KEMENTERIAN PENDIDIKAN TINGGI

POLITEKNIK MALAYSIA
PORT DICKSON

# Overhaul of petrol engine

*Inspection and Measurement*

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# Preface

This book is designed to support the DJA 20032 Diploma in Automotive Engineering Programme, specifically focusing on the "Overhaul of Petrol Engine" module. It aims to serve as a practical guide for students, assisting them in preparing comprehensive reports required for their assignments. Additionally, lecturers will find it a valuable resource for assigning coursework and reinforcing key concepts.

The content is tailored not only for students within this specific program but also for those from other institutions who seek to deepen their understanding of petrol engine repair and maintenance. The book offers clear and systematic instructions on inspecting and assessing petrol engines during the overhaul process, making it an essential reference for anyone interested in mastering the fundamentals of automotive engineering.

By providing detailed guidance and practical insights, this book aims to enhance the learning experience and ensure a thorough grasp of engine diagnostics and repair techniques.

# Table of CONTENTS

# 1. Introduction

Overhaul of petrol engine is one of the topics for the DJA 20032 Diploma in Automotive Engineering course at the Department of Mechanical Engineering.

This section discusses the items that need to be explained to assist students in preparing the required report. The contents of this e-book cover 9 aspects for the overhaul of a petrol engine, starting with 1. Introduction, 2. Objectives, 3. Theory, 4. Problem Statement, 5. Equipment, 6. Procedures, 7. Checking & Testing, 8. Discussion, Conclusion, and 9. References.

Automotive  Workshop DJA20032 Practice 1 link sites:
https://sites.google.com/view/automotive-workshop/home

Performing a complete engine overhaul typically follows a structured flow to ensure that the process is organized and all necessary steps are completed efficiently. Here is a general flow to perform a complete engine overhaul:

1. **Initial Evaluation:**
   Assess the condition of the engine to determine the extent of the overhaul needed. Identify any specific issues or symptoms that need to be addressed during the overhaul.

2. **Disassembly:**
   Remove the engine from the vehicle and place it on an engine stand. Disassemble the engine carefully, following manufacturer guidelines and making note of the placement of each component.

3. **Cleaning and Inspection:**
   Clean all components thoroughly to remove dirt, grime, and old gaskets. Inspect all parts for wear, damage, or signs of malfunction. Create a detailed list of parts that need replacement or repair.

4. **Machine Work:**
   Send components like the cylinder head, crankshaft, or block to a machine shop for necessary machining work, such as resurfacing or grinding.

5. **Replacement of Parts:**
   Replace worn-out or damaged parts with new components, including piston rings, bearings, gaskets, seals, and other necessary items.

6. **Reassembly:**
   Reassemble the engine following manufacturer specifications, torque settings, and proper alignment. Ensure all parts are installed correctly and in the right order.

7. **Testing:**
   Before installation, conduct tests to ensure proper function, compression, oil pressure, and check for any leaks. Address any issues found during testing before proceeding.

8. **Installation:**
   Reinstall the overhauled engine back into the vehicle, connecting all systems properly and refilling with necessary fluids. Double-check all connections and ensure everything is secured.

9. **Break-in Period:**
   Follow the manufacturer's recommendations for the break-in period to allow proper seating of components and ensure the engine operates smoothly.

# 2. Objectives

Here are some samples of reports that have been written with the goal of overhauling a petrol engine.

**Perform complete engine overhaul** — 2.1

**Inspect, adjust and measure clearance of engine assembly and its related components** — 2.2

**Reinstall engine assembly and related components and perform tune up** — 2.3

**Follow method, use tools, and observe safety precautions** — 2.4

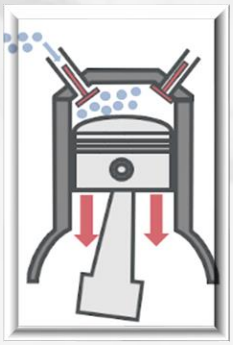
# 3. Theory

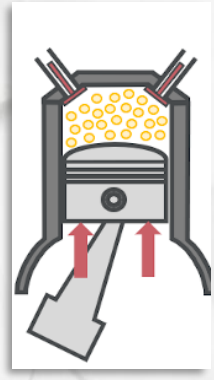
## 3.1 Overview of Petrol Engine Operation

A petrol engine, also known as a gasoline engine, operates on the principles of internal combustion. The engine converts chemical energy from fuel into mechanical energy through a series of controlled explosions (combustions). This process occurs in four main strokes of the engine cycle: intake, compression, power, and exhaust.

01

Intake Stroke: The intake valve opens, allowing the fuel-air mixture to enter the cylinder as the piston moves downward.



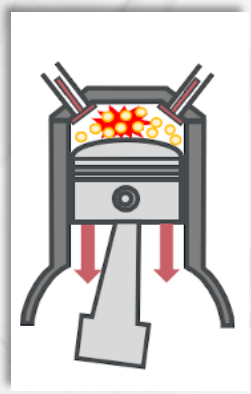


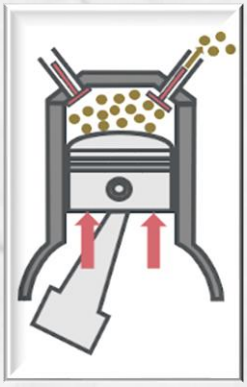
Compression Stroke: The intake valve closes, and the piston moves upward, compressing the fuel-air mixture.

02

03

Power Stroke: The spark plug ignites the compressed fuel-air mixture, causing an explosion that forces the piston downward.





Exhaust Stroke: The exhaust valve opens, and the piston moves upward again, expelling the burnt gases from the cylinder.

04

### 3.2 Wear and Tear in Petrol Engines

Wear and tear refer to the gradual degradation of engine components due to regular use, friction, and exposure to high temperatures and pressures. Key areas of wear and tear in petrol engines include:

**Cylinder and Piston Rings:**

Wear: Continuous friction between the cylinder walls and piston rings can lead to surface wear, reducing the efficiency of the seal and allowing blow-by gases.

Inspection: Measure the cylinder bore diameter and piston ring gap to check for excessive wear.

**Crankshaft and Bearings:**

Wear: Bearings and journals of the crankshaft can wear out due to friction and load, causing imbalances and knocking noises.

Inspection: Measure the crankshaft journals for wear and check bearing clearances.

**Valves and Valve Seats:**

Wear: Valves and their seats can wear out or become pitted, leading to poor sealing and compression loss.

Inspection: Perform a leak-down test and visually inspect valve faces and seats for damage.

**Camshaft and Tappets:**

Wear: The lobes of the camshaft and tappets can wear out due to the continuous motion and pressure, affecting valve timing.

Inspection: Measure the cam lobe height and inspect the tappet surfaces.

**Timing Chain/Belt:**

Wear: The timing chain or belt can stretch or wear out, leading to timing issues and potential engine damage.

Inspection: Check for proper tension and inspect for signs of wear or damage.

**Gaskets and Seals:**

Wear: Gaskets and seals can deteriorate over time, leading to oil and coolant leaks.

Inspection: Visually inspect for leaks and replace any worn or damaged gaskets and seals.

Engine overhaul is a process that involves disassembling, inspecting, repairing, and reassembling the engine. Some important components that need to be checked during measurements in this process are as follows:

**Engine Block**

- Cylinder diameter measurement: Ensuring there is no excessive wear.
- Crack inspection: Using visual or non-destructive methods such as dye penetrant testing.

**Piston and Piston Rings**

- Piston diameter: Ensuring there is no excessive wear.
- Piston ring gap: Measuring the gap between the piston ring and the cylinder wall.

**Crankshaft**

- Main journal and rod journal size: Ensuring there is no wear or damage.
- Crack inspection: Using non-destructive methods such as dye penetrant or magnaflux testing.

**Connecting Rods**

- Roundness of rod journal: Ensuring there is no deformation.
- Crack inspection: Same as the crankshaft.

**Cylinder Head**

- Valve leakage: Ensuring the valves close tightly.
- Crack inspection: Using non-destructive methods.

**Camshaft**
- Size and shape of the cam lobes: Ensuring there is no excessive wear.
- Crack inspection: Using non-destructive methods.

**Valve Train**
- Length and roundness of the valve stem: Ensuring there is no wear or deformation.
- Valve seat leakage: Ensuring there is no leakage between the valve and its seat.

