# DIESEL MECHANIC

MINING QUALIFICATIONS AUTHORITY

# CODE: VG

# GRIND VALVES

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TRG 9

# INDEX

The following elements are contained in this learning guide:

## OBJECTIVE

### What you must do

1. Remove the valves from a cylinder head.
2. Reface the valves on an electric valve grinding machine.
3. Reface the valve seats with a valve seat cutter.
4. Hand grinds the valves into their seats.
5. Assemble the cylinder head.
6. Test valve seat for leakage.

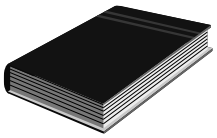
### What you will be given

1. A cylinder head fitted with exhaust and inlet valves.
2. All the necessary tools and equipment.

### How well you must do it

1. The angle of the valve seats must be according to specifications.
2. The angle of the valve face must be according to specifications.
3. The rim margin of the valve must not be less than the OEM minimum specification.
4. There must not be any damage to the valve guides.
5. There must not be any damage to the valves.
6. There must not be any damage to the valve seats.
7. There must not be any damage to any equipment used.
8. There must not be any grinding paste, carbon deposits or any dirt on any part after the cylinder head has been assembled.
9. The face of the valve should extend the correct amount as specified by the original equipment manufacture’s specifications.
10. The width of the seats must be concentric around the circumference of the valve faces and the valve seats as per OEM specifications.

## ADDITIONAL RESOURCES



1. Demonstration by a competent person, e.g. your Training Officer.
2. Workshop Manual.
3. Audio visual aids if available.

# HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM

## VG

## GRIND VALVES

| STEPS IN OPERATION / PROCESS | POTENTIAL ACCIDENT / INCIDENT | CONTROLS (BY RESPONSIBLE PERSON) |
|---|---|---|
| • Use hand tools | • Using damaged tools or wrong tools for the job can cause injury and damage to equipment. | • Always use the correct tool for the job.<br>• Ensure tools are in good condition.<br>• Use tools correctly.<br>• Wear appropriate PPE where necessary.<br>• Always take good care of tools. Maintain, clean and store it properly. |
| | • The Cylinder head is heavy and could fall of the work bench if due care is not taken. | • Make sure the cylinder head is placed securely on the work bench. |
| | • Testing the valve seat requires the use of Paraffin which is toxic. | • Use the appropriate PPE when working with hazardous chemicals. Consult MSDS documentation for the recommended PPE. |
| | • When removing and replacing the valves be aware of the stored energy in the valve spring's this could cause personal injury. | • Wear eye protection when removing and installing the valve springs. |

**NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC Form again and then sign the statement below:**

**The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.**

**Signature of Learner:……**

**Signature of Training Officer:……..**

**Date:…….**

# GRIND VALVES

**ITEM / TASK:** Introduction

**DESCRIPTION:**

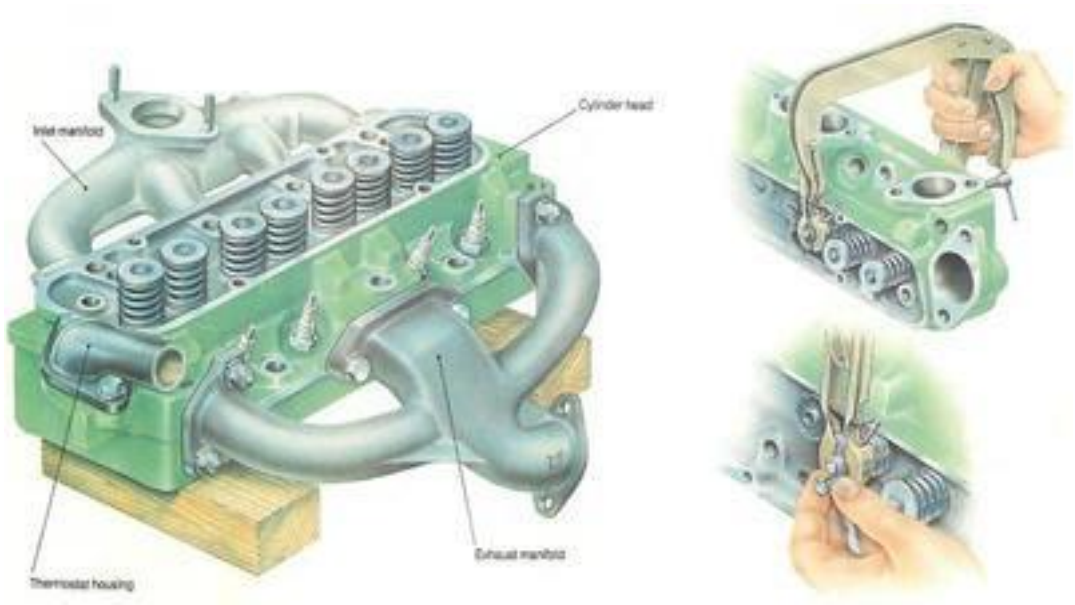
When the valve seats and the faces of the valves are badly pitted and worn hollow, they must be re-conditioned to ensure that there is no leakage between valve and valve seat. Valve grinding smooth's up the face of the valve seat and valve face so that the two refined surfaces mate so perfectly that leakage is eliminated.

