1. What are the specification & how they are used in Shop-Work?

A. Definition of Specification:-

“Specifications are technical data, numbers, clearances, and measurements used to diagnose and adjust automobile components.**”**

How to use Specification:-

Specifications can be referred to as specs. They are usually considered precise measurements under standard conditions. Most specifications can be measured with the measuring tools.

Specifications are supplied by the automotive manufacturer. Specifications have been used as guides to show the technician how the automobile was set up when it was manufactured. A technician working on a new car should follow the factory specifications as closely as possible.

However, when an automobile gets older, some specifications may not be exactly right for best operation. In this case, the manufacturer's specifications must be considered along with the technician's experience. This may result in a departure from the factory's specifications. However, it is important to stay as close to the original specifications as possible.

Types of Specifications:-

Many types of specifications are needed in the automotive shop. Many of the specifications require the automotive technician to obtain certain information from the vehicle identification number (VIN). This information can then be used to help identify other types of specifications needed. The following is a list of common specifications found in many service manuals. Depending on the exact service manual, the publisher may or may not list the specifications using the categories shown.

1. GENERAL ENGINE SPECIFICATIONS:-

These specifications identify the size and style of the engine. They include cubic-inch displacement, engine codes, fuel system settings, bore and stroke,

horsepower, torque, compression ratio, and normal oil pressure. Each publisher may include different data in this section. For example, engine numbers, firing order, and number of cylinders may also be included.

2. TUNE-UP SPECIFICATIONS:-

These specifications help identify adjustments necessary for a tune-up on the vehicle. These include spark plug gap, firing order, degrees of ignition timing, fuel system settings, and fuel pump pressure.

3. CAPACITY SPECIFICATIONS:-

These specifications include measurements needed to identify the capacity of different fluids on the vehicle. These include cooling capacity, number of quarts of oil, fuel tank size, transmission transaxle capacity, and rear axle capacity.

4. OVERHAUL AND MAINTENANCE SPECIFICATIONS:-

These include specifications used to aid the technician in servicing the vehicle. They include distributor advance at different speeds, valve seat angles, valve stem clearances, piston measurements, ring end gaps, bearing clearances, shaft end play, and many more. These specifications help the technician determine how much wear has occurred. The mechanic is then able to decide whether or not to replace the component in question. Usually maximum or minimum clearances are given for this purpose.

5. OPERATIONAL SPECIFICATIONS:-

These specifications tell how the vehicle is to operate, what type of oil to use, and so on. Some of them are found in the owner's manual. For example, the break-in speed limit May be taken from an owner's manual. Some specifications are found in magazines and other technical literature. For example, a performance comparison of several vehicles may be found. Other specifications include tire inflation, type of gasoline to use, tire size, and general information for the operator of the vehicle.

6. TORQUE SPECIFICATIONS:

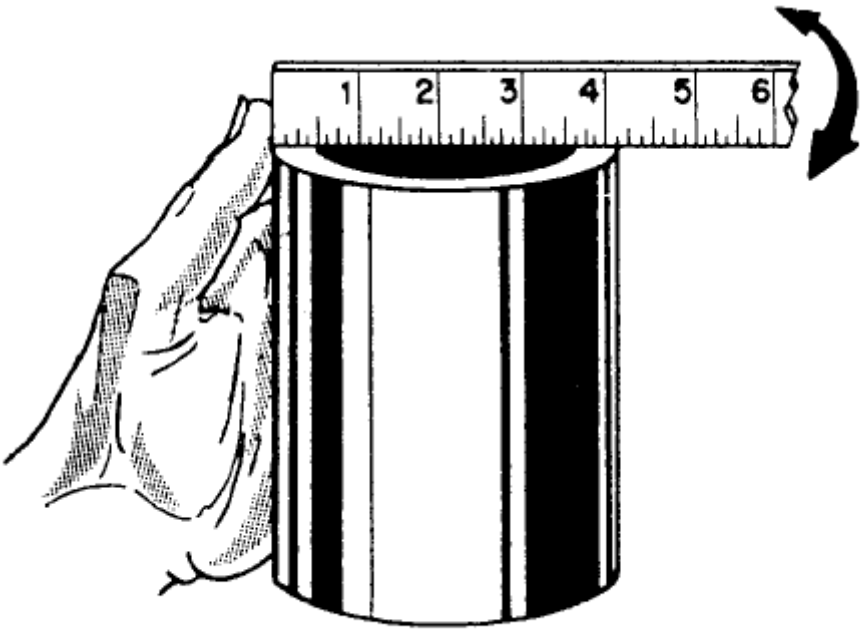
It is important to torque each bolt or nut correctly when replacing or installing a component on the automobile. Torque specifications are used for this purpose.

2. Name the precision instruments used for measuring cylinder wear and write the procedure for measuring ovality and taper of cylinder.