**Gasket and Seal**
- Condition of the gasket: Ensuring there are no cracks or damages that could cause leaks.

**Bearing**
- Clearance: Ensuring the proper clearance between the bearing and journal.

**Timing Chain/Belt**
- Physical condition: Ensuring there is no wear or cracking.
- Tension: Ensuring the proper tension.

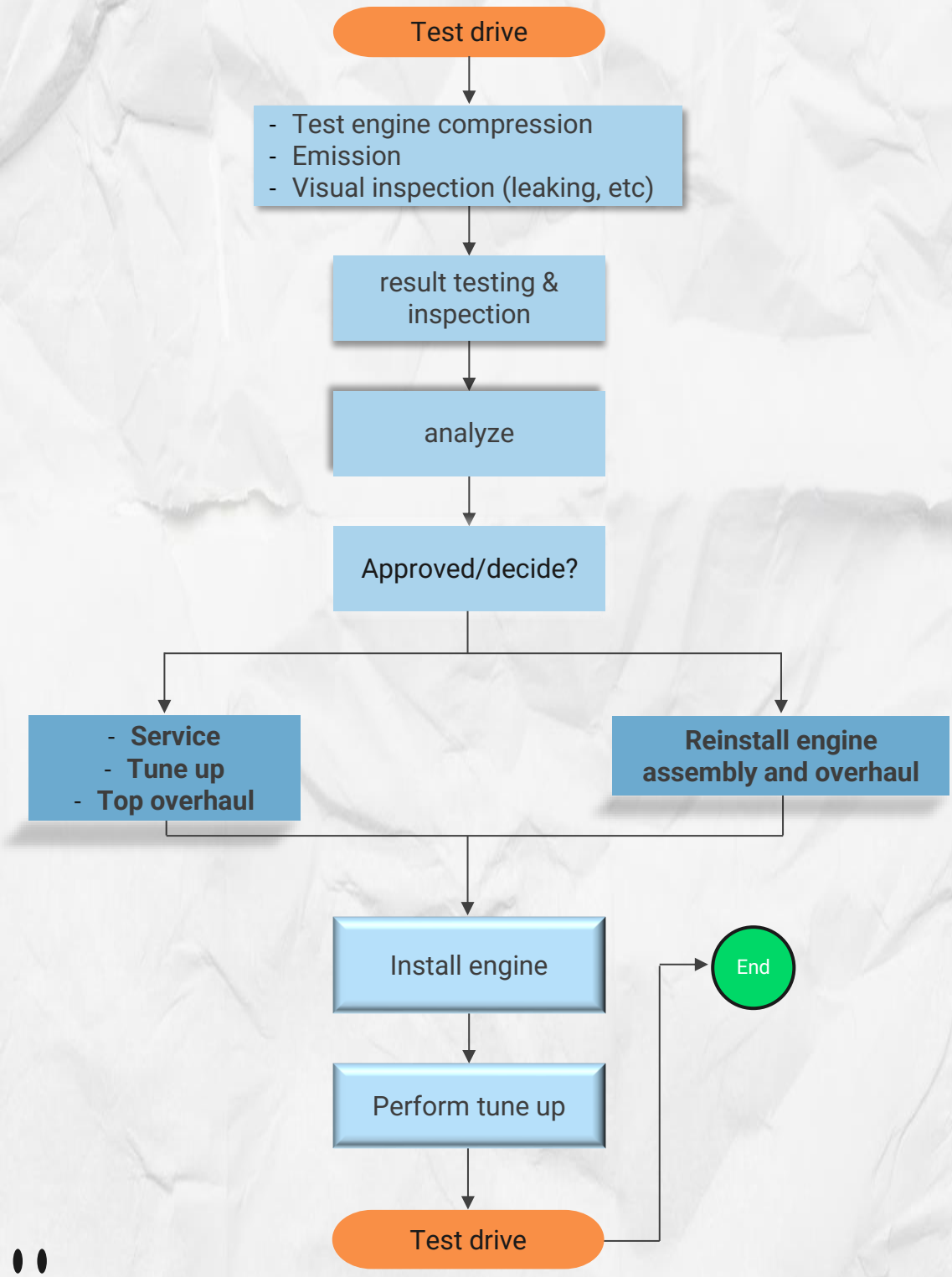
**Oil Pump**
- Output pressure: Ensuring the pump provides sufficient pressure.
- Physical condition: Ensuring there is no damage or excessive wear.

**Cooling System**
- Radiator: Ensuring there are no leaks and good fluid flow.
- Water Pump: Ensuring good physical condition and adequate flow.

**Fuel System**
- Injector: Ensuring proper flow and spray pattern.
- Carburetor/Fuel Pump: Ensuring proper pressure and flow.

**Note:**
The measurement and inspection of these components are crucial to ensure that all parts of the engine are in good condition and able to function optimally after the overhaul process is completed.

# Flow chart diagram to decide overhaul of petrol engine



# 4. Problem Statement

The following are some statements of issues from the tests and inspections conducted explaining why an engine overhaul is necessary:


4.1 The results from the compression tester show that there is a difference in readings between the dry and wet tests for all cylinders.

The car is found to be lacking power and consuming more fuel than it should. 4.2

4.3 From the inspection conducted, it was found that the vehicle's exhaust is oily, and when the engine is started, the exhaust gas is blue.

There are traces of engine oil on the air filter and steam production when the engine is started from the open oil cap filler. 04

# 5. Equipments

## 5.1 Hand Tools

Screwdriver set

Wrench set


Ratchet and socket set

Plier set

Power tool

etc

Allen key set, hammar, oil pan, pry bar , etc

# 5. Equipments

## 5.2 Special Tools

Torque Wrench

Check and adjust tightening of torque

Piston Ring Expander

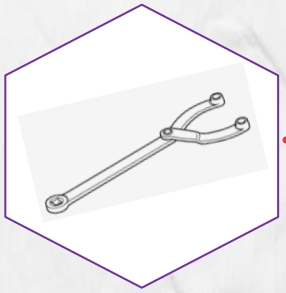
Remove and replace piston ring to piston

Valve Spring Compressor

Compress the spring on valve

Piston Ring Compression

compress the piston rings



End Yoke Holder

Hold the camshaft or sprocket when tightening or loosen

Valve Stem Seal Removal

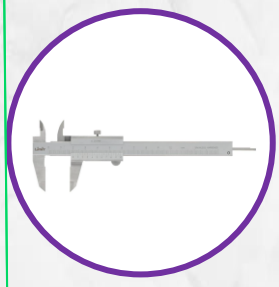
To remove valve seal

# 5. Equipments

## 5.3 Measurement Tools

Feeler Gauge

Measure gap



Vernier Caliper

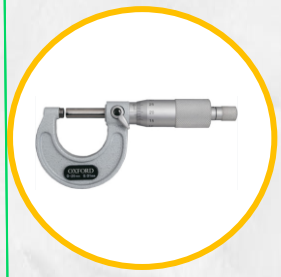
Measuring the dimension


Plastigauge

check bearing clearance and gap dimensions

Straight Edge

Checking straightness



Micrometer

accurate measurement of components

link : micrometer calibration

**https://www.youtube.com/watch?v=2qeXrP2pUvc**

# 5. Equipments

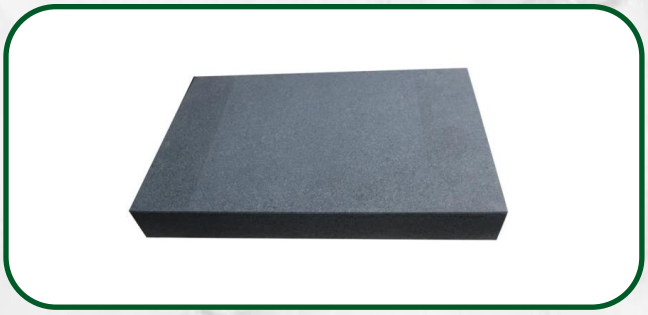
## 5.3 Measurement Tools

Bore Gauge

Measure internal diameters


Dial gauge with Magnetic Stand

Checking flatness



Flatness Surface Plate

Measuring points across the surface

# 5. Equipments

## 5.4 Personal Protective Equipment (PPE)

When performing an engine overhaul, it is essential to prioritize safety and protect yourself from potential hazards. Here are some recommended personal protective equipment (PPE) items to consider using during an engine overhaul:

**Safety Glasses or Goggles:**
Protect your eyes from debris, oil, and other particles that may be dislodged during disassembly and cleaning.

