3 stages.

1.11. Lubricate all threads and bolt head contact points. Use tension wrench where necessary. (big ends, mains, head, rockers, flywheel, cam gears etc. etc.)

1.12. Use lock tilt where bolts require safety lock. (cam thrust screws, chain adjusters, oil pick up mount, cam gear, etc.)

1.13. Don't fit bolts without tensioning immediately. (complete each procedure)

1.14. Never fit sump plug without new washer and tightened. (either tighten or leave out, this applies at any stage from dismantling to final assembly)

1.15. Use good quality sealer where necessary. (avoid standard silastic)

1.16. Fit camshaft bearings with no tight spots. (free spinning camshaft)

1.17. Fit crankshaft to turn freely. No tight start on rotation or binding.

1.18. Check crankshaft end float.

1.19. Check and adjust ring end gap.

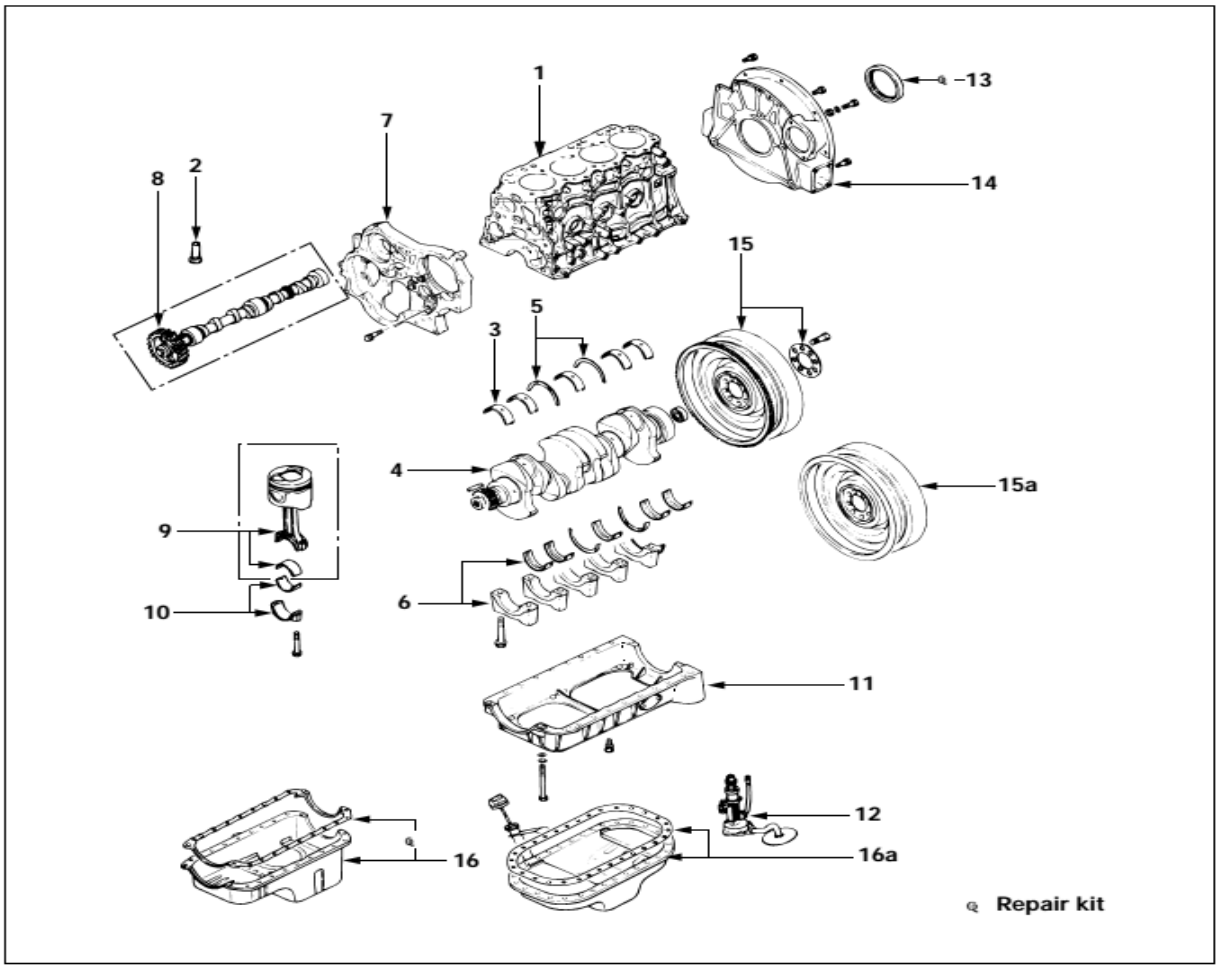
1.20. Check ring back clearance.

1.21. Fit rings correct way up. "inner chamfer upwards, outer chamfer down, unless otherwise marked."

1.22. Oil up rings and pins adequately before fitting, check free fall of rod for tight pins.

1.23. Don’t tap pistons down the bore after entry of top ring, gently push pistons down, checking for correct ring drag.
1.24. Always check big end side clearance before rotating engine.
1.25. Check piston deck height.
1.26. Tension cylinder head bolts in correct sequence.
1.27. Polish pressure relief valve so it rattles back and forth in housing freely.
1.28. Prime oil pump using a mixture of engine oil and petroleum jelly.

REASSEMBLY



Reassembly Steps – 1

- ▲ 1. Cylinder body
- ▲ 2. Tappet
- ▲ 3. Crankshaft upper bearing
- ▲ 4. Crankshaft with crankshaft timing gear
- ▲ 5. Crankshaft thrust bearing
- ▲ 6. Crankshaft bearing cap with lower bearing
- ▲ 7. Timing gear case
- ▲ 8. Camshaft with camshaft timing gear and thrust plate
- ▲ 9. Piston and connecting rod with upper bearing
- ▲ 10. Connecting rod cap with lower bearing
- ▲ 11. Crankcase (If so equipped)
- ▲ 12. Oil pump with oil pipe
- ▲ 13. Crankshaft rear oil seal
- ▲ 14. Flywheel housing
- ▲ 15. Flywheel
  - 15a Rear flywheel (If so equipped)
- ▲ 16. Oil pan
  - 16a Oil pan (If so crankcase equipped)

Inverted Engine

Figure 25 exploded view

2. Cylinder head Reassembly sequence

Cylinder head(s) should be completely assembled at this time.