**REMOVING THE VALVES FROM THE CYLINDER HEAD.**

(Refer to module OCA)

- Remove the valves from the cylinder head by using a valve spring compressor. (Fig. 1).

Fig 1

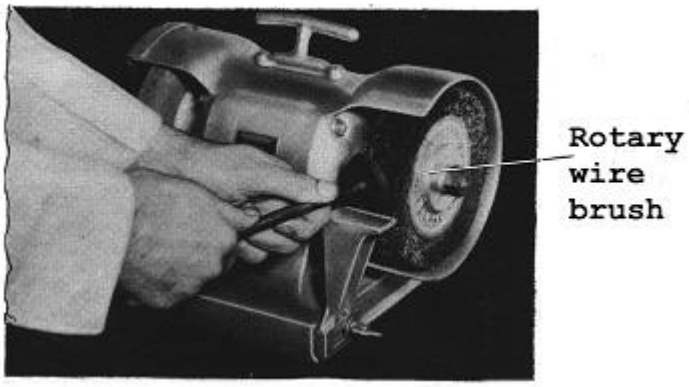


- Clean the cylinder head with a wire brush to remove all the carbon and other deposits. (Fig. 2)

Fig 2

- Clean the valves with a rotary brush on a bench grinder. (Fig. 3)

Fig 3



**PRACTICE**

Take a cylinder head and remove the valves and prepare the head assembly for re-conditioning. ( refer to module OCA)

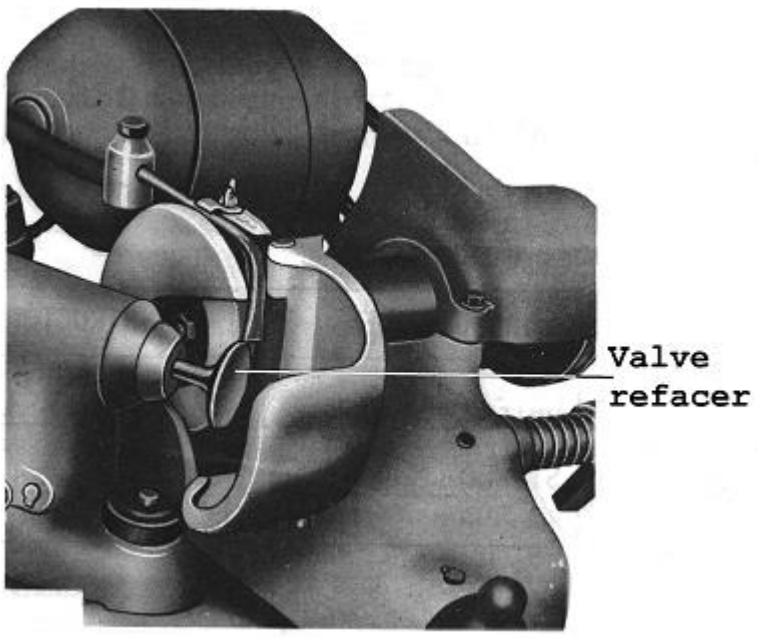
Call your Training Officer to check your work. When you have achieved the required standards, ask him to sign below before you go on to the next section.

| LEARNER | TRAINING OFFICER |
|---|---|
| **Date:** | **Date:** |
| **Signed:** | **Signed:** |

## REFACING THE VALVES

To reface the valves, a specially designed electrically driven grinding machine called a valve refacer is used (Fig. 4).

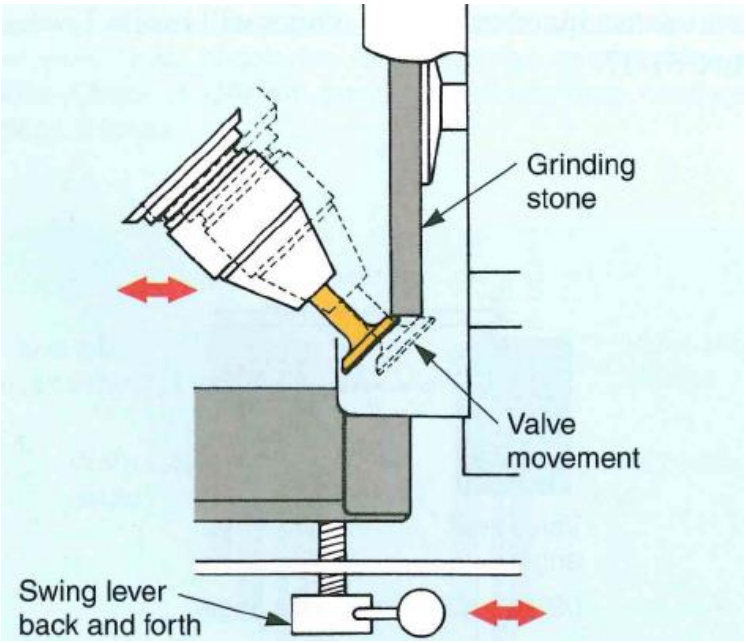
Fig 4




- Dress the grinding wheel if necessary. Refer to the operating instructions for the valve refacer.