A. Various precision Instruments used for measuring cylinder wear:-

1. Inside Micrometer
2. Outside Micrometer
3. Dial Bore Gauge
4. Telescope Gauge
5. Cylinder-Bore Gauge
6. Vernier Caliper

B. Procedure to measure Ovality with the help of Rule or Steel Scale:-



I. Disassemble the Engine Assembly.

II. Put the Cylinder Block on straight surface.

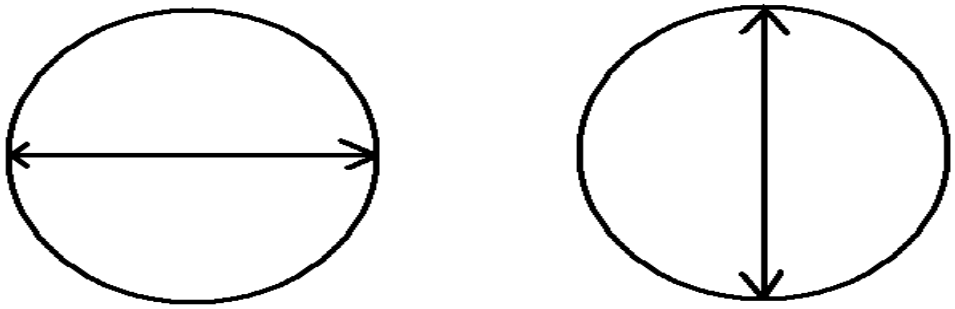
III. Measure the roundness from top of the cylinders.

IV. First reading takes as shown in fig (A) at the top & the bottom of the cylinder.

V. Take the second reading as shown fig (B) at the top & the bottom of the cylinder.

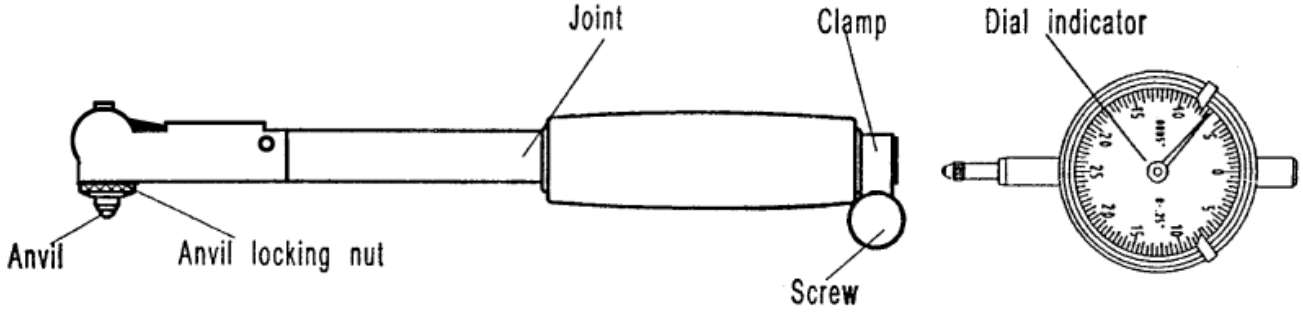
VI. Compare the readings with one another and you can find the ovality of that particular cylinder.

VII. Measure each cylinder as mention above.



Cylinder bores with less than 0.01mm ovality need not be rebored. They can be rectified by honing only.

C. Procedure to measure Taper with the help of Cylinder-Bore Gauge and Dial Gauge:-



Cylinder-Bore Gauge

I. Insert the dial indicator's stem into the bore gauge handle and tighten the clamp.
II. Choose the proper anvil length to match the bore size to be measured.
III. Insert the whole assembly in to the Cylinder whose Taper has to be measured.
IV. Take the readings from the Dial Indicator, when the anvil is at the bottom of the cylinder.
V. Then when the anvil is at the middle of the cylinder and after that at the top of the cylinder.
VI. If at each stage (Bottom, Middle and Top) the reading has found differ then the taper has been found out.
VII. The amount of Taper has found from the Reading.

Generally, maximum permissible tapper is 0.25mm. Depending upon the wear of the cylinder bore next oversize is selected so as to remove all taper. Cylinder with small taper as mentioned only requires new piston rings. However, the greater the taper more difficult it is for the rings to control blowby, oil burning, and exhaust emissions.

3. What do you understand by "Running-In-Period" of new engine of the vehicle?

A. Definition of "Running-In-Period":-

"A period during which certain restrictions or moderation in operating should be followed, as the avoidance of high speed, rapid acceleration, or severe braking for a new automobile is known as Running-In-Period or Break-In-Period."

General Information about Running-In-Period:-

Most modern cars usually come with a recommended break-in period between 600 to 1,200 miles.