A. Lubricate all valve stems and install?

B. Install all valve guide seals

C. Measure valve stem height correctly

D. Measure valve spring installed height correctly (Within specification)
E. Check to see if the valve seat to face contact area can hold a seal/fluid
F. Use new keepers and install them. (Unless it was determined that the old ones could be reused)
G. Install camshaft (if it's overhead)
H. Install rocker arm assembly (for some model)

LAP Test	Practical Demonstration

Name: _____ **Date:** _____

Time started: _____ **Time finished:** _____

1 Use recommended or proper tools and equipment for re-assembling
2 Refer service manual for correct procedure and manufacturer specification
3 Clean components parts before being install to original place
4 Before assembling as per required lubricate components parts

LG #25	LO #4- Checking and testing engine operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Mounting engine securely in preparation for starting
- Checking engine fluid levels, including lubrication and coolant
- Checking gauges and warning devices
- Starting engine and run for a specified period
- Doing On-the-road test of engine by a certified driver
- Checking engine for leaks and abnormal noises

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Mount engine securely in preparation for starting
- Check engine fluid levels, including lubrication and coolant
- Check gauges and warning devices
- Start engine and run for a specified period
- Do On-the-road test of engine by a certified driver
- Check engine for leaks and abnormal noises

Learning Instructions:

10. Read the specific objectives of this Learning Guide.
11. Follow the instructions described below.
12. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
13. Accomplish the “Self-checks” which are placed following all information sheets.

14. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
15. If you earned a satisfactory evaluation proceed to “Operation sheets
16. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
17. If your performance is satisfactory proceed to the next learning guide,
18. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1 Mounting engine securely in preparation for starting

1. Preparation for Engine Starting

Before starting the engine, the following checks and procedures must be followed

All components that have been overhauled should have been correctly reassembled and fitted and their function checked.

All devices and tools which were used, have been removed from the engine and that no cleaning rags or other items have been left behind.

a) Check the fluid levels of all the tanks in the engine systems including the leakage drain tanks.

b) Check that all the shut-offs for the engine cooling water and lubricating oil systems are in the correct position.

c) Open the air supply to the shipboard system and from the starting air receivers to the control air supply.

d) Prepare the fuel system

e) Start up the pumps for cylinder cooling water, crankcase bearing and crosshead bearing lubricating oil and set the pressures to their normal values. Preheat the cooling water to 60°C.

f) Check to ensure that all systems have been correctly vented and that there is a positive flow of cooling water and lubricating oil.

g) Open the indicator cock on each cylinder cover. Using the turning gear, turn the engine through a minimum of one full revolution to check that all the running gear is in order. Check if any water, oil or fuel has collected on the piston crown. Operate the cylinder pre-lubrication system. Shut the indicator cocks.

h) Check to ensure that all the crankcase doors are closed with all the latches tight.

I) Check to ensure that cut-out devices for all the fuel injection pumps are correctly positioned for normal fuel pump operation and that the exhaust valve actuator pumps are also ready for operation, i.e. the cut-out devices are removed.

j) Check that the fuel regulating linkage moves freely.

At the auxiliary maneuvering stand disengage the fuel control lever from the position

Self-Check 1	Written Test

Instruction: - chose and write the letter of the correct answer on the space provided (4 pts)

1 task of gaskets is to seal off the various media in the engine including gases

2 Inspection is not part of engine service

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet -2 Checking engine fluid levels, including lubrication and coolant

1. WHAT FLUIDS DO I NEED TO CHECK IN MY VEHICLE?

The six fluids you should check are Engine oil, Coolant (Antifreeze), Power steering fluid, Brake fluid, Transmission fluid (in an automatic transmission vehicle, not a manual), and Windshield washer fluid. Check these regularly to ensure proper vehicle function and longevity! Make a schedule and always watch out for unusual noises, odors, or vibrations.

2. WHAT IS THE PURPOSE OF THE FLUIDS IN MY VEHICLE?

Keeping proper fluid levels play a huge part in almost every function of your car - including fuel economy and longevity. With engine components spinning thousands of reps per minute, it's the engine oil that keeps everything lubricated and smoothly in motion. Coolant (antifreeze) keeps the engine cool in the summer and protects it from freezing during the winter. Coolant also prevents corrosion, deposits, and foam from reducing cooling efficiency. Power steering fluid allows easy steering maneuverability (Anyone remember driving a classic car without power steering?!). Brake fluid connects the brake pedal to the brakes - when stepping on the pedal, a plunger pressurizes the fluid inside the brake lines, which cause the brake pads to clamp on the rotors, thus slowing the vehicle. Transmission fluid lubricates and cools transmission components (gears, clutches, and valves). Vital to safe driving, windshield washer fluid allows the driver to see clearly.

3. WHEN IS IT BEST TO CHECK THE FLUID LEVELS?

A good rule of thumb is to schedule an oil change every 3,000miles (5,000 if using synthetic oil) and check all the other fluids at the same time. If you schedule an oil change at Dowell Automotive, we will routinely check all fluids, tire pressure, and other general maintenance items while the vehicle is in the shop. But if you're checking them at home, start with your car, truck, or SUV parked on level ground and the engine cold. Checking the oil with a hot engine causes inaccuracy, and coolant can spray and cause burns if hot.

Power steering and brake fluid can be checked whenever the vehicle is parked but should be monitored periodically.

Transmission fluid has to be checked with the vehicle in park or neutral and the engine running to be accurate. Many transmissions come with a "lifetime" fluid that should never need replacement, but checking it periodically will ensure proper transmission function.

Windshield washer fluid should be checked periodically, based on how often the driver uses it. If you frequently spray your windshield with washer fluid, checking the level when you fuel up your car would be an advised routine.

4. ENGINE OIL

The engine oil dipstick will be located near the front of the engine of you have a front-wheel drive vehicle or located behind the engine if a rear-wheel drive vehicle. Most vehicles have a cap with an oil image or "engine oil" or type of oil listed in wording (see image to the left). First, pull the dipstick out and wipe it clean with a towel or rag. Then, reinsert the dipstick all the way and pull it back out again. You should be able to see oil on the stick. The dipstick has marked indicators for maximum ("full") and minimum ("add") level. Oil should be near the maximum line/area. Engine oil is yellow/amber color when new and brown/black when it's time for an oil change. If the oil has a burnt or gasoline odor, please schedule an appointment with us to look into engine issues further.

