SYSTEMS ENGINEERING

REV HEADS

Steven Penna

Student Name: .....

L.A.P. tek

Student Learning Guide & Record

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ASSEMBLE AND DISMANTLE FOUR STROKE SINGLE CYLINDER BRIGGS AND STRATTON ENGINE

This unit provides an introduction to small engines. It covers the theory of operation, the construction and the assembly and disassembly of single cylinder Briggs and Stratton engines. To promote easier readability, particular attention has been placed on simplified explanations of small engine mechanisms and operation, with the aid of many illustrations and pictures.

INTRODUCTION

The four stroke engine has many primary moving parts (crankshaft, connecting rod, piston, camshaft, inlet valve and exhaust valve.).

There is a large variety of design and construction that may be incorporated in a four stroke engine, the engine may be small or large, be air or water cooled and be constructed, basically, of aluminium alloy, cast iron, or a combination of both.

Understanding how a four stroke engine works before you dismantle and assemble it will make the task more worthwhile.

Enjoy gaining the knowledge of how a four stroke engine works and look forward to the feeling you get from assembling and dismantling a Briggs and Stratton engine as per manufacturer specifications.

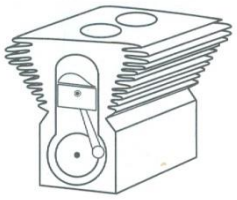
ENGINE CONFIGURATIONS

Engine configurations are usually described by the number of cylinders, arrangement of the cylinders (inline, horizontal, vee), position of the camshaft and how many camshafts. The alignment of the crankshaft is also sometimes mentioned and can be either horizontal or vertical shaft.

The majority of four stroke engines have one to eight cylinders, although twelve and sixteen cylinders designs are not unknown.

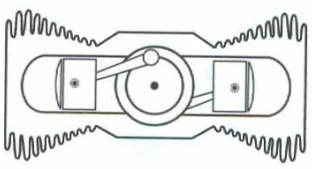
There are several different multi cylinder layouts. The three most common designs are:

1. **Inline** – In the inline layout, the cylinders are arranged inline with one another.



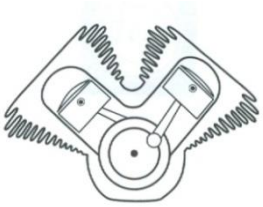
Inline Engine Layout

2. **Horizontal** – Horizontal engine layout (also called flat or opposed) are arranged with the pistons set 180° apart.



Horizontal Engine Layout

3. Vee – The name describes the cylinder arrangement well. The cylinders are set 90°, 60° or other variations of degrees apart.



Vee Engine Layout

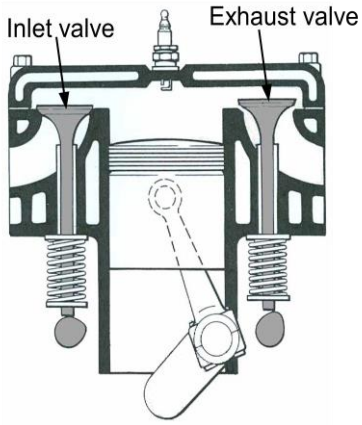
Engine variations: valve layout

Four stroke engines employ one of three basic valve and camshaft layouts;

- Side valve
- Overhead valve (OHV) and
- Overhead camshaft (OHC).

Side valve

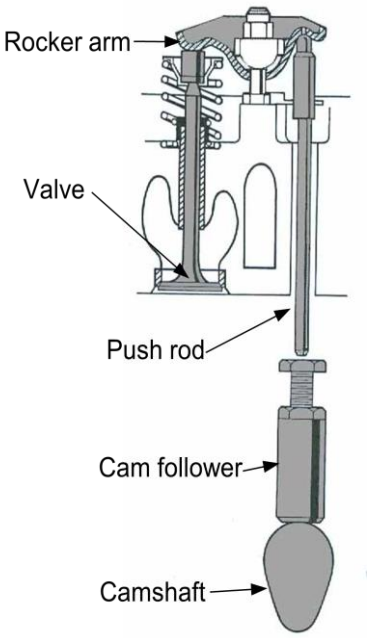
The side valve layout is almost a thing of the past. One will find it on older machines and on lawn mowers. Side valve engines have a flat cylinder head that generally houses no moving parts. In a side valve layout, the valves run along the outside of the cylinder. The valves are actuated by a camshaft driven through meshed gears or chain off the crankshaft. The design is simple to manufacture, but does not produce high compression ratios or let the engine breathe easily.