The future performance and reliability of the engine depends on the care and restraint exercised during its early life. It is especially important to observe the following precautions during the initial 960 km (600 miles) of vehicle operation.

- After starting, do not race the engine. Warm it up gradually.
- Avoid prolonged vehicle operation at a constant speed. Moving parts will break in better if you vary your speed.
- Start off from a stop slowly. Avoid full throttle starts.
- Avoid hard braking, especially during the first 320 km (200 miles) of driving.
- Do not drive slowly with the transmission in a high gear.
- Drive the vehicle at moderate engine speeds.
- Do not tow a trailer during the first 960 km (600 miles) of vehicle operation.

4. Explain importance of using Torque wrench.

A. Torque Wrenches are used to tighten bolts and nuts to their correct torque specification. Torque Wrenches are used to control the amount of tension on a bolt by measuring the amount of twist or torque developed while tightening the bolt.

Torque wrenches are designed to match sockets using 1/4-, 3/8-, and 1/2-inch drives. Other drives are also available but are not as common. They include 3/4-, 1-, and 1 1/2-inch drives for heavy-duty service.

Torque wrenches typically have a dial or scale that indicates the amount of torque in pound-inches (lb-in) or in pound-feet (lb-ft).

5. State the use of below tools.

A.

1. **Ring Expander: -** This tool is to be used for installing or removing piston ring without damage or breakage or distortion or any other damage.

2. **Ring Compressor: -** This tool is to be used for installing piston with rings in the cylinders. It consists of self-locking heavy ratchet pawl and tension bands of highest grade. This tool also keeps the end gaps intact.

3. **Ring Groove Cleaner: -** It has been used to clean the carbon built up in the ring grooves before installing new piston rings.

4. **Cylinder Deglazing Hones: -** Cylinder Deglazing Hone breaks the glaze (Combustion heat, engine oil, and piston movement combine to form a thin residue on the cylinder walls that is commonly called glaze.) in any cylinder.

6. Which measuring instruments should be used in a Service Station for following operation?

A.

1. **Cylinder Bore Wear: -** Telescope Gauge & Outside Micrometer
2. **Crank Pin Journal Wear: -** Outside Micrometer
3. **Valve Tappet Clearance Measurement: -** Thickness Gauge or Feeler Gauge
4. **Spark Plug Gap Measurement: -** Wire Thickness Gauge
5. **Piston Diameter Measurement: -** Outside Micrometer

7. Explain procedure for Valve Guide Changing & Valve Seat Cutting.

A.

Average Specifications for Valve Guides:

- For Intake: 0.001 to 0.003 inch [0.0254 to 0.0762 mm]
- For Exhaust: 0.0015 to 0.0035 inch [0.0381 to 0.0889 mm]

(Note: These readings may vary with different manufacturers and engine makes.)

If Intake Valve Guide is more than 0.00492 inch [0.125 mm] and Exhaust Valve Guide is more than 0.00590 inch [0.150 mm] wear found the Valve must be replaced.

Valve Guide Changing Procedure:-

1. The worn out guide may be driven out by hammering with a proper drift or with a special tool called Guide Remover.

2. After guide has been removed, check the guide bore for scoring. A badly scored guide bore may have to be reamed out to accommodate the next larger size guide.
3. After guide bore is checked, select the correct guide (intake or exhaust) and heat the cylinder head uniformly at a temperature specified in the service manual of manufacturer.
4. For fitting the new Guide, however hammering should not be resorted to; instead it should be installed with the help of a special guide installer.
5. In case of I head Valves this may be done in an arbor press.
6. After installation, the guide is reamed to proper size.
7. Valves with standard size stems can then be used.

Special care has to be taken while replacing Valve Guides on cylinder heads made of Aluminum. Aluminum being soft can be easily worn out while removing or installing the Valve Guide. To avoid this, sometimes the worn guides are not removed. Rather these are machined to some larger diameter and thin-walled bronze inserts are installed, with which standard valves may be used.

Valve Seat Cutting Procedure:-

The Valve Seat is the machined surface on which the Valve face rests when the Valve is closed. There are two types of Valve Seats: **Integral and Replaceable (also known as Valve-Seat Inserts)**. Most engines with cast-iron cylinder heads have integral valve seats. Generally Valve-Seat conical angles of 45° or 30° are used.

Valve seats can be refinished with a motor-driven grinding stone. Carbide-steel cutters turned by hand or with a motor can also be used. With either method, first service the valve guide. The pilot shaft for the stone or cutter installs in the valve guide. A dirty guide may cause the pilot shaft to be off center.

The valve-seat grinder rotates a grinding stone of the proper shape on the valve seat. The stone is kept concentric with the valve seat by the pilot installed in the valve guide. After refinishing the seat, measure the seat width with a steel scale. A typical recommendation is that the seat should be 1/16 inch [1.6 mm] wide and centered on the valve face. If the seat is too wide, narrow it to the specified width.