5. COOLANT

Find the radiator cap, usually with a symbol or "engine coolant" "antifreeze" wording open it to see if the fluid level is filled up to the top. Coolant comes in a variety of colors depending on vehicle model age and manufacturer - blue, yellow, green, red, pink or purple. Never mix coolant types and always replace with the same type of antifreeze your vehicle's manual recommends. In an emergency (on a hot summer day), you can pour straight water into the coolant reservoir, until you get more coolant bought - water will freeze in the winter and doesn't offer corrosion, deposit, or foam prevention like antifreeze.

6. POWER STEERING FLUID

Look for either a dipstick or reservoir cap in the engine bay with a label of power steering. Checking a dipstick for power steering fluid is similar to checking a dipstick for engine oil (see above). Power steering fluid is white wine/pinkish color.

7. BRAKE FLUID

Locate the brake fluid cap, usually identified by brake fluid text or the similar (see image to left). Checking the brake fluid reservoir under the hood is as simple as taking the cap off and

looking inside at the level and color. Brake fluid should be near the top and is an amber/white wine color.

8. TRANSMISSION FLUID

Some cars have a dipstick (like the left image), but others require a mechanic to inspect. If yours has a dipstick, the process to check is similar to engine oil but the engine needs to be running and the transmission in park or neutral depending on the manufacturer. It should be a translucent red/amber color.

9. WINDSHIELD WASHER FLUID

Usually blue, green, or orange/red in color, windshield washer fluid is one of the easiest (and most identifiable) under the hood. The cap usually has text or a symbol like the image to the left. If the fluid level isn't at or near the top, simply pour new washer fluid into the reservoir until it's full and close the cap. There are many brands and options of windshield washer fluid, but you might consider the type with a Rain-X additive for clearer windshield while driving in rain.

Self-Check 2	Written Test

Instruction: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (2 pts)

1. When we go to check the oil level check

   A. Engine oil C. steering oil

   B. Transmission oil D. all

2. Which one of the following oil is need to check daily?

   A. Transmission fluid C. brake flued

   B. Steering flued D. none E. all

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet -3	Checking gauges and warning devices

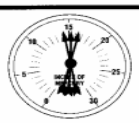
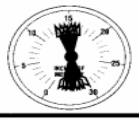
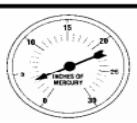
1. Engine Diagnostic and Testing

Certain engine problems will require more in-depth testing of the engine's overall mechanical condition beyond the preliminary testing steps discussed previously. Some of these more in-depth tests include those for engine vacuum, cylinder power balance, cylinder compression and cylinder leakage.

1.1. Manifold Vacuum and Testing Vacuum / Pressure

In reference to vacuum and pressure, keep in mind that a vacuum still has a certain amount of pressure. It is simply lower than atmospheric pressure. Normal atmospheric pressure at sea level is 14.7 pounds per square inch (psi)
(49.8kpa), but most standard pressure gauges, such as a tire gauge, assign atmospheric pressure a value of "0."

Some pressure specs are actually expressed in "psig," indicating "pounds per square inch – gauge," to distinguish them from absolute pressure.

	Readings	Possible Cause
	1. Average, steady readings between 15–22 inches Hg (normal readings for a 60° V6 engine may be lower, i.e., 12–16 inches Hg)	1. Normal
	2. Low but steady, between 12 and 15 inches Hg	2. Leakage around piston rings, late ignition timing, or late valve timing
	3. Needle fluctuates or drops between 1 and 2 inches Hg at idle	3. Burned or leaking valve or spark plug in one of the cylinders is not firing
	4. Irregular needle drop between 1 and 2 inches Hg	4. Sticking valve, intermittent spark plug misfire, or rich or lean air/fuel mixture
	5. Normal at idle speed, but excessive vibrations at higher rpm	5. Weak valve springs; valves sticking in guides
	6. Excessive vibrations at idle speed, but steadies at higher rpm	6. Worn valve guides
	7. Excessive vibration at all rpm	7. Leaky head gasket
	8. Needle oscillates slowly, or drifts, between 3 and 9 inches Hg lower than normal	8. Intake system leak
	9. Normal at idle speed, but drops to near zero and rises to lower than normal	9. Restriction in exhaust system

Manifold Vacuum Readings and Possible Indications

Figure 26 manifold vacuum reading and possible indication

When the throttle plate is closed at idle, the vacuum in the manifold is greatest. When the throttle plate is open and the manifold is exposed to atmospheric pressure, vacuum is lower.

Using a vacuum gauge to check manifold vacuum is a quick and easy way to test an engine. A manifold vacuum measurement is a good indicator of the engine's ability to run efficiently.

Some areas that can be diagnosed using vacuum readings include:

- Engine components (i.e., valves, valve guides and springs, piston rings)

- Manifold leaks
- Valve timing
- Restricted exhaust system.

1.2. Power Balance Testing

Power Balance Testing is another method of determining general engine condition. This test measures how much the engine speed changes when individual cylinders are disabled one-at-a-time. If each cylinder is contributing an equal amount of power to the engine, disabling any cylinder should change the engine speed equally.

Figure 27 power balance tester

1.3. Compression Testing

We have noted that the engine cylinders must produce and hold good compression pressure for proper combustion to take place. Cylinder compression pressure can be checked using a compression tester, an inexpensive and simple tool.

There are two types of compression tests:

- A cranking compression test, which can help identify leaking piston rings, leaking valves, or a blown head gasket.
- A running compression test, which determines the engine's "breathing ability" and volumetric efficiency. Volumetric efficiency is the measure of the quantity of air brought into the cylinder during engine operation.
- More correctly, volumetric efficiency is a ratio (or percentage) of the quantity of fuel and air that actually enters the cylinder during induction to the actual capacity of the cylinder under static conditions.

Figure 28 compression tester

1.4. Cylinder Leakage Testing

Cylinder Leakage testing is performed to determine the amount of compression loss in a cylinder and pinpoint the source of compression leakage. Several tool manufacturers make cylinder leakage testers, or one may be easily fabricated from an adjustable air pressure regulator and some pipe fittings.

Cylinder leakage testing should be done with the engine at operating temperature to produce the most accurate results. Remove the spark plug in the cylinder to be tested, bring the piston to TDC, and then introduce regulated compressed air into the cylinder via the spark plug hole.