**NB:** Dressing is necessary whenever the face of the wheel becomes dull, glazed or loaded. (Fig. 5 on next page)

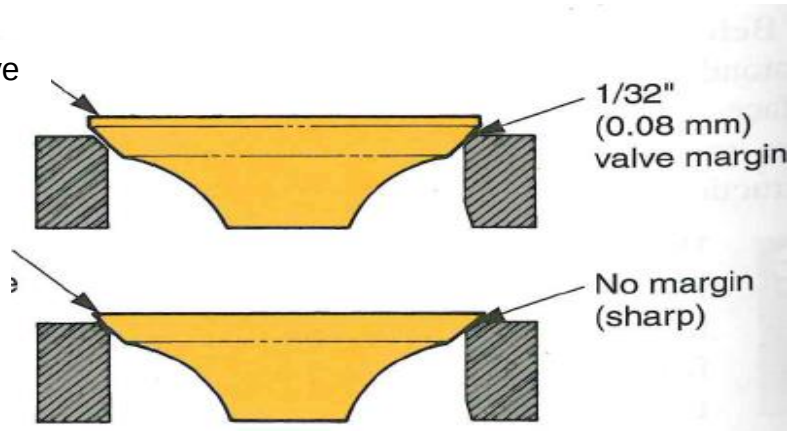
Fig 5




- Position the working head of the valve refacer at the specified angle with the valve head. Refer to the Workshop Manual for the correct angle (30°or 45°)
- Fit the correct collet for the size of valve. Ask your Instructor for a demonstration.
- Fit the valve in the collet and tighten the collet spindle.
- Adjust the feed and traverse slide to bring the face of the valve in front of the grinding wheel.
- Switch on the collet and grinding wheel motors and turn on the coolant supply.
- Make light cuts by slowly turning the feed screw handle - operate the traverse slide forwards and back-wards at the same time.

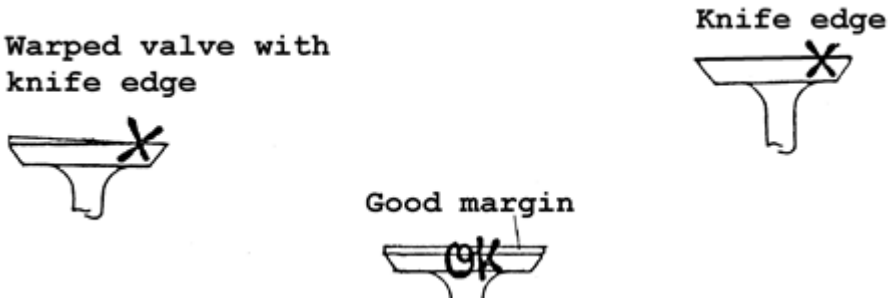
  **NB:** Scrap and replace any valve that cannot be entirely refaced while keeping a good valve margin. This rim margin must not be less than 0, 75 mm thick. The amount of grinding necessary to true a valve tells whether the head is worn or warped. (Fig. 6 on the next page)

Fig 6 Correct Valve



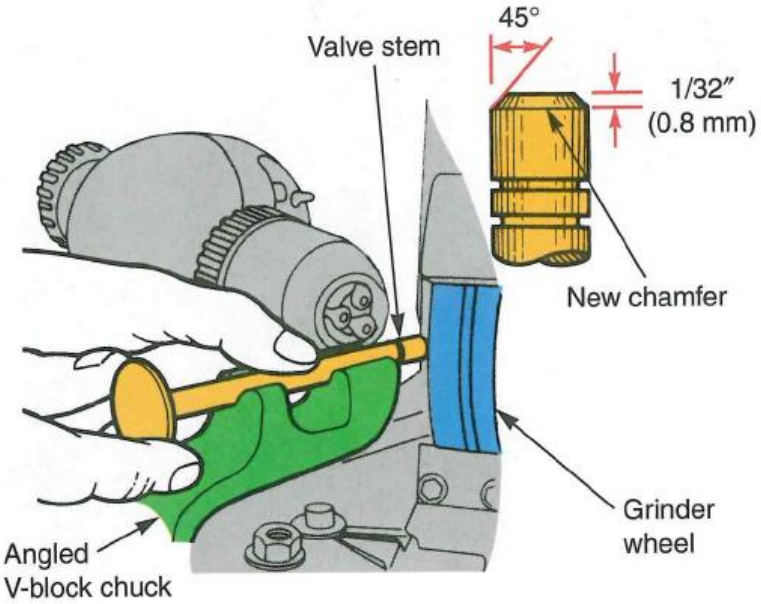

Avoid a knife edge around part or all of the valve head. Heavy valve heads are required for strength and good heat dissipation. Knife edges lead to breakage and burning. (Fig. 7)

Fig7




- Grind the end of the valve stem. If the end of the valve stem is pitted or worn, place the valve stem in the V-slot of the re-facer attachment and lightly grind the end of the stem on the side face of the grinding wheel. A very light grind is usually enough to square and clean the stem. (Fig. 8)

Fig 8




**GO ON TO THE NEXT PAGE FOR THE PRACTICE.**

## PRACTICE

Take the inlet and exhaust valves and by referring to your Notes and the valve re-facer operating manual, reface the valves.