- Use a 15-degree upper stone and a 60-degree lower stone as necessary to grind away the upper and lower edges of the seat. This narrows the seat contact line on the valve face.

- If the contact line is too high on the valve face, lower the seat by grinding with the 15-degree stone.

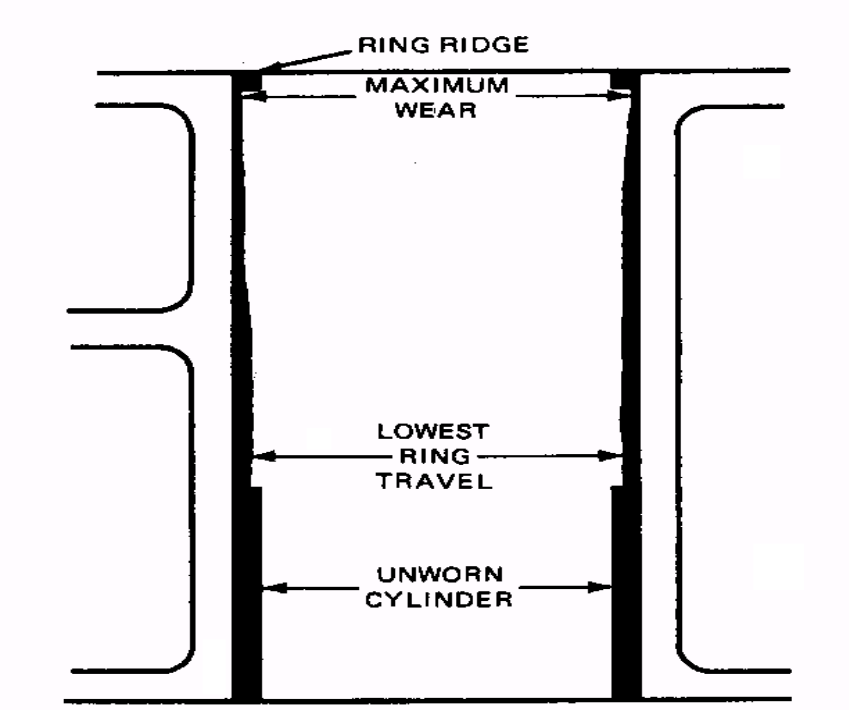
- If the contact line is too low, use a 60-degree stone to raise the seat.

Place the pilot in the valve-seat cutter. Then place the cutter on the pilot. As the cutter rotates, it cuts metal from the seat. Different cutters or blades are used to cut different seat angles. They can also narrow the seat and raise or lower it. Some cutters cut all three seat angles at the same time.

8. Explain why & how the "Ridge" is formed in the Cylinder Bore.

A. The "Ridge" is formed at the top of the cylinder. Because the top ring stops travelling before it reaches the top of the cylinder, a Ridge of unworn metal is left.

You can feel the Ridge with your fingernail.