Leakage location can be found by listening for the sound of air escaping while the cylinder is pressurized. There are five major leak paths where cylinder pressure can escape:

- Past the piston rings
- Past the intake valve
- Past the exhaust valve
- Past the head gasket
- Through a crack in the cylinder head or engine block

Cylinder Leakage Tester

Figure 29 cylinder leakage tester

Self-Check 3	Written Test

Instruction: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided or on the separate answer sheet (2pts each)

1) ----------is help to identify power loose on engine

   a. Compression tester c. oil pan
   b. Leakage tester d. a &b

2) Identifying any problem by using testing equipment is called

   a. Inspection c. diagnosis
   b. Leakage test d. power balance test

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet 4- Start the engine and run for a specified period

1. Break-in (mechanical run-in)

Break-in or breaking in, also known as run-in or running in, is the procedure of conditioning a new piece of equipment by giving it an initial period of running, usually under light load, but sometimes under heavy load or normal load. It is generally a process of moving parts wearing against each other to produce the last small bit of size and shape adjustment that will settle them into a stable relationship for the rest of their working life.

Engine break-in

A new engine is broken in by following specific driving guidelines during the first few hours of its use. The focus of breaking in an engine is on the contact between the piston rings of the engine and the cylinder wall. There is no universal preparation or set of instructions for breaking in an engine. Most importantly, experts disagree on whether it is better to start engines on high or low power to break them in. While there are still consequences to an unsuccessful break-in, they are harder to quantify on modern engines than on older models. In general, people no longer break in the engines of their own vehicles after purchasing a car or motorcycle, because the process is done in production. It is still common, even today, to find that an owner's manual recommends gentle use at first (often specified as the first 500 or 1000 kilometers or miles). But it is usually only normal use without excessive demands that is specified, as opposed to light/limited use. For example, the manual will specify that the car be driven normally, but not in excess of the highway speed limit.

2. Goal

The goal of modern engine break-ins is the settling of piston rings into an engine's cylinder wall. A cylinder wall is not perfectly smooth but has a deliberate slight roughness to help oil adhesion. As the engine is powered up, the piston rings between the pistons and cylinder wall will begin to seal against the wall's small ridges Additionally older design engines had a flat lifter that was pushed by the camshaft lobes. It needs to spin during operation to avoid excessive wear to the camshaft lobe. At idle speeds on a new engine poor machining tolerances could prevent the lifter from spinning and destroy the camshaft. After 20 minutes of wear, or "self-machining" at higher engine speeds they would typically be able to spin freely.

In the past, the engine break-in period was very important to the overall life and durability of the engine. The break-in period required has changed over the years with improved piston ring materials and designs. In reference to small engines, the break-in period now (5-10 hours) is short in comparison with that of engines of the past. Aluminum cylinder bore engine piston rings break-in faster than those used on cast iron cylinder bores.

3. Preparation

There are important preparations which must be made before the actual process of running the engine. The break-in can take place either in the vehicle or on an engine stand. Each engine has specific preparation needs of its own due to factors such as the many different types of engine models, the vehicles it belongs to, and conflicting expert instructions. For example, each engine should be lubricated and run on oil specified by its designers which can be found in a manual Process

The main area of controversy among engine break-in instructions is whether to run the engine slowly or quickly to initiate the process. Those who promote raising the power settings steadily will recommend changing the engine setting from low to high powers as to not work the engine too hard and create excessive wear on the cylinder wall (which would require the pistons to be removed and wall fixed). Other experts disagree and believe that to start the engine at a high power is the best way to effectively set in the pistons. The following are examples of how the two processes

4. **can be carried out:**

4.1. Start high power

Start with revolutions per minute (rpm) between 2500 and 4000, and run the engine for about 20 minutes while watching so that the oil pressure does not get too high, which is dangerous. After changing oil and checking that the engine functions, drive using lower power settings. A high power setting is relative to the vehicle type, so half as many rpms may be necessary if a car has a smaller cylinder wall.

4.2. Start low power

Revolutions per minute should be around 1500 rpm. Run for about half an hour while checking the oil pressure and there should not be any over-boiling of the engine's coolant, which is a combination of air, oil, and water. Once this initial step is completed, drive at

varying speeds on the road (or stand) by accelerating between speeds of 30 and 50 miles per hour Consequences

5. The following are consequences of a bad engine break-in:

Oil will gather in the cylinder wall, and a vehicle will use much more of it than necessary.

If a ring does not set into the grooves of the cylinder wall but creates friction against them each time an engine runs, the cylinder wall will be worn out.

Unsuccessful setting of piston rings into a cylinder wall will result in the necessity of new engine parts, or the entire engine depending on how extensive the damage is.

Camshaft lobes wear down and are destroyed on flat type lifters in older engine designs.

Self-Check 4	**Written Test**

Directions: Answer all the questions listed below. Write the answer on the space provided below :

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1) task of gaskets is to seal off the various media in the engine including gases
2) Inspection is not part of engine service

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet 5- Do On-the-road test of engine by a certified driver

1. Vehicle Requirements

1.1. The vehicle used to take the test must:

Have a current registration card with a valid window registration sticker (if applicable) or current sticker displaying a valid expiration date affixed to the plates (if applicable)

Have a motor vehicle liability insurance card or the policy, which must identify the vehicle and include the expiration date

Display a valid inspection sticker, if applicable. Vehicles displaying failed inspection stickers are not acceptable for the road test

Display front and rear license plates (if applicable), properly affixed to the bumper

Have properly functioning brake lights, turn signal lights, horn, windows that roll up and down, operable doors with inside and outside door handles, inside rear view mirror, and outside side (left/right) view mirrors properly placed, and a hand emergency brake located between the driver and front passenger seats

Have a windshield with no cracks or debris, providing an unobstructed field of vision and nothing hanging from the rearview mirror

Have tires that are in good condition and properly inflated. Spare (donut) tires are not acceptable

Rental vehicles are allowed for road tests only if the person taking the test is listed on the rental contract as an approved driver of the rental vehicle

Have no service or warning lights illuminated on dashboard, including low gas

1.2. Road Skills Test Requirements

The non-commercial driver license road test is available by using either in-house DC DMV personnel based on DC DMV's appointment system or by using a third party tester.

On the day of your test, go to the DMV road testing service location at your scheduled appointment time. If you fail the road skills test, you must wait 72 hours before you are eligible to retest. If you fail the road skills test 6 times within a 12 month period, you will not be allowed to take the 7th test until 12 months after the 1st failed test.