Side valve engine layout

Overhead valve

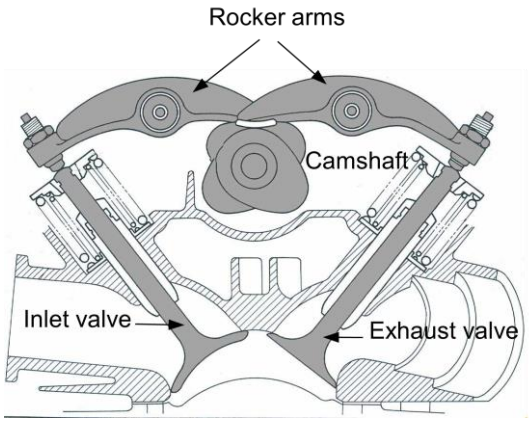
The overhead valve layout, though more advanced than the flat head design is found on a few motor cycle engines, on lawn mowers and on small industrial engines. This design allows the valve to be located in the head, above the pistons, so that they enter the combustion chamber from the top. Push rods activate rocker arms that open the valves. An OHV layout allows for more efficient delivery of the fuel and air into the combustion chamber, but has the disadvantage of considerable reciprocating mass in pushrods, rocker arms and sometimes lifters.



Overhead valve engine layout

Overhead camshaft

The overhead camshaft is the most advanced of valve design layouts. It is found on most high performance engines. The valves and the camshaft are situated above the combustion chamber. With valves and camshaft in close proximity (no more pushrods and often no lifters) the camshaft operates the valves. This layout greatly reduces reciprocating mass and allows the engine to rev higher before valve bounce occurs. This layout can employ a single cam (SOHC) or dual cams (DOHC) With SOHC , one camshaft actuates both inlet and exhaust valves. With DOHC, inlet and exhaust valves are actuated by independent camshafts. OHC designs often have three, four or even five valves per cylinder



Overhead camshaft engine layout

TASK 2: EXPLAIN THE TERM 'CONFIGURATION'

Explain in your own words what is meant by the term engine configuration.

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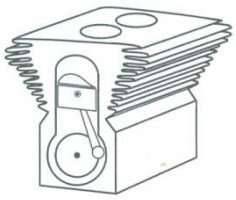
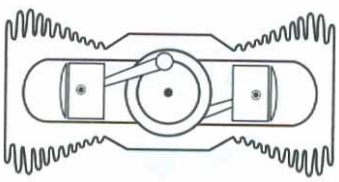
TASK 3: IDENTIFY ENGINE CONFIGURATIONS

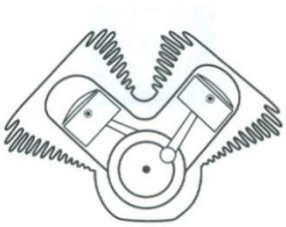
Engine configurations are usually described by the number of cylinders, arrangement of the cylinders, position of the camshaft and how many camshafts.

Identify the four stroke engine configuration in the following diagrams.

ENGINE CONFIGURATIONS







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Task 2 and 3

Teacher's Signature:

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TASK 4: IDENTIFY FOUR STROKE ENGINE CONFIGURATIONS

Walk around the workshop, read technical literature or search the internet, to identify different types of four stroke engine configurations.