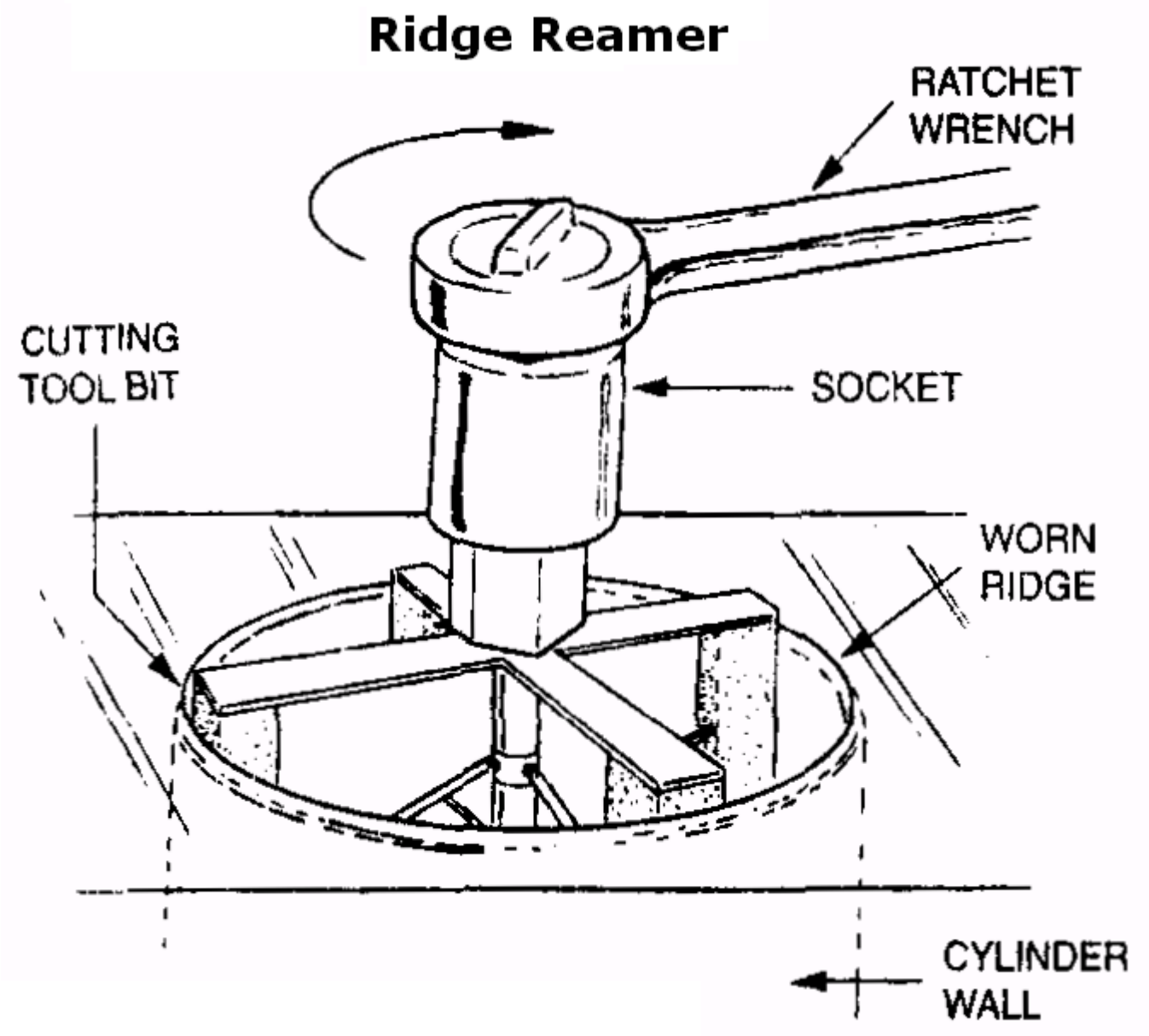


Ridge Formation

9. How "Ridge" is removed? What happen to the piston if it is taken out without removing the Ridge?

A. The Ridge must be removed during engine overhaul. The Ridge should be removed before the pistons are removed. If the ridge is not removed first, when the pistons are removed, the rings may be jammed or broken or the piston surface scratched or damaged.

The Ridge is removed by means of Ring Ridge Remover, also known as Ridge Reamer. If the wear is less than 0.3 mm, machine the piston ring ridge at the top of the cylinder.



“Ridge” removal procedure:-

It is devices that have cutting tools that is inserted, tighten down, and turned inside of the cylinder. As the tool is turned, the tool bits cuts the Ridge away from the top of the cylinder.

The ridge reamer is a tool that has three points of contact with the cylinder walls. One of the points has a cutting tool at its end. The ridge reamer is inserted into the cylinder bore and slightly tightened. Then, a standard socket and ratchet wrench is used to turn the tool. As the tool is turned, it slowly cuts away the ridge on the top of the cylinder. After the ridges have been removed and the piston removed, then the cylinder wall should be checked for wear, taper, and other damage.

10. Describe the procedure of removing & fitting of cylinder liners.

A.