2. Necessary Items

You must:

- ✓ Arrive at least 15 minutes before your appointment
- ✓ Arrive in a vehicle that fulfills the vehicle requirements below
- ✓ Bring your valid learner permit
- ✓ Be accompanied by a licensed driver 21 years or older
- ✓ Bring a car that has valid registration and proof of insurance
- ✓ Wear your seat belt
- ✓ Bring your 40-hour Certification of Eligibility for Provisional License form, if you are under 21 years of age

***Please note**: If you have a learner permit and drive yourself to your road test appointment without being accompanied by a licensed driver, you will not be allowed to take your test for 6 months.*

Self-Check 5	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided or on the separate answer sheet (2 pts each)

1) Driver age is one criteria to conduct the road test
2) Road test is the final parts of the road test

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet 6- Checking engine for leaks and abnormal noises

1. Symptoms of an Exhaust Leak

Exhaust systems work hard for your car and for you. How, you ask? The exhaust system removes harmful emissions from your vehicle's emissions and converts them into less harmful exhaust that is then routed out the tailpipe. Without a properly working exhaust system there would be a chance that these poisonous gases that are colorless and odorless could make their way into the passenger cabin, putting you and your passengers at serious risk of inhalation that could lead to death. If you suspect, you have an exhaust leak don't delay having an auto repair shop take a look and fix it. Here are three common signs of exhaust trouble that you should be aware of.

2. Increased Engine Noise

Probably the most common sign of an exhaust leak is increased engine noise. As the exhaust escapes it will cause your engine to rumble loudly as you drive down the road, but again the symptom will be more prominent during acceleration.

If you suspect an exhaust leak do yourself a favor and have it checked out right away, for the sake of your car, but also to ensure your own health. Exhaust fumes are dangerous and if they are able to make their way into the cabin you run a serious risk of major health issues. For expert exhaust repair in Saratoga Springs bring your vehicle to The Car Doctors Tire Pros. We conduct exhaust repair and many other forms of auto repair as well. Give us a call at (650) 492-6853 to schedule an appointment for quality auto repair in Saratoga Springs today!

3. Top Signs of an Exhaust Leak

The exhaust system has a very important job that starts under the hood and ends at the back of the car. The task at hand is routing harmful fumes produced by the engine under the passenger cabin, through the catalytic converter and out of the tailpipe. Measurements taken in the exhaust help to establish the correct air and fuel mixture and leaks can result in

numerous engine issues. However, it is important to understand that while a leak is bad for your car, it can be much worse for you and your passengers. Exhaust fumes are deadly and often times undetectable until it is too late. If you notice any of these signs of an exhaust leak don't hesitate to get to a repair shop for proper diagnostics and repair.

4. Loud Engine Rumbling

One of the most common signs of an exhaust leak is if the engine begins to sound much louder than normal. Since the exhaust system is designed to dampen engine noise a leak in it will cause the increased volume. This will be most noticeable during rapid acceleration, such as when getting on the highway.

5. Gas Pedal Vibrations

Another symptom of an exhaust leak is if you can feel the gas pedal vibrating, even slightly. The sensation is caused by exhaust fume rapidly existing the system through a small hole, causing reverberations. A bad leak could also cause steering wheel vibrations or the whole car may shake.

6. Decreased Fuel Efficiency

While there are many things that can result in a loss of fuel economy an exhaust leak will often cause a massive drop. This is because the oxygen sensor in the exhaust system will detect excessive oxygen if there is a leak, which will cause the vehicle to use more fuel than is necessary.

7. Check Engine Light

The check engine light is a sign of an exhaust leak, but it can also represent many other problems. Anytime the check engine light comes on it is important to get it checked out to find out what is going on. Many times the issue will start small and grow into something worse, such as a bad oxygen sensor causing a failed catalytic converter.

If you believe you have an exhaust leak don't hesitate to have diagnostics ran. For professional exhaust repair in Everett head to ONB Automotive. Our crew is designated to providing the highest quality auto repair for all makes and models. To learn more, or to schedule an appointment for expert auto repair in Everett, give us a call at (425) 317-9618 and we will be happy to assist you.

Self-Check 6	Written Test

Directions: Answer all the questions listed below. Write the answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts)

1) Check engine lamp is one method to now the engine fault
2) Exhaust gas leakage is having the abnormal sound

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Operation Sheet-1 Check and Run engine for specified period

Step-1 Engine - initial start-up after overhaul

1. With the engine refitted in the vehicle, double-check the engine oil and coolant levels. Make a final check that everything has been reconnected, and that there are no tools or rags left in the engine compartment.
2. Remove the spark plugs. On models with a distributor, disable the ignition system by disconnecting the ignition HT coil lead from the distributor cap, and earthing it on the cylinder block. Use a jumper lead or similar wire to make a good connection. On models with a static (distributor-less) ignition system, disable the ignition system by disconnecting the LT wiring connector from the ignition module, referring service manual for further information.
3. Turn the engine on the starter until the oil pressure warning light goes out. Refit the spark plugs, and reconnect the spark plug, referring service manual for further information.
4. Start the engine, noting that this may take a little longer than usual, due to the fuel system components having been disturbed.
5. While the engine is idling, check for fuel, water and oil leaks. Don't be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.
6. Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose, then switch off the engine.
7. Check the ignition timing and the idle speed settings (as appropriate), then switch the engine off.
8. After a few minutes, recheck the oil and coolant levels, and top-up as necessary.
9. Engines with hexagon type cylinder head bolts, it will be necessary to re-tighten the head bolts after the engine has been run up to normal working temperature then switched off and allowed to cool. On all other engines, if they were tightened as described, there is no need to re-tighten the cylinder head bolts once the engine has first run after reassembly.
10. If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 500 miles (800 km). Do not operate the engine at full-

throttle, or allow it to labor at low engine speeds in any gear. It is recommended that the oil and filter be changed at the end of this period.

Step-2 compression

a) Warm-up the engine to normal operating temperature.
b) Remove the sparkplugs of all cylinders using the proper tool.
c) Disconnect terminal 15 of the ignition coil.
d) Crank the engine with starting motor speed for a few seconds only; this will blow out residues of combustion through the plug hole.
e) Starting from the first cylinder, insert the compression tester into the spark plug hole.
f) Open the throttle vale fully to ensure that the maximum amount of air will enter the cylinder.
g) Crank the engine through 5 to 10 compression strokes.
   NB: - All cylinders should be tested with the same number of compression strokes.
h) Write down the maximum pressure indicated by the tester or gauge and compare this figure with the normal one given by the vehicle manufacturer.
i) Continue with the next cylinder.