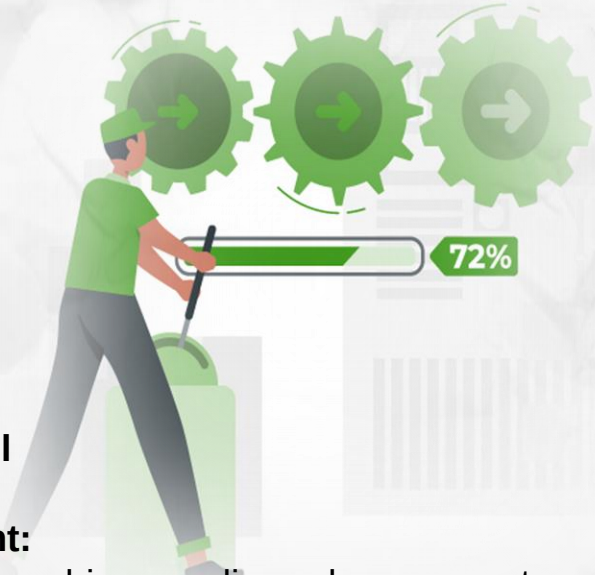
**Gloves:**
Wear mechanic's gloves to protect your hands from cuts, abrasions, and exposure to chemicals or solvents.

**Coveralls or Work Jumpsuit:**
Wear coveralls or a work jumpsuit to shield your clothing from grease, oil, and dirt. This can also prevent skin exposure to chemicals.

**Steel-Toed Safety Boots:**
Wear sturdy, closed-toe shoes or steel-toed safety boots to protect your feet from heavy objects or accidental impacts.

**Safety Harness (if applicable):**
If working at elevated heights or in awkward positions, ensure you have the necessary safety harness and fall protection equipment.
Prioritizing safety by wearing the appropriate personal protective equipment can help prevent injuries and ensure a safer working environment during the engine overhaul process. Always follow safety guidelines and manufacturer recommendations when performing maintenance tasks on vehicles.

# 6. Procedures




**Technique and Procedure for Overhauling and Troubleshooting a Petrol Engine**

## 6.1 Preparation for Overhaul

**Gather Tools and Equipment:**
Wrenches, socket sets, screwdrivers, pliers, hammers, torque wrench.
Micrometers, calipers, dial gauge, feeler gauges.
Engine hoist, engine stand.
Cleaning supplies, solvent, brushes, rags.
Replacement parts, gaskets, seals.

**Safety Precautions:**
Wear appropriate personal protective equipment (PPE).
Ensure the workspace is well-ventilated and free from fire hazards.
Disconnect the battery to prevent accidental electrical shorts.

## 6.2 Preparation for Overhaul

1. Preparation Phase:
   - Gather Tools and Equipment
   - Safety Precautions

2. Disassembly Phase:
   - Remove the Engine
   - Disassemble External Components
   - Disassemble Cylinder Head
   - Disassemble Short Block

3. Reconditioning and Replacement Phase:
   - Machining (if necessary)
   - Component Replacement
   - Cleaning

4. Reassembly Phase:
   - Assemble Short Block
   - Assemble Cylinder Head
   - Install External Components
   - Final Assembly

5. Troubleshooting Phase:
   - Initial Checks
   - Start-Up
   - Diagnostics
   - Adjustment and Fine-Tuning
   - Road Test

## 6.3 Disassembly Procedure

**Remove the Engine:**
Drain the engine oil and coolant.
Disconnect the battery and remove any electrical connections to the engine.
Detach the exhaust system, intake manifold, and fuel lines.
Use the engine hoist to remove the engine from the vehicle and mount it on the engine stand.

**Disassemble External Components:**
Remove the alternator, power steering pump, and other accessory drives.
Take off the timing belt or chain, and timing cover.
Remove the water pump and oil pump.

**Disassemble the Cylinder Head:**
Remove the valve cover and rocker arms.
Take out the camshaft(s) and lifters.
Remove the cylinder head bolts and lift the head off the block.

**Disassemble the Short Block:**
Remove the oil pan and oil pickup tube.
Remove the piston rod caps and push the pistons out of the cylinders.
Remove the crankshaft main caps and lift the crankshaft out of the block.

## 6.4 Inspection and Measurement

**Visual Inspection:**
Check for signs of wear, damage, or overheating on all components.
Look for cracks or deformation in the block, head, and other major parts.

**Measurement:**
Measure cylinder bore diameter and compare with the manufacturer's specifications.
Measure the diameter of the piston and the piston ring end gap.
Measure the crankshaft journal diameter and check for roundness.
Measure camshaft lobes for wear.

**Non-Destructive Testing:**
Use dye penetrant or magnetic particle inspection to check for cracks in the block, head, and crankshaft.
Reconditioning and Replacement

**Machining:**
If necessary, have the cylinder bores honed or rebored.
Have the crankshaft ground and polished.
Resurface the cylinder head if it is warped.

**Component Replacement:**
Replace worn or damaged pistons, rings, bearings, gaskets, and seals.
Replace the timing chain/belt, and consider replacing the water pump and oil pump.

**Cleaning:**
Thoroughly clean all parts using a solvent to remove any oil, dirt, and debris.
Ensure all oil passages and galleries are free of obstructions.

## 6.5 Reassembly Procedure

**Assemble the Short Block:**
Install the crankshaft and torque the main caps to the specified values.
Install the pistons with new rings and attach the rod caps, torquing to specifications.

**Assemble the Cylinder Head:**
Install the valves, springs, and retainers.
Install the camshaft(s) and lifters.
Attach the cylinder head to the block and torque the head bolts in the correct sequence and to the specified torque.

**Install External Components:**
Attach the oil pump, oil pan, water pump, and timing components.
Install the intake and exhaust manifolds.
Reinstall the alternator, power steering pump, and other accessories.

**Final Assembly:**
Reinstall the engine into the vehicle using the engine hoist.
Reconnect all electrical connections, fuel lines, and exhaust components.
Fill the engine with oil and coolant.
Troubleshooting Procedure

## 6.6 Troubleshooting Phase

**Initial Checks:**
Check all fluid levels.
Verify all electrical connections and sensors are properly connected.

**Start-Up:**
Start the engine and listen for any unusual noises.
Check for leaks of oil, coolant, or fuel.

**Diagnostics:**
Use a diagnostic scanner to check for any error codes.
Perform a compression test to ensure proper sealing of the combustion chamber.
Perform a leak-down test to check for any internal leaks.

**Adjustment and Fine-Tuning:**
Adjust the ignition timing and fuel mixture for optimal performance.
Ensure the engine idle speed is within specifications.
Verify that all engine parameters are within normal ranges using diagnostic tools.

**Road Test:**
Conduct a road test to ensure the engine performs well under various driving conditions.
Check for any abnormal vibrations, noises, or performance issues.
By following these detailed procedures for overhauling and troubleshooting a petrol engine, you can ensure the engine is thoroughly inspected, properly rebuilt, and tested for optimal performance and reliability.