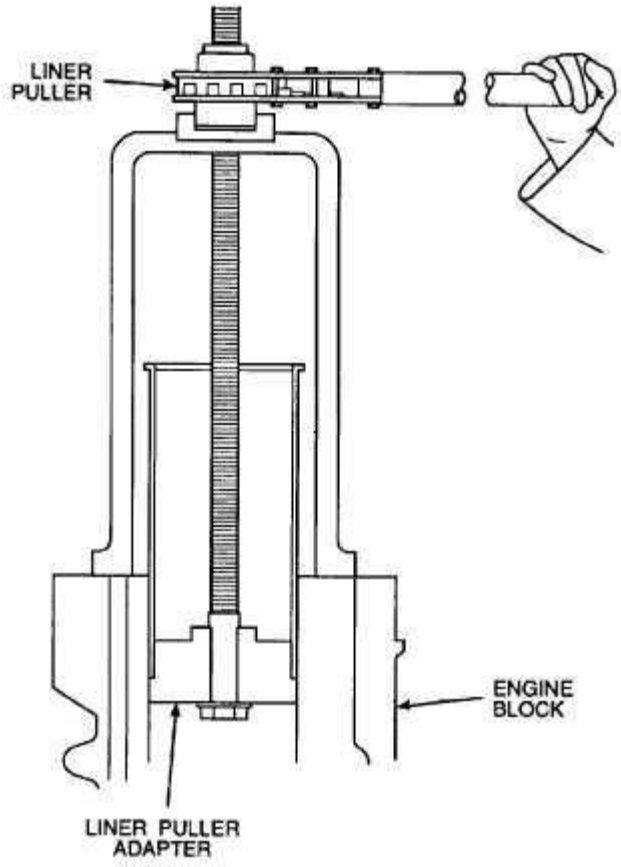
Cylinder Liner Removing Procedure:-

1. Mark the position of the cylinder liners in relation to the cylinder block.

2. After piston and rod removal use the universal wet sleeve puller and remove cylinder sleeves or liners.

3. Position the puller in the sleeve (liner). Hold the jaws of the puller and turn the screw, which spreads the jaws to grip the edge of the cylinder sleeve (liner). Tighten the locking bar against the top of the sleeve (liner).

4. Withdraw the sleeve (liner).



Cylinder Liner Puller or Remover tool

Cylinder Liner Fitting Procedure:-

1. The cylinder must be stripped of all removable parts: studs, nuts, bolts, manifolds, etc.

2. The cylinder is bored out to accept the sleeve.
3. The cylinder is then heated in an oven between 400°C, up to 450° C for an hour or more.

4. The cylinder is then removed from the oven and the sleeve will drop easily into the cylinder. You will have between five and ten seconds before the sleeve and cylinder lock up.

5. The cylinder must then be put under a hydraulic press to keep the sleeve from rising while the cylinder is cooling.

6. The ports of the sleeve must then be blended with the cylinder by using an assortment of hand grinding porting tools. Mismatched ports will cause some power loss to the engine.

7. After the ports have been matched, the cylinder (sleeve) must be bored out and honed to insure proper piston clearance.

8. Measure your piston at the skirt to properly bore the sleeved cylinder to the correct bore size.

11. Explain the procedure of Tappet Setting of Multi-Cylinder Engine.

A.

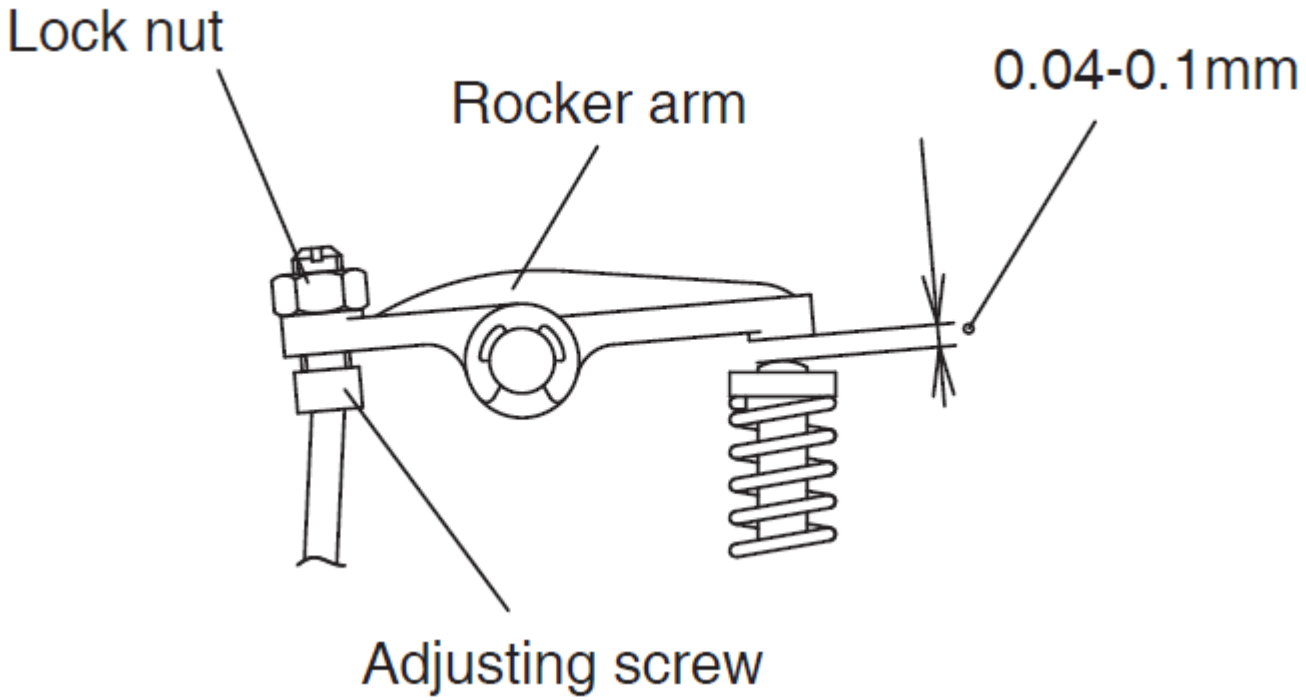
1. Tappet clearance is factory preset. No adjustment is necessary generally.