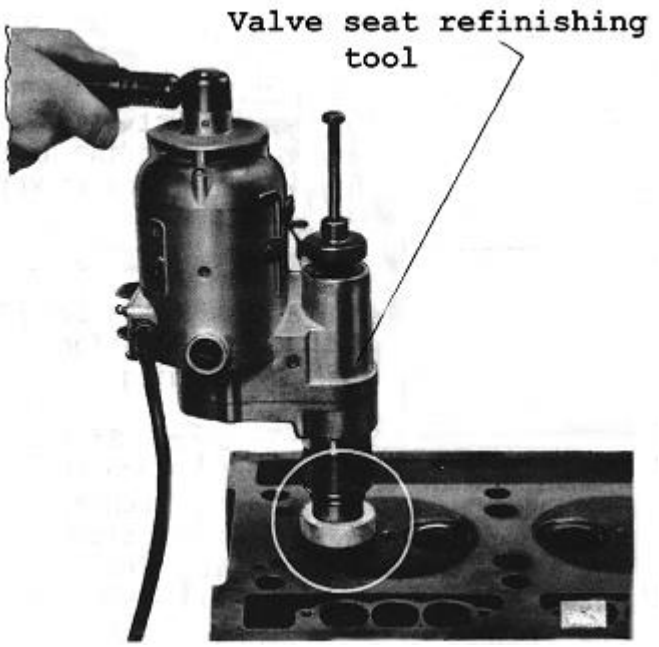
Call your Training Officer to check your work. When you have achieved the required standards, ask him to sign below before you go on to the next section.

| LEARNER | ASSESSOR |
|---|---|
| **Date:** | **Date:** |
| **Signed:** | **Signed:** |

## REFACING THE VALVES SEATS

To reface the valve seats, a specially designed electrically driven grinding machine called a valve seat refinishing tool is used (Fig. 9). The valve seat refinishing tool is equipped with a grinding wheel that has the same angle as the valve seat.

Fig 9

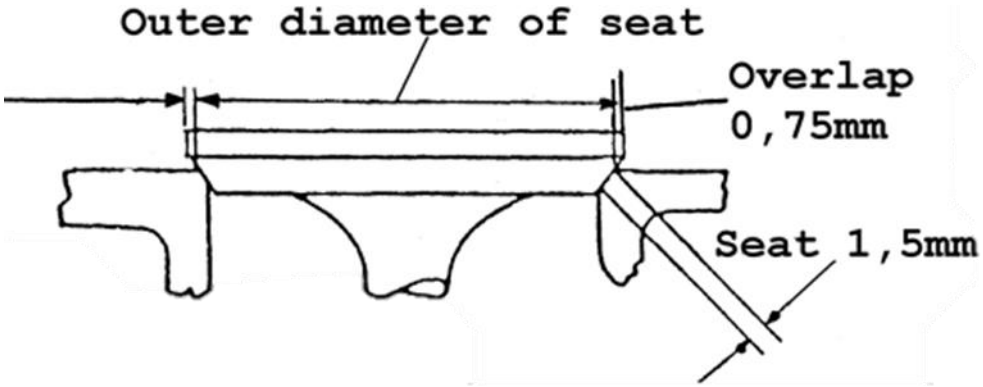



When grinding valve seats, it is important to have the correct seat width. If the seat is too narrow it may wear unduly because it is not wide enough to resist the continual pounding against it. Also, an exhaust valve seat that is too narrow may overheat the valve because of inadequate contact area between valve and seat.

On the other hand, if the valve seat is too wide, the valve may not seat tightly. Usually, the wider the seat is, the more likely it is to leak.

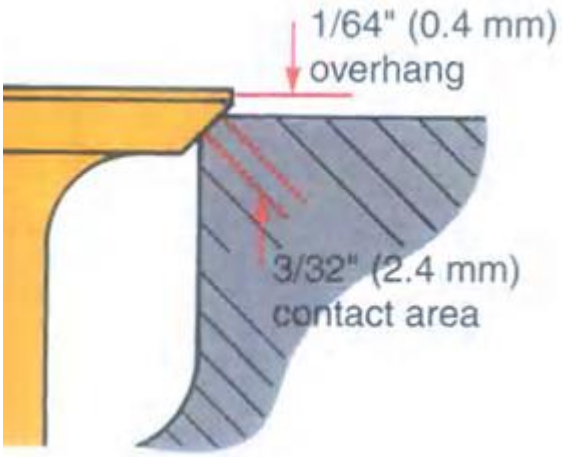
Therefore, for best valve service, the width of the seat should be neither too much nor too little. The recommendations of the various engines should be carefully followed, but if in doubt as to what the best width is, you cannot go wrong if you make the seat width 1, 5 mm (Fig. 10 on next page).