Step-3 Leakage test

a) Warm-up the engine to normal operating temperature.
b) Remove the spark plugs, radiator cap, oil filter cap, oil dip stick, air cleaner.
c) Open fully the carburetor throttle valve.
d) Connect the leakage tester to the shop air supply and make sure the pressure regulator on the tester is adjusted to “zero “.
e) Select the appropriate adapter and fit into cylinder No.1.
f) Using a whistle, determine the TDC position.
g) After determination of TDC remove the whistle from the cylinder adapter.
h) Adjusting the pressure regulator to 100%, connect the leakage tester to the cylinder.
i) Lock the crankshaft or engine in the TDC position to avoid crankshaft rotation when pressure is applied to the cylinder.
j) Check the places where excessive air leakage can be heard, felt or seen.
k) Proceed with the other cylinders.

LAP Test	Practical Demonstration

Name: _____ **Date:** _____

Time started: _____ **Time finished:** _____

1 Use recommended or proper engine testing device
2 Perform and register engine performance test result
3 Check and calibrate engine system
4 Perform engine compression and leakage test

LG #26 LO #5- Preparing engine for delivery to customer or installation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Sealing engine openings and passages
- Finalizing and processing work completion documentation
- Making final inspection to ensure protective features
- Cleaning engine to workplace expectations
- Processing Job card with workplace procedures
- Cleaning and making ready workstation for the next

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Seal engine openings and passages
- Finalize and processing work completion documentation
- Make final inspection to ensure protective features
- Clean engine to workplace expectations
- Process Job card with workplace procedures
- Clean and making ready workstation for the next

Learning Instructions:

19. Read the specific objectives of this Learning Guide.
20. Follow the instructions described below.
21. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
22. Accomplish the “Self-checks” which are placed following all information sheets.

23. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
24. If you earned a satisfactory evaluation proceed to “Operation sheets
25. Perform “the Learning activity performance test” which is placed following “Operation sheets”
26. If your performance is satisfactory proceed to the next learning guide,
27. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1 Sealing engine openings and passages

1. What Is Engine Sealing?

The engine gasket is a key component. It contributes to an efficient, safe and cost-effective engine running. Gaskets are highly technical and complex engine components. They are used in many different forms and material compositions in modern combustion engines and assemblies. Professional engine sealing is a good way to ensure that your engine components are staying in tip-top shape for many kilometers to come. Your car's head gasket is an important part of the engine. It seals the cylinder head to the engine block. The cylinder head houses the engine valves while the engine block contains the crankshaft and pistons. Over time, head gaskets can start to leak. These leaks vary in terms of severity, and while a minor leak may simply increase oil or coolant consumption, a more severe leak or blown head gasket can cause complete loss of compression. It can also cause your cooling system to fail and make your car's engine overheat. At Pfaff Tuning in Vaughan, ON, we can take care of your engine sealing and resealing needs. Keep your engine and all its components in the best shape possible with Pfaff Tuning!

It is important to know how the head gasket works if you are opting for engine sealing or resealing services. Below, we have included some facts about the head gasket part of the engine makeup.

1.1. Function

The primary task of gaskets is to seal off the various media in the engine including gases, water, and oil from both one another and the outside world. However, gaskets also function as power transmission links. For example, the cylinder head gasket between the engine block and the cylinder head has a significant impact on power distribution within the entire tensioning system and the resulting component deformations.

1.2. Engine seal damage

Drivers usually only notice components of the engine sealing system that they cannot see in the event of a leak. However, in such cases, the failure of the seal is not the cause of the leak. In most cases, it is damage to surrounding components that exposes the sealing element to excess stress and strain. The engine overheating, for example, can trigger a gasket fault.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Write the Answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

6) task of gaskets is to seal off the various media in the engine including gases
7) Inspection is not part of engine service

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet-2 Finalizing and processing work completion documentation

1. Finalizing and processing work completion documentation

Regulated business realizes the importance of keeping up on their vehicles' maintenance. What are not always clearly understood, however, is the vehicle maintenance records the Federal Motor Carrier Safety Administration (FMCSA) requires. This includes the specific documents that need to be kept, the manner in which information is to be maintained and the retention periods. These regulations apply to any owned or leased vehicle (provided the leased vehicle is being operated for at least 30 days) that meets one or more of the following requirements:

- Has a Gross Vehicle Weight Rating (GVWR) or Gross Combination Weight Rating (GCWR) of 10,001 pounds or more
- Carries hazardous materials and requires placarding

2. Vehicle Maintenance Files (VMFs)

The FMCSA requires that individual files be maintained for all CMVs. Many companies do retain maintenance records; however, they are often disorganized and kept in one file. In the event of a FMCSA audit, this can make it difficult for the safety auditor to make an accurate assessment of the company's maintenance methods. And that means headaches – and possibly hefty fines – for the company.

Let's take a moment to look at a situation that although hypothetical, the owner of a home services company undergoes an FMCSA compliance review. When the safety auditor requests to see vehicle maintenance records, the owner is confident knowing that he is on top of maintaining his CMVs. He plunks down a large file that he has been keeping for years containing repair receipts, DMV records, insurance forms, etc. What he's not prepared for is the excruciating 4-hour examination of documents by a stringent auditor who has to rummage through a mass of disorganized paperwork. He receives several violations for failing to keep records of inspection and vehicle maintenance. The owner is shocked…. he has been maintaining all of his records for years, isn't it obvious he takes care of his vehicles?

3. Filing methods and documentation of repairs and maintenance

A good way to make sure you set up acceptable Vehicle Maintenance Files (VMFs) is to put yourself in the auditor's shoes for just a minute. Would you want to go through a jumbled mass of years of paperwork, trying to sift out pertinent documents?

3.1. Here are three steps to keep in mind when creating and maintaining your own files:

3.1.1. Create one separate file for each vehicle (including trailers)

The auditor wants to be able to select a vehicle file and be able to immediately and clearly identify the vehicle. Therefore, the first stand-alone document should be a Vehicle Identification Record that contains identifying information such as the make, model, year and VIN.

3.1.2. Clearly identify receipts of repairs and regular maintenance

It's important to keep receipts, but the auditor needs to be able to tell what the receipt is for. For example: you purchase new windshield wipers, light bulbs and batteries. You also throw in some air fresheners, heavy duty garbage bags and a pack of gum. You should keep a document or form of the vehicle purchases and staple the receipt to it, highlighting the date and the purchases that pertain to the vehicle.