2. Clearance adjustment should be done when the engine is cool. When the engine temperature is high, clearance is higher due to thermal expansion.

3. The proper clearance setting should be at 0.04-0.1mm.

4. Rotate the engine by the top pulley nut until no.1 piston is at TDC.

5. The adjustment is achieved by loosing the locknut and turning the adjusting screw. Tighten the locknut after the adjustment is achieved.
6. Check the Clearance with the Feeler Gauge.



Tappet Setting/Adjustment

12. Describe the procedure of Compression Test.

A. A compression test is made to determine the condition of the engine parts that affect cylinder pressure. This test should always be performed as part of a tune-up or whenever there is a complaint about poor engine performance. This check should also be made when there is excessive oil or fuel consumption. A compression test is a performance comparison between the cylinders, which is then compared with manufacturer specifications. The specifications are listed in many automotive maintenance and service manuals. All conditions during the test should be the same. These include the cranking speed, position of throttle and choke, and the temperature of the engine during the entire test. There are two types of compression test: The Dry and The Wet Compression Test. Preparation for both tests include the following:

1. The engine must be at normal operating temperature.
2. Check to be sure the battery is fully charged.
3. Check the starter for operation at the same speed.
4. Remove all spark plugs.
5. Connect a jumper wire between the high-tension terminal of the coil and ground. This connection will disable the ignition system to prevent high-tension sparking while cranking.
6. Connect a remote starter switch so the engine can be cranked from the engine compartment,

THE DRY COMPRESSION TEST:-

The dry compression test is performed to get a basic comparison between the cylinders and to determine the overall condition of the compression chamber. The dry compression test is performed as follows:

1. Hold the carburetor linkage and choke wide open.
2. Screw the compression tester into the spark plug hole. Do not use a wrench to tighten the compression tester.
3. Crank the engine until the compression gauge reaches the highest reading. This should be reached with three or four revolutions of the engine. Write down the highest reading.

4. Repeat this procedure with the same number of revolutions on all cylinders. Be sure to release the compression gauge after each test.

5. Compare the readings of all cylinders.

6. A 20% variation between the cylinder readings is usually satisfactory. If the readings vary more than 20%, the cause should be determined. Refer to the manufacturer's specifications for the exact amount of variation on each cylinder,

PRECAUTIONS:

- Be careful not to touch the hot exhaust manifold if the engine is at operating temperature.
- Be careful not to get the remote starter wires or other tools in the fan area.

THE WET COMPRESSION TEST:-

The wet compression test is taken to determine if low readings are caused by compression leakage past the valves, piston rings, head gasket, or other leaks such as a crack or hole in the piston. The procedure for the wet compression test is as follows:

1. Squirt a small amount of oil into each cylinder through the spark plug hole.

2. Now perform the compression test as outlined in the dry test. The oil should temporarily form an improved seal between the piston and cylinder wall.

3. If the readings are 10 pounds or more higher than during a dry test, compression is probably leaking by the rings.

4. If there is no difference between the wet and dry test, or if the wet test is less than 10 pounds higher, a compression loss is probably caused by compression leaking past the valves.

5. When taking a compression test on new rings, you may not be able to obtain the full compression until the rings are seated.

PRECAUTIONS:

- Never perform a Wet Compression Test on a Diesel Engine. The heat of compression could ignite the oil and damage the compression tester. Also, since the oil is not compressible, it could fill the combustion chamber and create a hydraulic lock. This prevents the crankshaft from turning and may damage the engine.

THE RESULT OF COMPRESSION TEST:-

Sr. No.	COMPRESSION GAUGE READING	PROBABLE ENGINE CONDITION
1	Fails to climb during all compression strokes	Valve Sticking Open
2	20 PSI[138 kPa] below normal	Faulty rings or valve seating
3	More than 20 PSI[138 kPa] below normal in two cylinders next to each other	Faulty head Gasket
4	20 PSI[138 kPa] above normal	Excessive carbon buildup in combustion chamber

If adding oil does not increase compression pressure, the leakage may be past the valves. Possible causes include:

1. Broken valve spring
2. Incorrect valve adjustment
3. Sticking valves, valves not seating
4. Worn or burned valves
5. Worn or burned valve seats
6. Worn camshaft lobes
7. Dished or worn valve lifters

A Blown Head Gasket also causes a low reading during a Wet Compression Test.

13. Describe the Vacuum Test of the Engine.

A. These Tests are performed only with the help of a vacuum gauge, which is attached to an adapter on the intake manifold. For these tests it must be remembered that an idling engine develops power just sufficient to overcome factional and pumping losses, while the small surplus power determines the idling speed. Various vacuum tests usually performed are:

1. Mechanical condition of the engine:-

This may be determined by a number of alternative tests:

I. Irregular Gauge Reading:

The intake vacuum in an engine will fluctuate over the operating four-stroke cycle. There will be a suction stoke every 720° in case of a single cylinder engine.