# 7. Checking & Testing

## 7.1 Inspection

i. Timing belt/timing chain

ii. Tappet inspection

iii. Valve Seats

iv. Oil Pump

## 7.2 Measurement

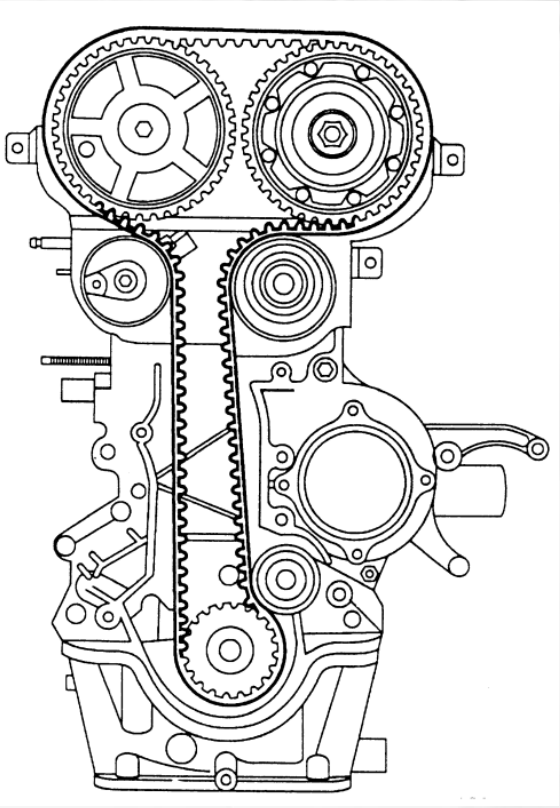
i. Camshaft

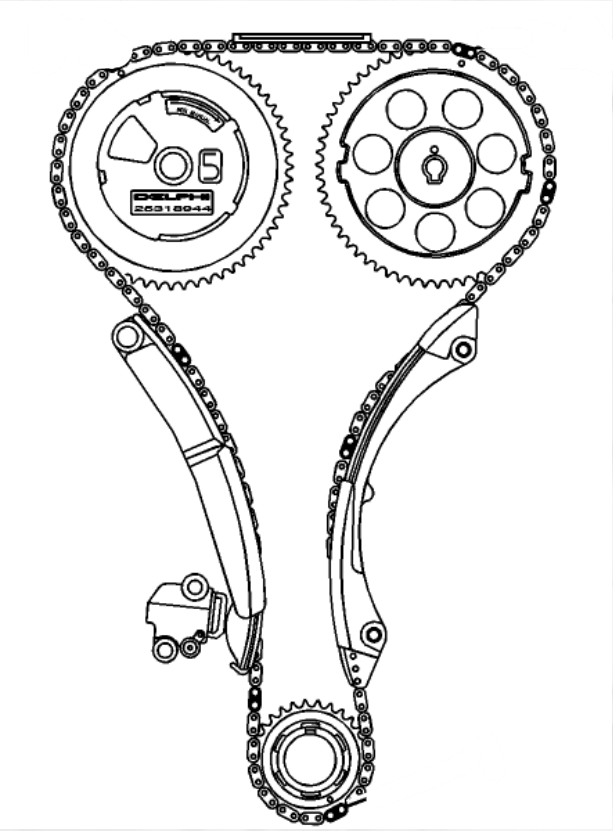
ii. Cylinder head,
Cylinder head bolt condition,
Cylinder Head Flatness,
Valve Springs, Valves & Valve Guide

iii. Piston & Piston Rings

iv. Crankshaft Oil Clearance, Cylinder Blok & Boring Cylinders

## 7.1 Inspection





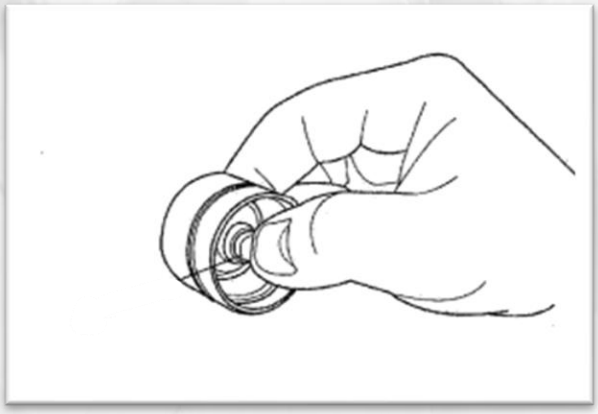
### i. Inspect Timing Belt/Chain

1. Check the tension of the timing belt/chain. A properly tensioned chain should have minimal slack. Excessive slack indicates a worn chain or faulty tensioner.
2. Look for any signs of wear on the chain links and sprockets, such as elongation, rust, or broken links.
3. Inspect the timing chain guides and tensioners for wear or damage.
4. If the engine has been running with noise coming from the timing chain area, it may indicate a problem with the chain or associated components.
5. Some manuals provide specifications for allowable chain stretch. Use a ruler or measuring tool to check the length of a specified number of links and compare it to the specifications.

**Remarks:**
If the chain, tensioner, guides, or sprockets show signs of wear or damage, they should be replaced. A worn timing chain can lead to poor engine performance or catastrophic engine failure

# 7.1 Inspection

## ii. Tappet inspection



| Standard Value (service specifications) | |
|---|---|
| Intake | |
| Exhaust | |

| Tappet | INLET | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Result | | | | | | | | |
| Tappet | EXHAUST | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Result | | | | | | | | |

**Remarks:**

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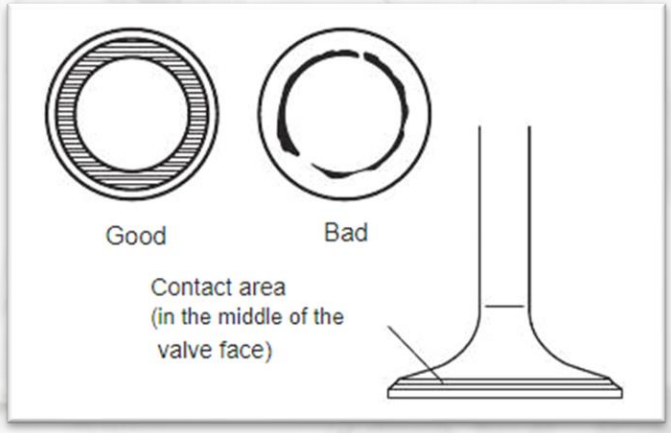
## iii. Valve Seats

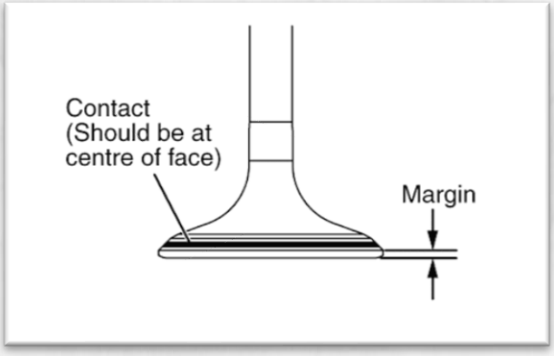
Assamble the valve, then measure the valve atem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.




1- Check the valve face for correct contact. If contact is uneven or incompleate, reface the valve seat.
2- if the margin is less then specified, replace the valve

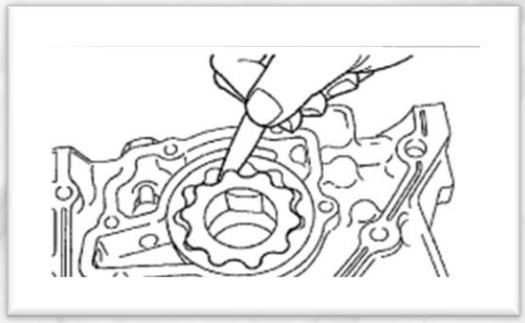
Standard value:
Intake : 1.0 mm
Exhaust : 1.5 mm

Limit:
Intake : 0.5 mm
Exhaust : 1.0 mm

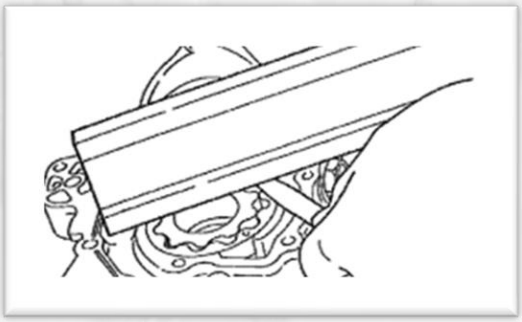


## iv. Oil Pump

### - Oil Pump Clearance inspection



Note:
Measure the clearance between the straight edge and the cylinder head face using feeler gauge at 8 point



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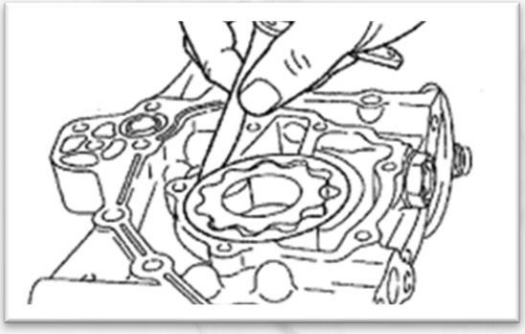


Note:
Measure the clearance between the straight edge and the cylinder head face using feeler gauge at 8 point and head surfaces must be flat