Four Stroke Engine Configuration	Location
i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	

Task 4

Teacher's Signature:

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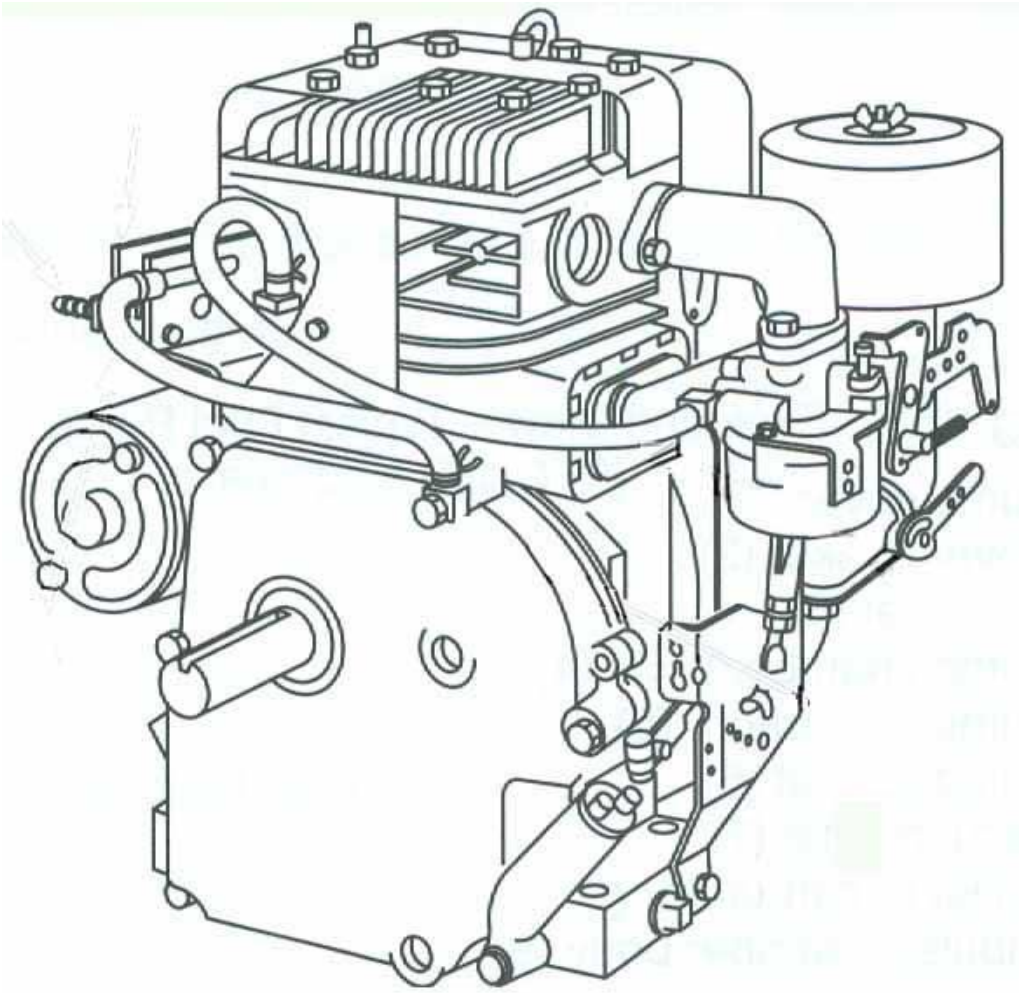
OPERATION OF A FOUR STROKE CYCLE ENGINE

EQUIPMENT:

- Four stroke Briggs and Stratton engine



Four Stroke Engine

INTRODUCTION

FOUR STROKE ENGINE

The name ‘four stroke’ comes from the fact that the piston makes four strokes in the cylinder to complete one full cycle. The strokes are induction, compression, power and exhaust. Two of the strokes are down (intake and power) and two are up (compression and exhaust). Valves open and close to route gasses or to create compression.

TASK 6: FOUR STROKE PRINCIPLE OF OPERATION

Complete the following to display to your teacher your understanding of the four stroke principle of operation.

1. Indicate the position of each valve and the direction of piston travel during each of the following four strokes.

   i. **Induction Stroke**: Inlet valve .....