Similarly in case of 4 and 6 cylinder engines, the suction stroke will occur every 180° and 120° respectively. If the mechanical condition of the engine is O.K., the successive vacuum fluctuations seen on the vacuum gauge for different cylinders will be equal. However, if any one or more cylinders have some mechanical defect, e.g., a leaking valve, broken or sticking piston rings, a damaged cylinder head gasket, the vacuum of that/those cylinder(s) would be less which will be seen as a momentary drop in vacuum indicated by the irregular gauge reading.

II. Cranking Method:

Short the 'CB' terminal of the ignition coil with the earth, which will not allow the spark to occur at the spark plug terminals. Now crank the engine by means of the starter motor for about 15 seconds, with the throttle completely closed. If the mechanical condition of the engine is good, a high manifold vacuum of the order of 350 mm Hg or more will be produced. However, if the vacuum gauge readings show lesser vacuum, it would indicate mechanical defects such as worn piston rings or cylinder bores, poor valve sealing or damaged manifold gasket.

III. Throttle Method:

When the engine is idling, note the gauge reading and quickly open the throttle so that the engine reaches its maximum speed. Then immediately close the throttle. If by so doing, the vacuum gauge reading rises immediately above the normal vacuum to 125 mm Hg or more and then comes backs to its original value, the engine is in good mechanical condition. However, if the rise in vacuum is small, it would be due to loss of compression which may be on account of worn cylinder bores, pistons and/or rings.

IV. Idling method:

In this, the engine is run at idling speed and vacuum gauge reading is noted, If the engine is in good mechanical condition, it would give, steady reading, 460-510 mm Hg in case of a 4-cylinder engine and 480-540 mm Hg in a six-cylinder engine. An intermittent drop of about 80-100 mm Hg would indicate leaking valve (s).

2. Cylinder balance:-

To determine this, the engine is run at idling speed and spark plug leads are removed in turn, while carefully observing the gauge reading in each case. If there is equal fall in vacuum of about 20 to 50 mm Hg in each case, it would indicate that each cylinder is contributing same power. In case there is less vacuum drop in a particular cylinder, it would mean that that particular cylinder is producing lesser power, which may be due to defect in the cylinder or even due to defective fuel supply and/or ignition systems. Further investigations shall be needed to pin-point the exact cause.

PRECAUTIONS:

- Connect the Vacuum Gauge to the Intake Manifold. Start the engine and run it until it reaches normal operating temperature.

14. Explain Crack Detection Method in Cylinder Head & Cylinder Block.

A. Detecting a Crack in a metal casting means not only finding that Crack exists but also determining the exact location and extent of the Crack.

The three most common Methods of Crack Detection are as follow:

1. Use a Magnet and Magnetic Powder (Frequently referred to as the Magna Flux Process)
2. Use Penetrate Dye (Developed specially for non-magnetic castings such as Aluminum Heads and Blocks)
3. Pressurize the Head or Block with a Pressure Tester
4. Pressure Testing of the water jackets with Compressed air and soap water

1. Magnet and Magnetic Powder (Or Magna Flux Process):-

In this Method of Crack Detection the use of Metal Fillings and Magnetic Force has been done. The fillings are sprinkled on the part and Magnetic Force is applied. If there is a crack, the fillings will cluster around it.

2. Dye Penetrate Inspection:-

Dye Penetrate Inspection (DPI), also called Liquid Penetrate Inspection (LPI) or Penetrate Testing (PT).

This Method is a widely applied and low-cost inspection method used to locate surface-breaking defects in all non-porous materials (metals, plastics, or ceramics). LPI is used to detect casting, forging and welding surface defects such as cracks, surface porosities, and leaks in new products, and fatigue cracks on in-service components.

DPI is based upon capillary action, where low surface tension fluid penetrates into clean and dry surface-breaking discontinuities. Penetrant may be applied to the test component by dipping, spraying, or brushing. After adequate penetration time has been allowed, the excess penetrant is removed, a developer is applied. The developer helps to draw penetrant out of the flaw where a visible indication becomes visible to the inspector. Inspection is performed under ultraviolet or white light, depending upon the type of dye used - fluorescent or non-fluorescent (visible).

Hydraulic test procedure:-
First of all air tightening is done to the water jacket of the cylinder head with the help of rubber bush.
As shown in fig., now connect the pressure gauge & pressure pump to the water jacket of the cylinder head.
Now, apply pressure to the water stored in water jacket with the help of pressure pump.(50 phi)
The pressure will the reduce if the crack exists in the cylinder head.

15. State the effects of excessive backlash between Timing Gears.

Backlash is the tangential clearance between two meshing teeth.