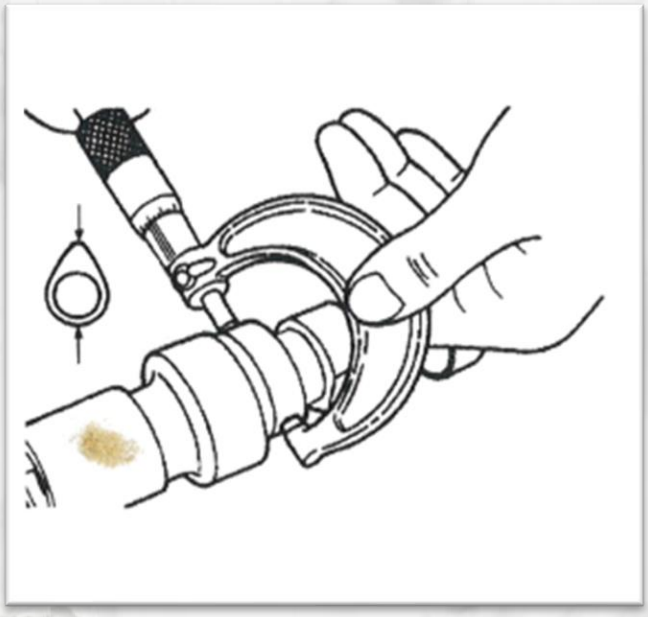
| Standard value (service specifications) | |
|---|---|
| Tip Clearance | |
| Side Clearance | |
| Body Clearance | |

| Clearance | Reading | Remarks |
|---|---|---|
| Tip | | |
| Side | | |
| Body | | |

**Note:**
**Measuring Tools:** measured using feeler gauges

## 7.2 Measurement

### i. Camshaft



| Standard Value (service specifications) | |
|---|---|
| Intake | |
| Exhaust | |

| CAM | INLET | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| HEIGHT | | | | | | | | |
| CAM | EXHAUST | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| HEIGHT | | | | | | | | |

**Remarks:**

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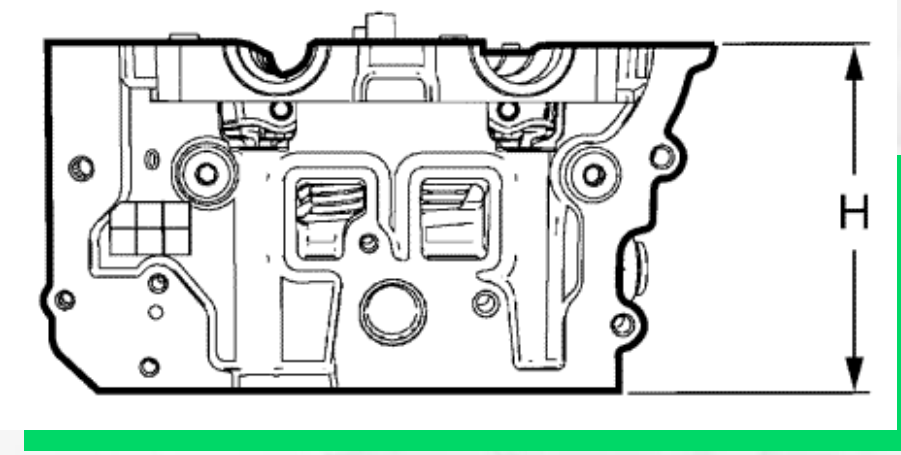
**Note:**
**Measuring Tools:** outside diameter

## 7.2 Measurement

### ii . Cylinder Head High




| Standard Value (service specifications) | |
|---|---|
| Flatness Limit | |
| Cylinder Head High | |

**Remarks:**

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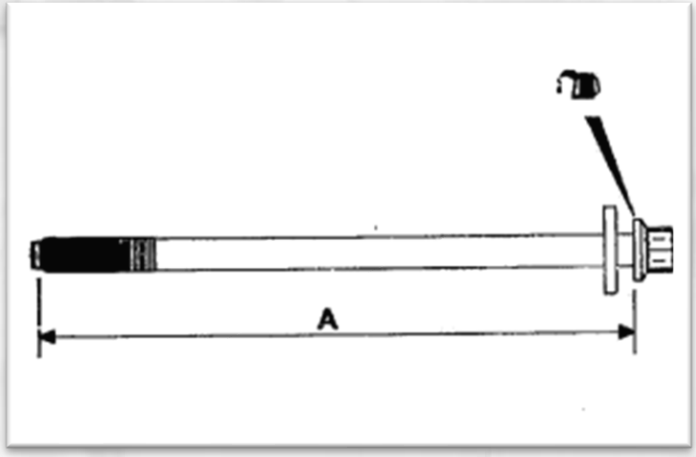
---

---

Note:
Measure the clearance between the straight edge and the cylinder head face using feeler gauge at 8 point and head surfaces must be flat within 0.05mm maximum. Inspect the cylinder head for cracks and damage. **Measuring Tools:** vernier caliper

## ii. Cylinder head bolt condition

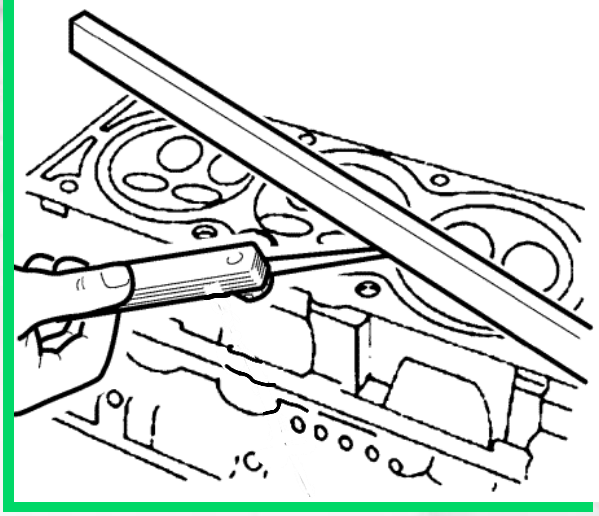


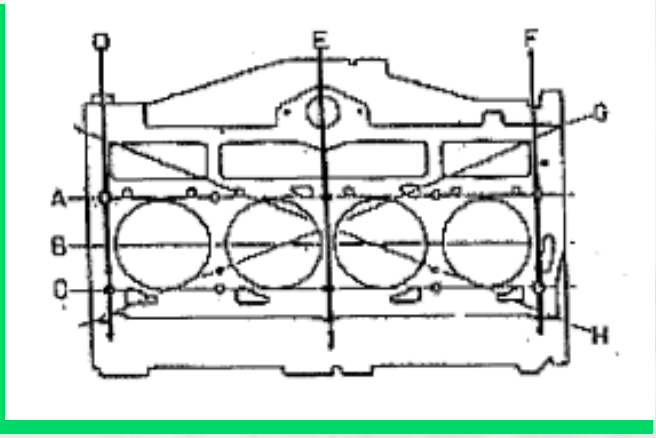

| Standard Value (service specifications) | |
|---|---|
| Length | |

| Bolts | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Length | | | | | | | | | | |
| Judgment | | | | | | | | | | |

**Note:**
**Measuring Tools:** measured using vernier caliper

## ii. Cylinder Head Flatness



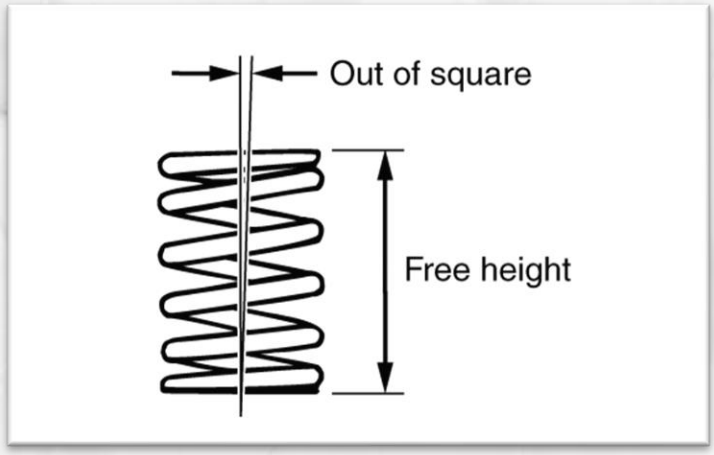



| Standard Value (service specifications) | |
|---|---|
| Flatness Limit | |

| No | Cylinder Head Flatness of Surface |
|---|---|
| A | |
| B | |
| C | |
| D | |
| E | |
| F | |
| G | |
| H | |

Note:
Measure the clearance between the straight edge and the cylinder head face using feeler gauge at 8 point and head surfaces must be flat within 0.05mm maximum. Inspect the cylinder head for cracks and damage. **Measuring Tools:** straight edge and filler gauge

## ii. Valve Spring




Measure the valve spring's free height. If the measurement is less than specified, replace the spring.

| | | Standard mm | Limit mm |
|---|---|---|---|
| SOHC 12-VALVE | Intake | 46.1 | 45.6 |
| | Exhaust | 46.8 | 46.3 |
| SOHC 16-VALVE | | 50.9 | 50.4 |
| DOHC | | 49.1 | 48.6 |

Measure the squareness of the spring. If the measurement exceeds the specified limit, replace the spring.