   Exhaust valve .....

   Direction of piston travel .....

   ii. **Compression Stroke**: Inlet valve .....

   Exhaust valve .....

   Direction of piston travel .....

   iii. **Power Stroke**: Inlet valve .....

   Exhaust valve .....

   Direction of piston travel .....

   iv. **Exhaust Stroke**: Inlet valve .....

   Exhaust valve .....

   Direction of piston travel .....

2. Explain the effect on pressure in the cylinder, with the change in volume during each stroke.

   Induction: .....

   .....

   Compression: .....

   .....

   Power: .....

   .....

   Exhaust: .....

   .....

3. What ratio of air/fuel mixture flows through the inlet manifold and the open inlet valve into the cylinder.

   .....

FUSION WELDING USING MANUAL METAL ARC WELDING PROCESS

REFERENCE:

- Learner Reference Guide (Page 42 – 47)
- Introduction to Motor Mechanics (Page 118 – 123)

EQUIPMENT:

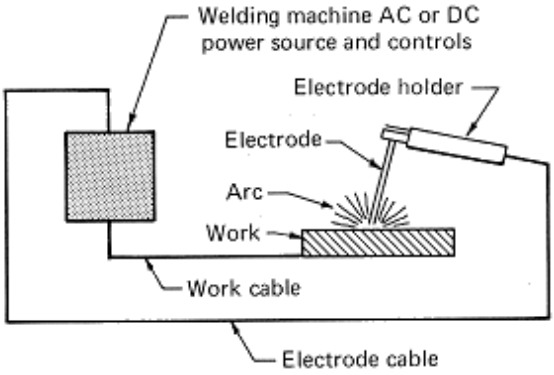
- Electric welder
- All safety equipment and protective clothing
- Mild steel sheet
- Electrodes

LEARNER REFERENCE GUIDE

INTRODUCTION TO ARC WELDING

Manual Metal Arc Welding Process

In metallic arc welding the welding rod, or electrode, is connected to one side of the electric circuit and the work to the other side. When the tip of the electrode is brought in contact with the work an electric current flows. If the electrode is now withdrawn slightly an electric arc will occur in the gap between the work and electrode. The heat generated by the arc (about 6000°C) causes melting of both electrode and work, i.e. causes a change of state of the metal from SOLID to LIQUID.



FUSION WELDING USING MMAW PROCESS EXERCISES

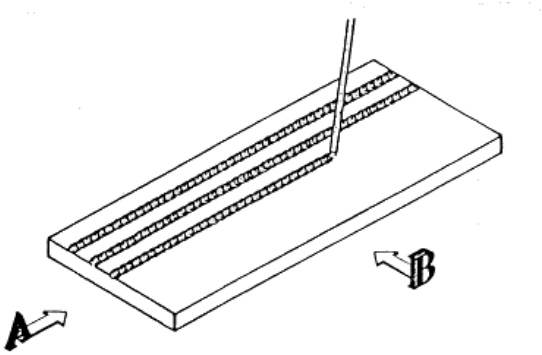
Like oxy-acetylene welding, manual metal arc welding is a skill that improves with practice. To help you to gain the necessary introductory skills complete Tasks 16 – 18.

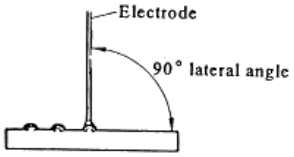
TASK 18: WELD BEADS ON MILD STEEL PLATE

Deposit uniform weld beads on mild steel plate to the requirements given below. The beads must be uniform with consistent, even restarts, free from slag and splatter.

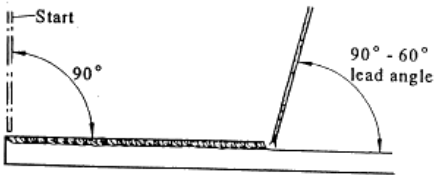
Method

1. Position the plate on the bench so that a right-handed operator would weld across the body from left to right. (left handed operator in the opposite direction)
2. Deposit a weld bead along the plate length, maintain the angles shown with an arc gap of approximately 2mm.
3. Deposit additional runs parallel to the plate approximately 6mm apart.
4. When the top surface of the plate has been covered, turn the material over and repeat steps 1 to 4.