Fig 10



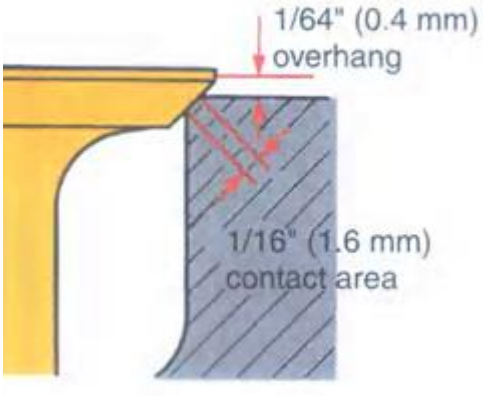

**Example of exhaust valve seat width.** (Fig. 11)

Fig 11




**Example of Intake valve seat width**. (Fig. 12)

Fig 12

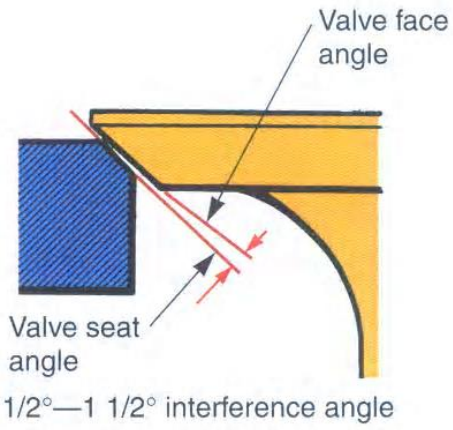


The face of the valve should extend about 0, 75 mm beyond the face of the seat. This overlapping is desirable so that the valve face will have full contact with the seat.

**The interference angle**

(A 1° difference between valve face angle and valve seat angle) is recommended for some older engines. If, for example, the valve seat angle is 45°, the chuck is set to grind the valve face to 44°. The interference angle provides a thin line of contact between the valve face and the valve seat, reducing the valve's break-in time. This difference between the seat and face angles causes a cutting action when the valve closes on the seat and will also help prevent carbon build up on the seats. (Fig. 13)

Fig 13



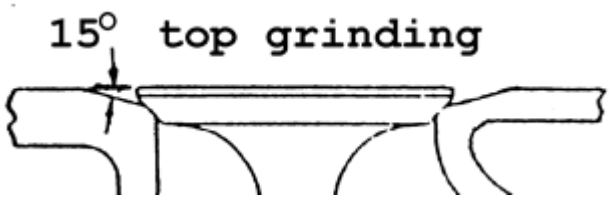

When a valve seat is ground, both the width of the seat and the outer diameter of the seat are increased. If the width of the seat is greater, the rim of the valve no longer overlaps the outer circumference of the seat (Fig. 14)

Fig 14

Usually it is only necessary to remove a few hundredths of a millimetre from the seat to smooth it up. In fact so little may be removed that seat width, etc., may not be appreciably affected. On the other hand, if the seat is badly burned, it is necessary to grind off all the burned metal, in which case, the dimensions mentioned may be greatly increased.

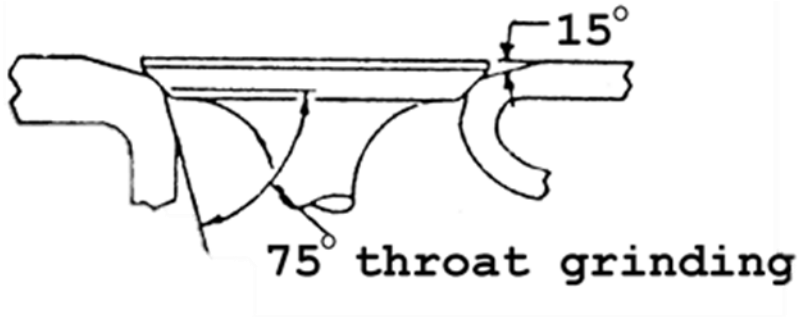
The outer diameter of the seat can be reduced by means of a 15° grinding wheel (Fig. 15). Enough material is ground off the seat so that its outer diameter is reduced to what it was in a new engine and overlap is now correct. This operation also reduces the width of the seat.

Fig 15



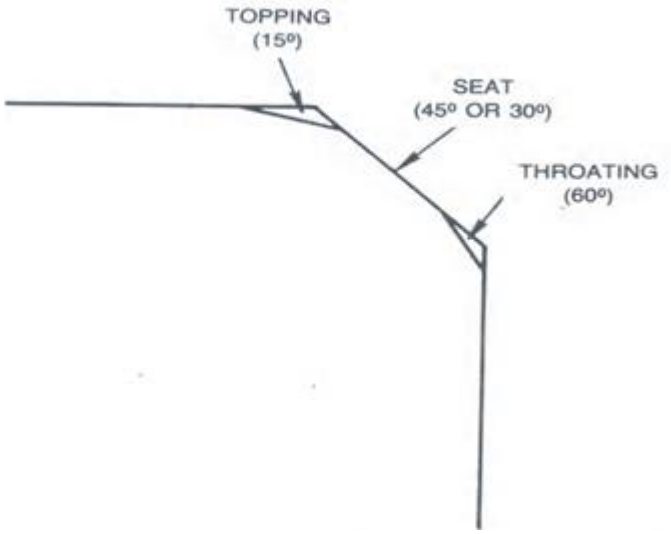

But, if the seat is still too wide, its width should be reduced to the correct dimensions with a 75° grinding wheel (Fig.16)