**Standard value: 2° or less**
**Limit: 4°**

**Remarks:**

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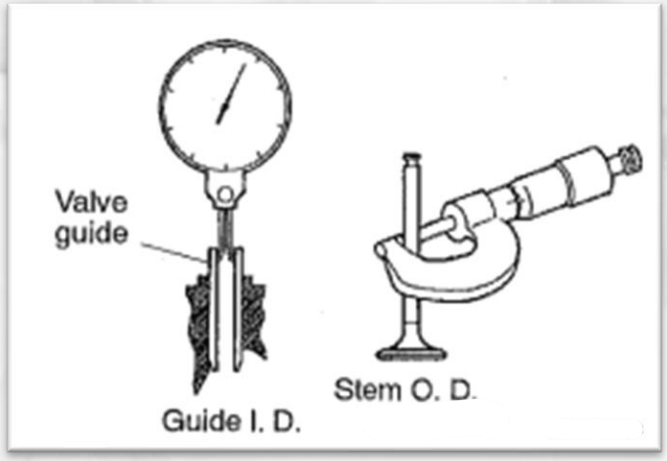
**Note:**
**Measuring Tools:** measured using Flatness Surface Plate and Try Square

## ii. Valve Guide




- Measure the Valve Spring free height.
- Measure the squareness of the spring.
  Limit: 4 degree

| | | Standard mm | Limit mm |
|---|---|---|---|
| Intake | SOHC 12-VALVE | 0.020 - 0.050 | 0.10 |
| | SOHC 16-VALVE | 0.020 - 0.047 | 0.10 |
| | DOHC | 0.020 - 0.047 | 0.10 |
| Exhaust | SOHC 12-VALVE | 0.050 - 0.085 | 0.15 |
| | SOHC 16-VALVE | 0.030 - 0.062 | 0.15 |
| | DOHC | 0.030 - 0.057 | 0.15 |

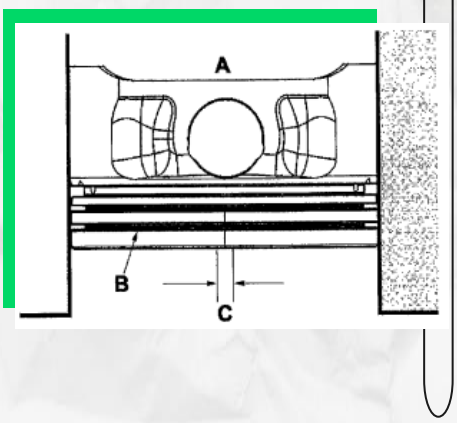
- Example Spec or refer (service specifications)

**Note:**
**Measuring Tools:** outside diameter

## 7.2 Measurement

### iii. Piston Rings End Gap

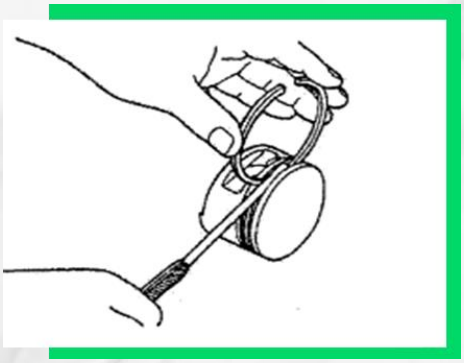
| Standard Value (service specifications) | Limits |
|---|---|
| Piston Ring No. 1 | |
| Piston Ring No. 2 | |
| Oil Ring | |




### ii. Piston Ring Side Clearance

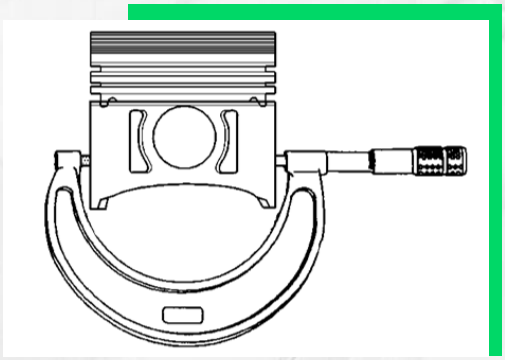
| Standard Value (service specifications) | |
|---|---|
| Piston Ring No. 1 | |
| Piston Ring No. 2 | |

| Piston Rings Side Clearance | | |
|---|---|---|
| **Piston No.** | **Piston Ring No. 1** | **Piston Ring No. 2** |
| **1** | | |
| **2** | | |
| **3** | | |
| **4** | | |



### iii. Piston Outside Diameter

| Standard Value (service specifications) | Limits |
|---|---|
| | |



**Remarks:**

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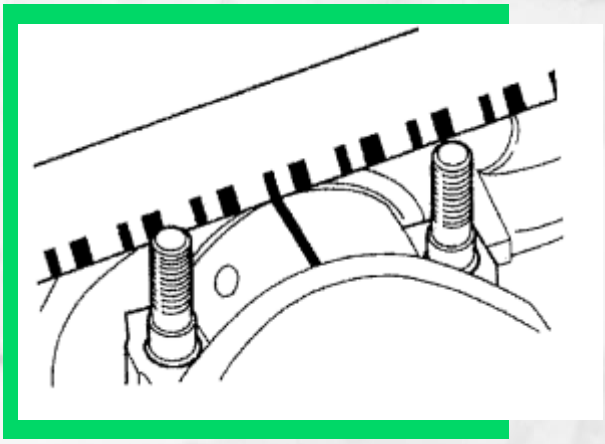
**Note:**
Measurement use:
Piston Rings End Gap & Piston Ring Side Clearance – filler gauge
Piston Outside Diameter - outside micrometer

## 7.2 Measurement

### iv. Crankshaft Pin Oil Clearance Inspection



| Standard Value | Limits |
|---|---|
| | |

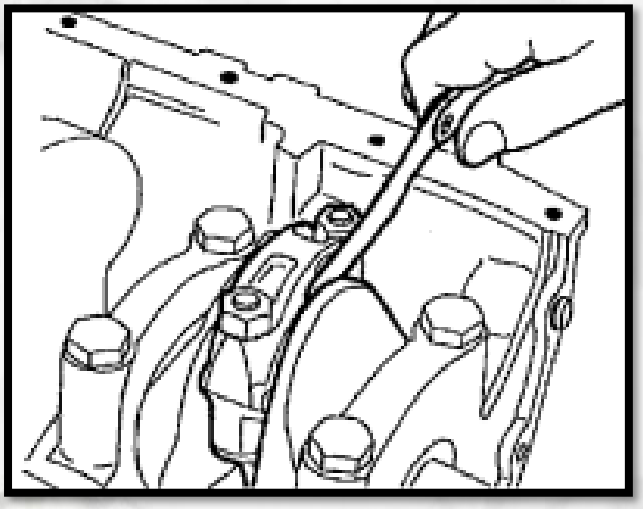
| Crankshaft Pin | Judgments | Remarks |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

**Note:**
Measuring Tools: plastigauge

video link: Crankshaft Pin Oil Clearance Inspection
**https://youtu.be/tgkT_p5pnSI**

## vi. Connecting rod big end side clearance

The connecting rod big end side clearance refers to the lateral gap between the sides of the connecting rod's big end and the crankshaft's crankpin cheeks. This clearance is crucial for the proper operation of the engine for lubrication, thermal expansion, mechanical tolerance and preventing metal to metal contact.