3.1.3. Document roadside inspections

Any time a roadside inspection occurs, whether violations are found or not, you need to keep the roadside inspection report in the vehicle's file. Moreover, if defects (aka violations) are found, it is crucial to get them fixed promptly and to staple evidence of the repair to the inspection report.

Your VMFs need to reflect that you are on top of all regular maintenance needs, and that you repair all defects in a timely manner. An auditor wants to be certain that your vehicle is able to be safely operated on public roadways. Therefore, not only do you want to be able to document when you last had maintenance performed, but also when you project it will next be needed.

3.1.4. Retention Periods

All vehicle maintenance records must be retained for a minimum of 12 months with one exception: Annual DOT Inspection Reports must be retained for 14 months.

4. Periodic/Annual Inspections and Reports

Annual or Periodic DOT Inspection Reports are a crucial aspect of maintenance records that are often overlooked. These are the inspections in which you receive a sticker on the CMV indicating that it has passed its annual inspection. Even if you are not expecting a FMCSA audit in the near future, do not put off getting organized and implementing an effective Vehicle Maintenance Filing System.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Write the Answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1) task of gaskets is to seal off the various media in the engine including gases
2) Inspection is not part of engine service

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____ **4** _____

Information Sheet-3 Making final inspection to ensure protective features

1. Making final inspection

1.1. A pre-delivery inspection is an inspection carried out, either by a customer or service garage, prior to the final delivery of the product. It is used in several garages.

2. Automotive industry

In the automotive industry, a pre-delivery inspection is "the final check carried out by the dealer on a car before they hand it over to you", and includes various checks to ensure that the vehicle is up to a certain standard before it is presented to the purchaser.

2.1. Basic PDI Car Checks

Pre-delivery inspection is a crucial task because it helps secure the safety of your customers. It is performed to prevent car manufacturing product recalls and accidents due to factory defects or damage. The following are the basic checks performed during the pre-delivery inspection of a light vehicle.

2.1.1. Engine Compartment

- The engine should not produce any growling sounds
- All fluids such as washer, coolant, brake, power steering, transmission, and oil are free from leaks and at their normal levels
- Hood latch should be lubricated to ensure smooth operation
- The battery is tested and fully operational

2.1.2. Underside

- There are no visual defects such as tears or holes on hoses, electrical lines, exhaust systems, and suspension components
- Brakes should be tested and checked for damage indicators such as brake lights on, squeaking noises, vibration, and soft brake pedal

2.1.3. Interior

- The steering wheel should be aligned
- Locks, latches, and hinges are lubricated and functional
- Fuses are installed for electronic accessories

- No evident damage on car seats
- Seat belt, wheel covers, wheel locks, and airbags are installed properly

2.1.4. Exterior

- All lighting should be checked if operational
- Headlights are aligned
- Tire pressure is set to manufacturer-suggested specifications, including the spare tires
- All mirrors should be fixed and clear
- Windshield wipers and washer fluid level are examined
- Paint condition and emblems are damage free

PDI also includes checking of owner's manual, service passport, warranty booklet, and guides before handing vehicle over to customers. It is also necessary to perform the recommended 10-kilometer road test both on city roads and the highway to check overall car performance.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Write the Answer on the space provided below:

Instruction: - chose and write the letter of the correct answer (2 pts)

1. Which one of the following part is inspect as interior parts?
   A. The steering wheel should be aligned
   B. Locks, latches, and hinges are lubricated and functional
   C. Fuses are installed for electronic accessories
   D. All

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-4 Cleaning engine to workplace expectations

1. How to Clean Your Car's Engine?

Follow these 10 simple steps, and you'll be proud to show off what's under the hood.

Don't you feel good when your car is clean and all shined up? A well-kept car looks great rolling down the street or sitting in your driveway, and you'd swear it even drives better. But if you want to take your ride all the way to beautiful, you also should to address the dirt and grime under the hood. Even though the engine bay is not exposed to the elements—at least not from above—debris and dust creep in from openings around the hood and the vehicle's front end. Cleaning your engine might sound daunting—how do you wash a big hunk of metal and plastic? —but following these 10 steps can turn the job into a simple afternoon task, and a very satisfying one. Here's how to clean your engine quickly and efficiently.

Step 1: Schedule Ideally, pick a warm day. Warmer weather, especially low humidity with some wind, will help dry the engine and components after cleaning.

Step 2: Cool If the car was running, flip the hood up and allow the engine to cool for at least 15 minutes. Hot engine components can not only burn you, but they can also be damaged by rapid contraction if sprayed with cool water.

Step 3: Remove any plastic covers under the hood. These can be scrubbed separately. Also remove the negative terminal from the battery. This will help protect the electrical components from getting damaged if they get wet. You can also remove the battery if you'd prefer, but we've cleaned many an engine bay without doing so.

Step 4: Cover Using plastic bags, cover any sensitive electrical components, such as the battery, ignition wires, and engine control unit. If there's an exposed engine air intake under the hood, you'll want to cover that as well. If you feel like you'll be particularly careful with your rinsing, then you can skip this step. However, protecting these electronics will allow you to clean more thoroughly with less risk of damaging anything.

Step 5: Degrease Thoroughly spray the entire engine compartment with degreaser. Any household degreaser will work, whether it's a kitchen cleaner or a purpose-made engine degreaser. We've used Simple Green (we like its eco-friendly formula). Don't hold back—every square inch should be covered.

Step 6: Scrub Depending on how dirty your engine is, you may not need to scrub. However, some areas, like the valve cover, may have years of caked-on oil and dirt. A small brush with synthetic—not metallic—bristles will go a long way toward working the degreaser in and cleaning away the gunk. Add more degreaser if needed.

Step 7: Rinse If you have a power washer, you can use it on a light setting, but a standard hose will work as well. Or you can use the sprayer at the local DIY carwash. Rinse the entire compartment, working from back to front, washing away all degreaser. Try not to directly spray electrical components, and try to prevent spraying much water into areas that won't dry easily.

Step 8: Dry If you have compressed air available to you, you can blast air in the nooks and crannies to remove excess water. If not, wipe everything you can reach with a shop towel or rag. This will not only remove water but will also help remove any remaining grime.

Step 9: Replace Reinstall the negative terminal on the battery and remove the bags covering the electrical components.