Fig 16




Removing material from the top of the seat is called **topping**, while removing it from the throat of the valve port is called throating.
The wheel angles for topping usually are 15° or 20° and for throating 60° to 75°.
(Fig.17 on the next page)

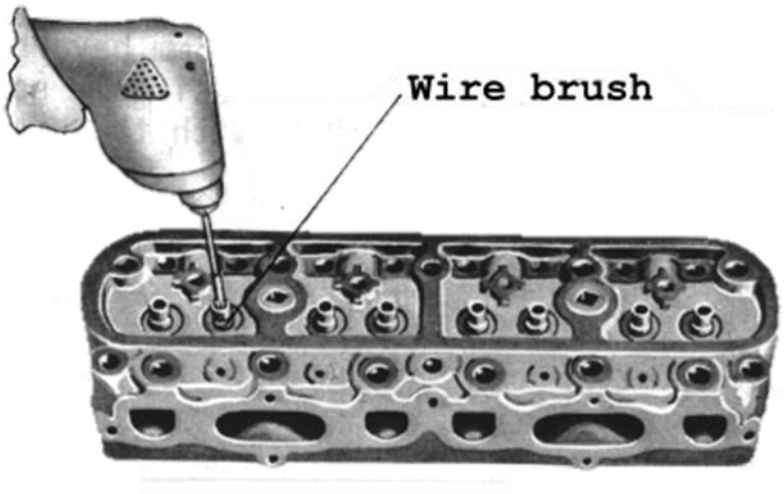
Fig 17




**The following steps must be followed when re-facing the valve seats.**

- Clean the valve guides thoroughly.
- Use the correct size wire brush in an electric drill (Fig. 18).
- Run the brush up and down the full length of the guide. A few drops of light oil or kerosene will help to fully clean the guide.

Fig 18

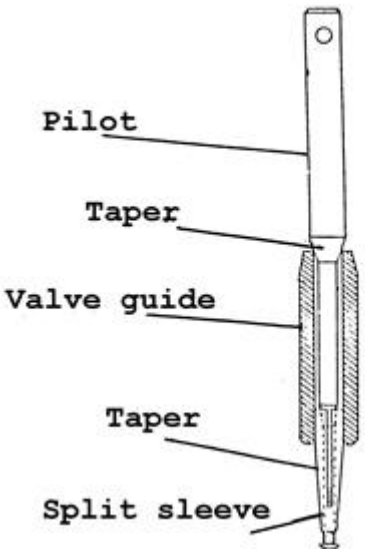


- Dress the grinding wheel of the valve seat refinishing tool to obtain the proper seat angle with the tool shown in (Fig. 19)

Fig 19

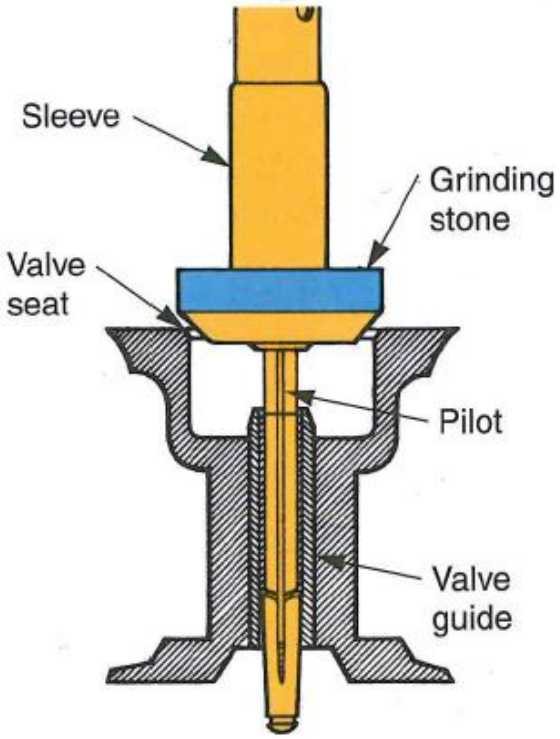

- Insert an expanding pilot of the correct size in the valve guide and push it down as far as it will go. Maintain the downward pressure, screw down the pilot by means of the special tommy bar provided (Fig. 20).

Fig 20



- Clean and place a film of oil over that part of the pilot covered by the stone sleeve (Fig. 22)

Fig 22




- Fit the sleeve over the pilot.

- Support the machine so that the pilot shaft is in line with the stone sleeve, switch on and at short intervals, say every second, raise and lower the machine. This action will allow the stone to clear itself.

  **NB:** Do not grind for too long. Only a few seconds are required to re-condition the average valve seat.

- Only a light pressure sufficient to keep the stone cutting is necessary when grinding. On no account should pressure be applied that will make any appreciable reduction in the speed of the motor.