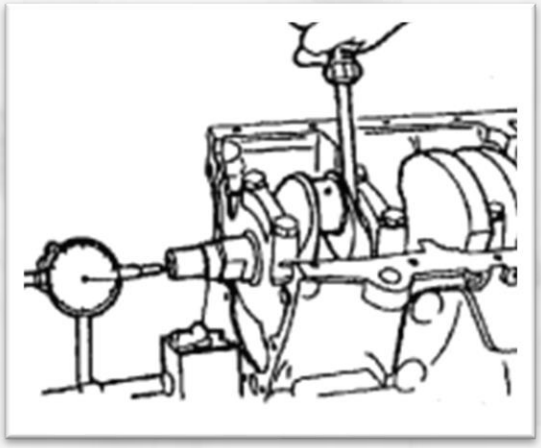


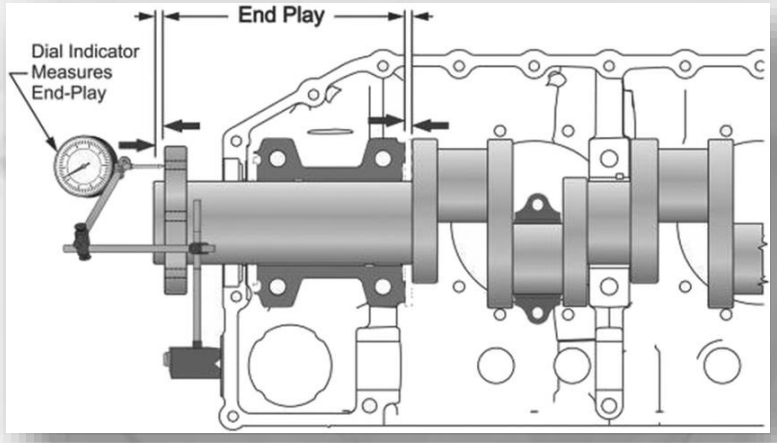
**Standard Value : (service specifications) or general 0.10 – 0.25 mm**
**Limit : 0.4 mm**

| Connecting rod big end | Value | Remarks |
|---|---|---|
| No. 1 | | |
| No. 2 | | |
| No. 3 | | |
| No. 4 | | |

**Measurement and Specifications:**
•**Measuring Tools:** Side clearance is typically measured using feeler gauges or a dial indicator.
•**Specifications:** The exact clearance specifications vary by engine design and manufacturer, but common values range from 0.1 mm to 0.4 mm (0.004 inches to 0.016 inches). Always refer to the engine's service manual for precise specifications.

## vi. Crankshaft End Play






Measure the end play the crankshaft. If the measurement exceeds the specified limit, replace the crankshaft bearing

**Remarks:**

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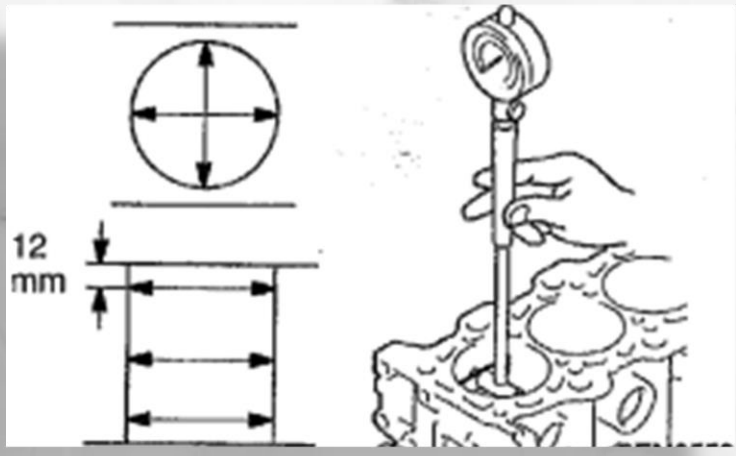
**Note:**
**Measuring Tools:** Dial Gauge with Magnetic Stand

video link:
**https://youtu.be/CUze3UYsolY**

## vi. Cylinder bore and cylinders




**Cylindricity** refers to geometric tolerance that defines the allowable variation of a surface from an ideal cylindrical shape. For a cylinder, cylindricity ensures that the surface is uniformly round and straight along its axis.

**Boring** of a cylinder refers to the process of enlarging a hole or improving its roundness and straightness. In the context of an engine cylinder, boring involves machining the cylinder walls to a precise diameter, ensuring a smooth surface for the piston to move within. This process is essential for maintaining proper engine performance and extending the life of the engine.

| Cylinder No. | Value A | | | Value B | | | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

**Note:**
Measuring Tools: Dial Bore Gauge

video link:
**https://youtu.be/J0MebKoesjI**

# 8. Valve Grinding Process

**1. Preparation**
•**Safety Gear:** Wear appropriate personal protective equipment (PPE), including safety glasses, gloves, and a dust mask.
•**Work Area:** Ensure the work area is clean and well-lit. Set up all necessary tools and equipment.

**2. Disassembly**
•**Remove Valves:** Carefully remove the valves from the cylinder head using a valve spring compressor.

•**Clean Components:** Clean the valves and valve seats thoroughly to remove carbon deposits, oil, and dirt.

**3. Inspection**
•**Check for Wear and Damage:** Inspect the valves and valve seats for signs of wear, pitting, or burning. Replace any components that are excessively worn or damaged.

**4. Grinding the Valves**
•**Valve Grinding Compound:** Apply a small amount of valve grinding compound to the face of the valve. This compound typically contains abrasive materials to aid in the grinding process.

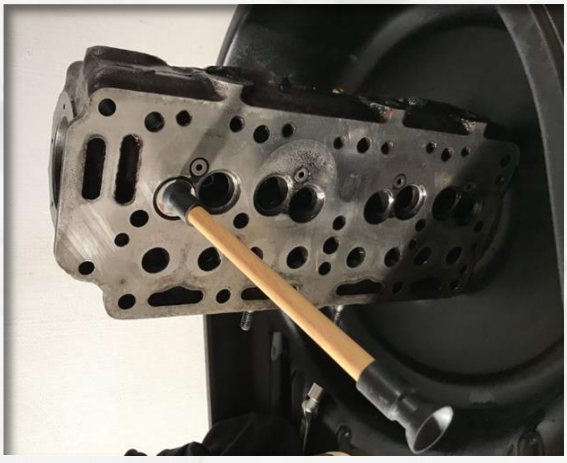
•**Grinder Setup:** If using a valve grinder machine, secure the valve in the machine according to the manufacturer's instructions.

•**Hand Grinding:** For manual grinding, insert the valve into the valve guide and attach a suction cup tool to the valve face. Rotate the valve back and forth between your hands while applying light pressure.

•**Check Progress:** Periodically remove the valve and wipe off the compound to inspect the valve face. Look for a consistent, smooth surface with a uniform grey appearance, indicating proper grinding.

•**Repeat as Necessary:** Reapply the grinding compound and continue the process until the desired finish is achieved.

# Valve Grinding Process




•**Hand Grinding:** For manual grinding, insert the valve into the valve guide and attach a suction cup tool to the valve face. Rotate the valve back and forth between your hands while applying light pressure.

•**Check Progress:** Periodically remove the valve and wipe off the compound to inspect the valve face. Look for a consistent, smooth surface with a uniform grey appearance, indicating proper grinding.

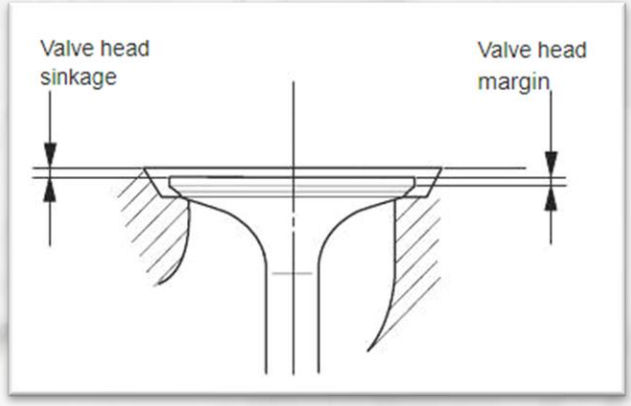
•**Repeat as Necessary:** Reapply the grinding compound and continue the process until the desired finish is achieved.

**5. Lapping the Valve**

•**Fine Lapping Compound:** After grinding, use a finer lapping compound to polish the valve seat and improve the seal.