View A



View B

Points to Watch

- Amperage setting and heat input
- Position of the plate on the bench
- Correct method of striking the arc
- Correct arc length
- Correct welding speed and travel
- Electrode angles.

Safety

- Follow OH&S workshop procedures
- Protect your eyes from the welding arc and wear the appropriate eye protection.
- Wear suitable protective clothing including dry leather gloves.

Task 18

Teacher's Signature:

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TASK 22: DEPOSIT BEADS ON A PLATE USING THE GMAW PROCESS

NOTE: ***Before commencing this task read Pages 123 – 127 Introduction to Motor Mechanics. This will give you the necessary knowledge to successfully operate the equipment.***

Deposit a bead weld on a piece of mild steel plate using the GMAW process, to the following requirements:

- Smooth regular weld profile free from splatter.
- Bead height of 3mm with a tolerance of +2mm and –1mm.

DEPOSIT BEADS ON PLATE USING GMAW PROCESS

Method

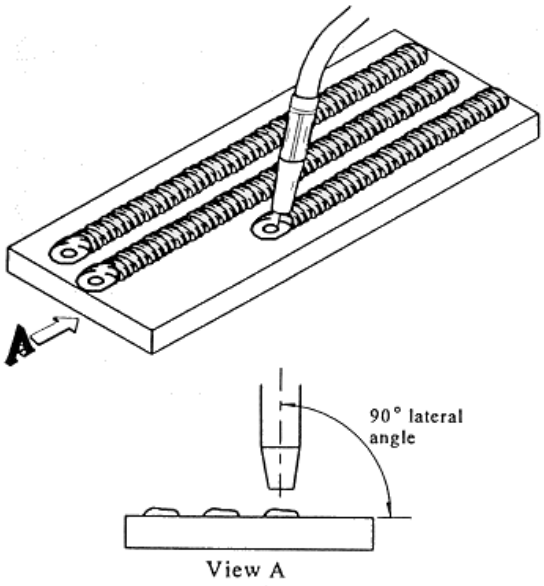
1. Trial welding conditions on scrap metal, to establish weld procedure.
2. Deposit the weld as shown.
3. Clean up the bead weld and submit your work for inspection.
4. Turn the plate over and repeat the exercise.

Points to Watch

- The stick-out length is about 7mm.
- The nozzle tip is a distance of 10mm above the piece of metal.
- Maintain a nozzle tip distance of 10mm as you move the torch at a constant rate.
- Torch angles.

Safety

- Follow OH&S workshop procedures.
- Wear the correct eye protection.
- Wear suitable protective clothing
- Cool your work, or attach a sign telling others it is hot.



Hold The Torch In The Correct Position

Task 22

Teacher's Signature:

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TASK 23: DEPOSIT A PAD WELD USING THE GMAW PROCESS

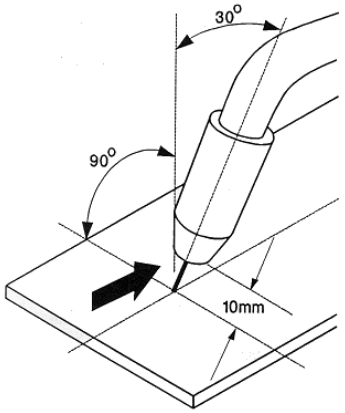
Deposit a pad weld on a piece of mild steel plate using the GMAW process, to the following requirements:

- Smooth regular weld profile free from splatter.
- Bead height of 3mm with a tolerance of +2mm and –1mm.
- A maximum of four significant surface defects per unit area.