- Use a coarse stone for the first operation and grind until a true seat is just completed and finish with the finishing stone.

- Check the seat width and if necessary use a 15° or 20° to top the seat.

- If the seat is still too wide, use a 60° or 75° stone for throating.

## PRACTICE

Take the cylinder head and by referring to your Notes and the Workshop Manual, reface the valve seats.

Call your Training Officer to check your work. When you have achieved the required standards, ask him to sign below before you go on to the next section.

| LEARNER | ASSESSOR |
|---|---|
| **Date:** | **Date:** |
| **Signed:** | **Signed:** |

## HAND GRINDING

Slight grinding or lapping of valves and seats which have been refinished by power tools is good practice. The valve is hand lapped in its seat with very light pressure and for enough time to ensure that the valve is perfectly tight on its seat by using lapping tool (Fig. 23) and lapping compound (Fig. 24).

Fig 23

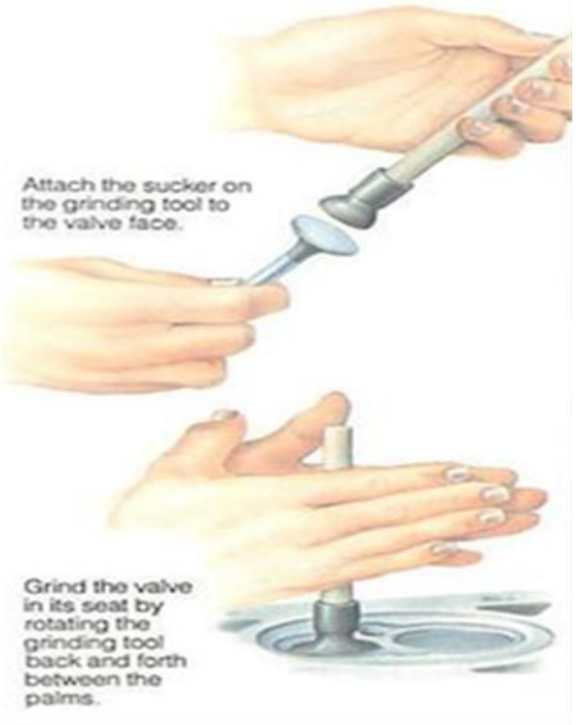



Fig 24

**The following steps must be followed to hand-grind a valve into its seat.**

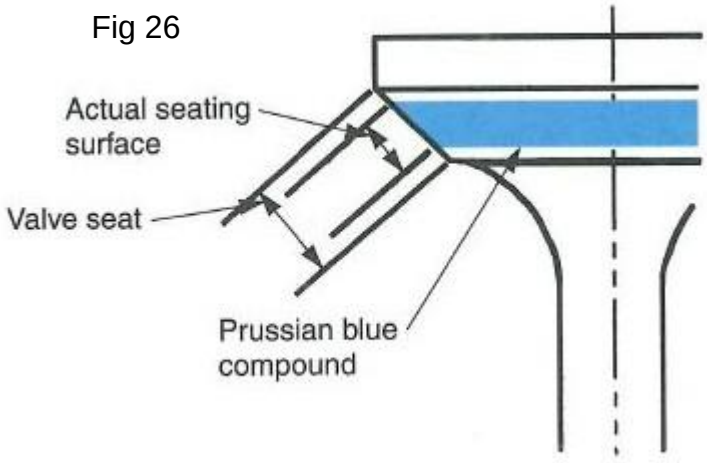
- Spread a thin coating of course valve grinding compound on the face of the valve.
- Fit the valve onto the suction cup (Fig. 23).
- Rotate the grinding tool between your hands as shown in (Fig. 23) and apply only enough downward pressure to force the valve against its seat.
- After a few clockwise and anti-clockwise turns, lift the valve and turn it through a part of a revolution allowing the compound to settle on the face of the valve.
- After a minute, remove all the abrasive with a rag moistened with gasoline or kerosene. Inspect the valve face and the seat. When the seat has been ground down so that bright metal shows all around its circumference, and when a similar band of smooth surface appears on the valve face, the valve face is acceptable.
- Finally inspect the valve to see how tightly it fits into its seat. Two simple methods are as follows in (Fig. 25)

Fig 25


- Spread a thin coating of Prussian blue evenly on the valve face (Fig. 26).

- Put the valve on its seat and rotate it a few times.
- If the valve is tight, there should be a continuous band of blue on the seat.

Fig 26




- Make a few pencil marks across the width of the valve face (Fig. 27 and Fig. 28 on next page).
- The marks should be evenly spaced around the circumference.
- Put the valve on its seat and rotate it a few times.
- Remove the valve and inspect the pencil marks.
- If all of them show signs of being rubbed by the seat, the job is satisfactory.