•**Lapping Tool:** Use a lapping tool to rotate the valve back and forth in the valve seat. This process smooths the surface and ensures a perfect fit.

•**Clean Thoroughly:** Clean all components thoroughly to remove any residual lapping compound, which can be abrasive and cause engine damage.




**6. Reassembly**

•**Check Valve Fit:** Ensure that the valve seats properly in the valve seat without gaps.

•**Reinstall Valves:** Reinstall the valves into the cylinder head using a valve spring compressor. Ensure all components, such as springs and retainers, are correctly positioned.

•**Final Inspection:** Perform a final inspection to ensure all valves operate smoothly and seal properly against the valve seats.

**7. Testing**

•**Leak Test:** Conduct a leak test to confirm that the valves are sealing correctly. Apply a liquid to the combustion chamber side of the valve and check for any seepage around the valve seat.

**Conclusion**

The valve grinding process is essential for maintaining engine efficiency and performance. Properly ground valves ensure a tight seal, preventing compression loss and improving combustion.

# 9. Discussion

When conducting an overhaul of a gasoline engine, it is crucial to meticulously inspect all components to identify any that are worn or damaged. This process ensures the longevity and performance of the engine post-overhaul. Key steps include:

•**Thorough Inspection:**
Carefully examine pistons, cylinders, crankshaft, camshaft, valves, and bearings for wear, cracks, or other signs of damage.

•**Measurement and Testing:**
Use precision measurement tools, such as micrometers and dial indicators, to check tolerances against manufacturer specifications.

•**Replacement of Parts:**
Replace any component that does not meet the required standards. Using high-quality OEM (Original Equipment Manufacturer) parts is recommended to ensure compatibility and performance.

•**Upgrading Components:**
Consider upgrading certain components, such as pistons or camshafts, to higher performance parts if the engine is being modified for better performance.

**2. Safety While Doing Engine Overhaul Work**
Safety is paramount when performing engine overhaul work. Adhering to safety protocols can prevent accidents and ensure a smooth workflow. Recommendations include:

•**Personal Protective Equipment (PPE):**
Always wear appropriate PPE, including safety glasses, gloves, and steel-toe boots.

•**Proper Lifting Techniques:**
Use engine hoists or cranes to lift heavy components, and ensure that all lifting equipment is rated for the weight.

•**Ventilation:**
Ensure proper ventilation when working with solvents, cleaners, and other chemicals to avoid inhalation hazards.

•**Tool Safety:**
Use tools correctly and ensure they are in good condition. Avoid using damaged or worn tools that could fail during use.

•**Work Environment:**
Keep the work area clean and organized to prevent tripping hazards and ensure easy access to tools and parts.

•**Fire Safety:**
Be aware of fire hazards, especially when working with flammable liquids. Keep a fire extinguisher nearby and ensure that all workers know how to use it.

**3. Conclusion from the Petrol Engine Overhaul Work**
Conducting an overhaul on a gasoline engine can significantly extend its life and improve performance when done correctly. The key takeaways include:

•**Component Replacement:**
Ensuring that all worn or damaged parts are replaced is essential for the reliability and efficiency of the engine. Precision in inspection and adherence to specifications are critical.

•**Safety Precautions:**
Implementing stringent safety measures protects workers and ensures a smooth overhaul process. Safety training and proper use of equipment are vital.

•**Quality of Workmanship:**
The overall success of the overhaul depends on the attention to detail and quality of workmanship. Using high-quality replacement parts and following best practices leads to optimal engine performance.

•**Performance Improvement:**
A well-conducted overhaul can restore the engine to its original performance levels or even enhance it if performance parts are used. By following these recommendations, mechanics and technicians can achieve successful engine overhauls that enhance performance, safety, and reliability.

# 10. Conclusions

This mechanical movement creates friction, resulting in wear on the components.

The effects of engine component wear will cause the engine to lose power, increase fuel consumption, and produce exhaust gases that exceed the permissible limits.

**01**

Overhaul is a procedure carried out to inspect the wear occurring on mechanical components based on standard sizes, the measurements obtained, and the specified size limits. Based on these, a decision must be made as to whether the components can still be used, need replacement, or need to be readjusted

**02**

Before performing an overhaul, inspections and tests must be conducted to gather data. In performing an overhaul for a petrol engine, inspecting the components is crucial.

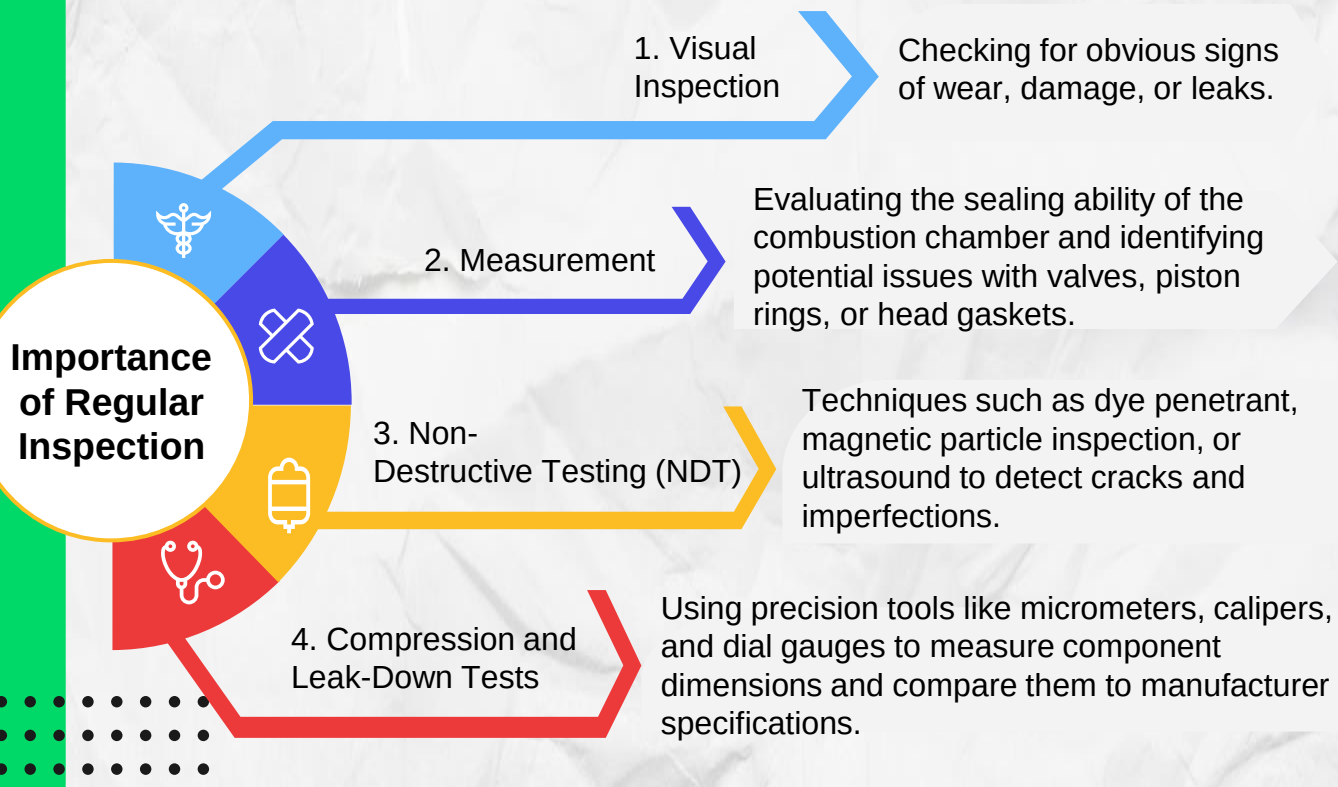
**03**

This inspection is carried out by measuring the components to ensure that the level of wear and the condition of the components have either exceeded the specified limits or are still within the allowable limits, referring to the specification manual for that engine.

## Importance of Regular Inspection

Regular inspection of petrol engine components is crucial for maintaining engine performance, efficiency, and longevity. Early detection of wear and tear allows for timely maintenance and repairs, preventing severe engine damage and costly overhauls.

Methods of Inspection :




Understanding the theory behind petrol engine operation and the common areas of wear and tear is essential for effective inspection and maintenance. By regularly monitoring and measuring the condition of engine components, automotive engineers can ensure optimal engine performance and prevent premature failures.

# 11. References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