BEAD WELDING USING THE GMAW PROCESS

Method

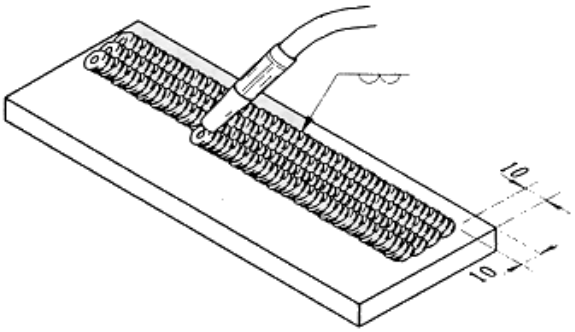
1. Trial welding conditions on a piece of scrap metal.
2. Mark a rectangular outline of the required bead weld on the plate with a piece of chalk.
3. Deposit the pad shape as shown.
4. Clean the weld and submit your weld for inspection.
5. Turn the plate and repeat the exercise.



Hold The Torch In The Correct Position

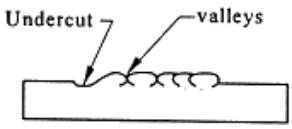
Points to Watch

- The stick-out length is about 7mm.
- The nozzle tip is a distance of 10mm above the piece of metal.
- Maintain a nozzle tip distance of 10mm as you move the torch at a constant rate.
- Torch angles.



Safety

- Follow OH&S workshop procedures.
- Wear the correct eye protection.
- Wear suitable protective clothing
- Use tongs to handle hot work
- Cool your work, or attach a sign telling others it is hot.
- Warn others before striking an arc.



Common faults

Task 23

Teacher's Signature:

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TASK 41: FIT SEAT AND GUARD PROTECTIVE COVERS

Demonstrate to your teacher the correct fitment and use of guard and seat covers on an appropriate car.

Task 41

Teacher's Signature:

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SERVICE A CAR: CARRY OUT A 15,000 KM SERVICE

REFERENCE:

- Introduction to Motor Mechanics (Page 141 – 148)
- Relevant workshop manual
- Lubrication & Tune up manual
- Owner's manual

TASK 42: QUESTIONS AND EXPLANATIONS

Complete the following questions to extend your knowledge of car servicing.

1. A farmer drives his car mainly on unsealed roads and his car endures long periods of idle. Would this have any effect on his car servicing schedule? Explain your answer.

   .....

   .....

2. You drive your car to and from work every day, the return trip is only 4 kilometers. Would this have any effect on your car servicing schedule? Explain your answer.

   .....

   .....

3. When installing a new oil filter it is important to install it according to maker specifications. Write the installation procedures for the filter you are going to replace.

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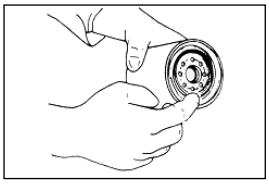
4. The seal on 'spin on' one piece oil filters must be lubricated prior to fitting so it can slip on the mating surface.



Oil Filter Seal

USE THE FOLLOWING STEPS TO CARRY OUT A COMPRESSION TEST.

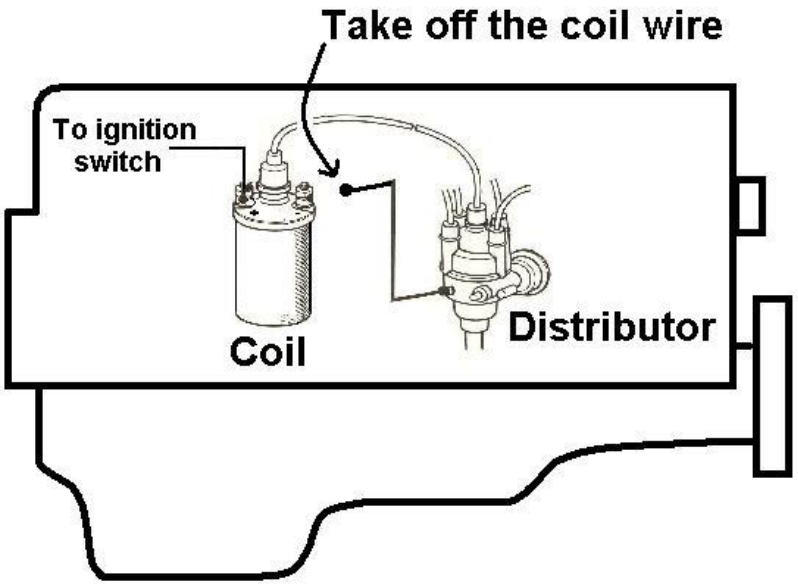
STEP 1: Read all of the instructions before commencing this task