Step 10: Repeat The key to making this project simple is not letting your engine compartment get too dirty in the first place. A quick degreasing every year or two will help keep your engine looking clean with no more than an hour of work. Your ride's engine may never look as sexy as the one above, but a gleaming engine bay is guaranteed to make you feel happy.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Write the Answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts each)

1. Degreasing means the process of removing the grease
2. The process of removing water from the part is Drying

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-5 Process job card with workplace procedures

1. Process job card with workplace procedures

The job card is meant to ensure that the technician working on the vehicle, has a detailed 'patient' file which will help ensure that every job is completed professionally and every vehicle receives the technician's full attention and application.

The job card is also a great tool for your technicians to highlight additional repairs or maintenance items that they notice and which really need attention. This is where your job card works in conjunction with your cross selling lists, a subject to be covered as part of this series of business strategies.

Let's face it, technicians are only human, and they have lazy or bad days, and they might forget things. So the number one role of the job card is to prompt technicians to undertake every job to your workshop's high standard and to the customer's expectations.
To make this work, your job card must contain every item you would like your technicians to check and report on. The job card can be as detailed as you like.

1.1. **The advantages of a good job card are**:

- to reduce idle time by giving technicians the information and tools to be productive and efficient
- to provide clear, logical and suitable information to the technician and to the person costing the job
- to provide a very effective automatic link between the workshop and the front office
- to provide particulars of each job accurately
- to provide detailed information on the vehicle both at the time of repair and on future visits to the workshop.

1.2. The job card should contain the following information:

1.2.1 Job number

Larger workshops use job numbers to identify vehicles and to allow technicians to easily find jobs when required. These can sometimes also be customer numbers. It's important to only refer to job and customer numbers in-house and not

directly with a customer. Always refer to a customer by name and their vehicle by make and model.

1.2.2 Customer's name and full contact details

Correct customer information is very important. Names must be spelt correctly and any titles clearly noted. Make sure the contact phone number is the one on which the customer will be available, and the correct mailing address so you can send them a thank you letter or service reminder. Most point of sale programs will print this out on your job card, but you should always ensure details are correct.

1.2.3 Complete vehicle details

This would include ergo number, make and model, manufacture details including VIN number, manufacture date, engine code and number of cylinders. Such detail is vital when ordering parts. Kilometers travelled must be noted, particularly if related to warranty. Other details might include when the vehicle is due for service or service interval, and registration renewal.

1.2.4 Jobs required

A very clear and precise job description and detailed explanation of the issues including the history of the issue, if any. If any doubts remain about any issues, the technician working on the job may need to contact and talk to the right person to gain all the information to correctly diagnose the vehicle.

1.2.5 Time the vehicle is required by the customer

This is important for all technicians to know so priority can be given to jobs

1.3. **There should be space on the job card for this kind of information:**

1.3.1. **Parts used on the job**

This could include part numbers, description and quantity. Any part not on the job card might get left off the invoice and therefore lower profitability.

1.3.2. **Work performed**

This must be in detail. Technicians may have to be taught the importance of this information, because it directly influences the invoiced amount. If a technician encounters a problem with a job, they should inform the right person as well as write it on the job card. The time taken is as important as the information on the type of work performed. You could have a section on the job card for recommended time for certain jobs. This can be useful where a technician

becomes expert at a particular repair through experience and the time taken is reduced. In situations like this, it is not logical to reduce the invoice amount to match because the repair job still should retain its full value, regardless of how good a technician becomes at performing it.

2. **Service details**

These would include things like

- Suspension, a good fair and fail option on front and back suspension.
- Timing belt – note whether the vehicle has a timing belt and if it has a service history.
- Drive belts – good, fair or fail on drive belts and tensioners.
- Coolant – good, fair or fail based on coolant testing.
- Battery test results.

3. **Part suppliers**

On hand reference to trace where parts came from. Include a phone number, contact person, parts ordered or quote received, your price and retail price and time of order

4. **Report section**

This is a spot for technicians to write a report on other items found requiring attention or to expand or any issues already listed. This is where a note may be made to recheck something next service, or to highlight something quirky about the vehicles.

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Write the Answer on the space provided below:

Instruction: - write true if the statement is correct or write false if the statement is incorrect (2 pts)

1. The advantages of a good job card are

   a. reduce idle time c. provides detailed information

   b. provide clear d. all

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

1 _____ **2** _____

Information Sheet-6 Cleaning and making ready workstation for the next

1. Cleaning work station

Cleaning and inspect equipment and work area for serviceable condition accordance with work place procedure.

- Clean and remove rug and west scrap.
- After work rearrange the woke area and suitable condition to work.

1.1. Procedures Products saturated with cleaning products require special handling and disposal by licensed transporters. some basic principles for cleaning of workshop should be as followed:

When cleaning an area start with the cleaner surfaces and articles and then go to clean more heavily soiled areas so as to prevent the spread of soil dorm dirty to cleaner surfaces.

- While wet cleaning or polishing the floor, the cleaner should walk backwards while cleaning in front of him
- Suction cleaning should be preferred over sweeping wherever possible
- Sweeping should be done before dusting and dusting before suction cleaning
- Stains should be removed as soon as they occur
- The cleaner should take all safety precautions while cleaning. In particular, cleaning agents and equipment's should be stacked neatly to one side.
- The cleaner should start cleaning from the farthest end of an area working towards the exit

Self-Check 6	Written Test

Directions: Answer all the questions listed below. Write the answer on the space provided below:

Instruction: - chose and write the letter of the correct answer (6 pts)

1. The work shop has to be dried immediately with a jet of.
   A. compressed air B. detergent substances
   C. oil D. alkaline substance
2. which lubricate used to slow-moving parts of equipment such as shafts and bearings
   A. oil B. grease C. kerosene D. all
3. ____are useful for cleaning grease or polish from surfaces.
   A. Detergents B. Alkaline cleaners
   C. Solvents cleaning D. Deodorants

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

True/False

1 _____ **2** _____ **3** _____

Operation Sheet-1 Cleaning and making ready workstation for the next

Procedures clean dirty surfaces.

- cleaning or polishing the floor,
- clean by using suction should be preferred over sweeping wherever possible
- Sweep should be done before dusting and dusting before suction cleaning
- remove stain
- perform safety precautions while cleaning. In particular, cleaning agents and equipment's should be stacked neatly to one side.
- The cleaner should start cleaning from the farthest end of an area working towards the exit

LAP Test	Practical Demonstration

Name: _____ **Date:** _____

Time started: _____ **Time finished:** _____

1. clean by using suction should be preferred over sweeping wherever possible
2. Sweep should be done before dusting and dusting before suction cleaning
3. remove stain