Fig 27

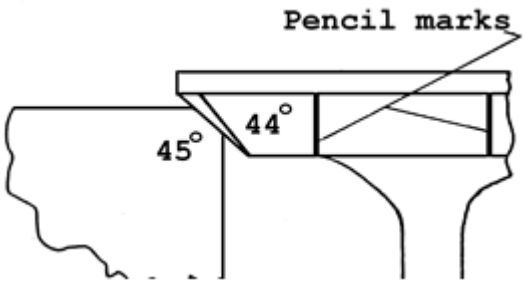
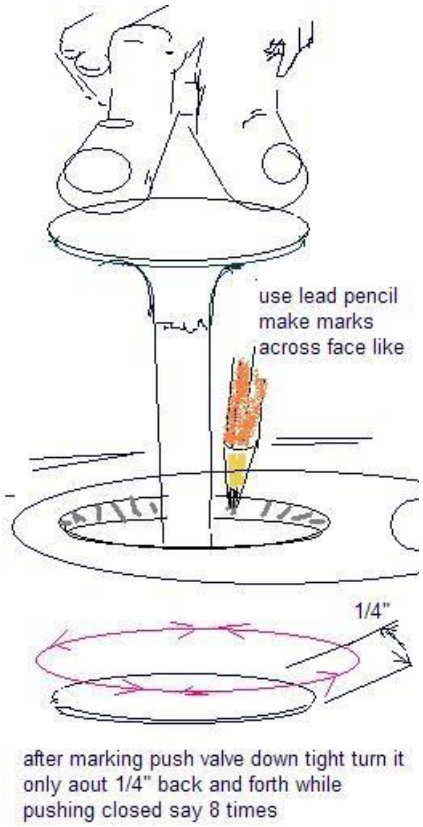
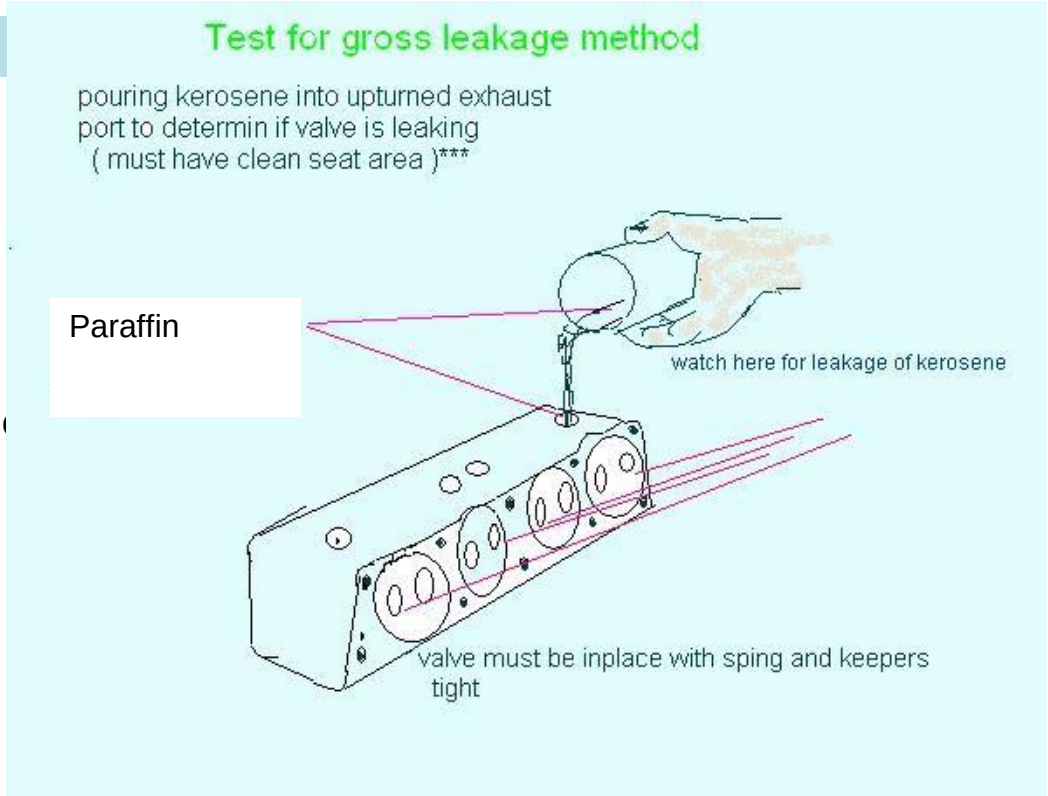



Fig 28

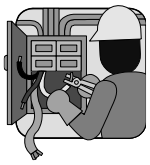



- Use the next method to check all valves individually if they seal properly. (Fig. 29)

Fig 29




**GO ON TO THE NEXT PAGE FOR THE PRACTICE.**



## PRACTICE

Take the refaced valves and the cylinder head with the refaced seats used in the previous practices and hand-tap the valves into their seats.

Call your Training Officer to check your work. When you have achieved the required standards, ask him to sign below.

**Ask for the criterion test when you feel ready.**

| LEARNER | ASSESSOR |
|---|---|
| **Date:** | **Date:** |
| **Signed:** | **Signed:** |

**REMEMBER ALWAYS WORK SAFE**

**Once you have passed the entire self-tests and practices, you are now at liberty to request a Formative Assessment from your Assessor.**