- Note which way the sparkplugs leads are connected to the sparkplugs.
- Remove the leads from the sparkplug end only.
- If the sparkplug leads don't go back in the same order, the engine will not start.

STEP 2: Remove all sparkplugs using a sparkplug socket, extension and ratchet.

STEP 3: Screw the adapter into the spark plug hole then attach the compression tester.

Compressor Tester



STEP 4: To prevent the possibility of an electric shock, disconnect the wire from the ignition coil.

STEP 5: Turn the ignition key to the start position and "crank the engine over" five turns. You will be able to hear each compression stroke, just count five of them.

STEP 6: Write down the Kpa and PSI compression readings for each cylinder.

REMOVE AND REPLACE A CYLINDER HEAD

INTRODUCTION

Removing and replacing a cylinder head, is not to be mistaken as simply a 'teardown' operation. You should be equipped with proper tools, correctly fitting spanners, gear pullers, lifting equipment and other specialised devices, for speedy and safe removal and replacement of the cylinder head. Tape and a marking pencil, are essential pieces of equipment, to use prior to the removal of the cylinder head. Mark all connections, pipes and hoses prior to dismantling, this simple act will save you hours of work when you reinstall the cylinder head.

Gradual removal of bolt stresses from cylinder head bolts and manifolds recommended. Warpage can be introduced by leaving several bolts fully tightened after the remainder have been loosened.

Parts removed from the engine, should be cleaned and placed in an orderly position, ready for inspection and measuring.

It cannot be stressed on you enough to always follow the manufacturer steps and procedures when both removing and replacing your cylinder head. Remember, even the most experienced and best mechanics, rigidly follow the service manual.

TASK 50: REMOVE AND REPLACE A CYLINDER HEAD

This task provides you with the opportunity to apply what you have learnt so far. Remove and replace a cylinder head strictly in accordance with the manufacturer procedures and specifications.

Procedure:

1. Read appropriate workshop manual
2. Complete the following information chart
3. Complete the following torque setting chart
4. Remove the cylinder head as per manufacturer procedures
5. Perform cylinder head measurements and calculation
6. Replace the cylinder head as per manufacturer procedures.
7. Carry out reassembly inspection

Engine Information

Engine Model: .....

Engine Number: .....

No. of Cylinders: .....

Engine Configuration: .....

.....

Engine Size: .....

Report to your teacher and discuss the cylinder head condition with him/her.

Task 53

Teacher's Signature:

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Replace the cylinder head as per manufacturer procedural steps, taking all precaution as previously stated in Task 6.

Task 53

Teacher's Signature:

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TASK 54: CARRY OUT REASSEMBLY INSPECTION

The cylinder head is now in place, but the job is not yet finished.

After you have completed any major or minor work on an engine, you must get into the habit of carrying out an inspection of the work that you have done

Complete an inspection of all the work carried out by you to remove, inspect and replace the cylinder head. The inspection must include:

- An inspection of engine components/sub assemblies for correct location.
- An inspection of components/sub assemblies for attachment, security and locking devices.
- An inspection of tappet clearance.
- An inspection of valve timing.
- An inspection of ignition timing.
- An inspection of how easy the engine turns over.

Task 54

Teacher's Signature:

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TASK 55: RECTIFY ANY FAULTS DISCOVERED

It has been a big task and at times faults become evident after you have completed the job. Carry out an inspection of your assembled engine to ensure that it is perfect and record and rectify the faults that you discovered.

Faults discovered.