IN ALL CIRCUMSTANCES VALVES SHOULD BE FITTED IN ACCORDANCE WITH THE INSTRUCTIONS AS GIVEN IN THE VEHICLE MANUFACTURERS MANUAL. FAILURE TO ADHERE TO THESE RECOMMENDATIONS COULD INVALIDATE YOUR GUARANTEE

VALVE GUIDES: We strongly recommend that valve guide replacement should only be carried out by qualified engine repair shops. By virtue of high interference fits and molecular lock on old guides it is all too easy for an unskilled person to actually scrap a cylinder head. In whatever eventuality it is important that the cylinder head valve seat is refaced to comply with the centre line of the new valve guide and concentricity of all faces must be maintained within 0.025mm/0.001". Lubricate guide bores and valve stems with a high viscosity lubricant. DO NOT use A.T.F. or grease.

CLEARANCES: As a rule of thumb, valve to valve guide clearance should be held within the following chart.

VALVE STEM DIAMETER (mm)	INLET VALVES CLEARANCE		EXHAUST VALVES CLEARANCE	
	MIN	MAX	MIN	MAX
5.0 to 7.0	0.025mm/0.001"	0.040mm/0.0016"	0.040mm/0.0016"	0.055mm/0.0022"
7.0 to 9.0	0.035mm/0.0014"	0.050mm/0.002"	0.050mm/0.002"	0.065mm/0.0026"
9.0 to 10.0	0.040mm/0.0016"	0.070mm/0.0028"	0.070mm/0.0028"	0.085mm/0.0034"

VALVE SEATING: On a new engine the valve face and valve seat angle differ by half a degree. For example a valve would be ground at 45 degrees and the valve seat at 44.5 degrees. This results in a "finite" line contact which ideally should be one third of the way down the valve face (from the margin). On start up the valve "peens" itself and the seat to an air tight seal and does so within the first few minutes of running. As the engine attains normal working temperature the valve head expands more so than that of the cylinder head seating and as a result the peen line moves further away from the margin and the resultant contact line will widen to around 0.75mm/0.030". In other words our initial "finite" line beds in to the conventional seat that we witness when viewing a used head. If we consider the following Fig. 1, Fig. 2 and Fig. 3 below, we attempt to demonstrate the correct way to retain the original seating but on a worn cylinder head.

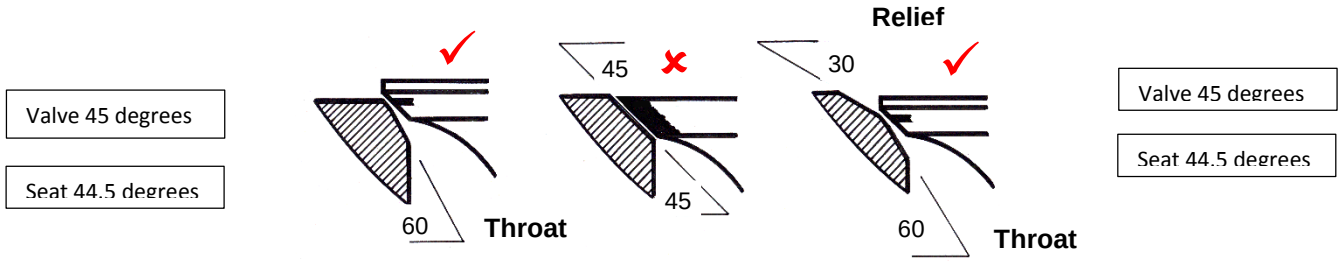


FIG.1 NEW HEAD **FIG.2 USED HEAD** **FIG.3 USED HEAD**

Fig. 1. - The desired valve seat as found on a new engine.

Note the valve contact with the seat is approximately one third down the valve face and the seating contact is circa 0.75mm/0.030" in width. The valve edge (margin) is above the valve seat face giving exposure to cooling when the cold induction charge passes. The margin also has a thick edge to conduct heat away from the rim and into the throat and valve stem but also provides edge strength to the valve face and prevents edge cupping.

Fig. 2. - A badly machined valve and seat (valve pocketed).

Note the valve has been over ground to the extent that the margin has become a sharp edge. This margin would absorb too much heat and would very quickly burn away. In operation pre-ignition might also be evident. Note the valve seat has been "over cut" allowing full face contact with the valve. Too much contact can encourage momentary valve stick. Metal loss and adhesion can result to ultimate valve failure i.e. by creation of a "gutter path".

Fig. 3. - A correctly relieved valve and seat.

In this instance the valve seat witnessed in Fig. 2 has been "relieved" to reinstate the seat to Fig. 1. By machining a 30 degree lead at the combustion chamber face followed by a 60 degree "throating" of the port, the valve seat has been narrowed back to the required 0.75mm/0.030" width. Also the valve has been replaced. Arguably the valve has now sunk into the head and rocker arm or cam follower geometry will have been altered. By "topping" (grinding) the valve stem and/or the rocker arm end, all of this error can be simply nullified. Similarly valve spring tension can be reinstated with adding purpose made base washers placed under the valve spring. Where hydraulic cam followers are employed it is important that valve length protrusions are kept to within manufacturers limits, therefore valve seat cutting and relieving must be controlled.

SEAT PROOVING: The following paragraphs are dedicated to the technicalities of “lapping in” valves. Although in aftermarket repairs "lapping in" is still employed to proove valve seatings, it is strictly an unprofessional procedure and should be deemed as a thing of the past. We must in the first instance consider that at the vehicle makers manufacturing source that seating is reliant on the accuracy of the machining and valves are certainly not lapped in.

ENGINEERS BLUE: Valve and seat concentricity should be checked with Engineers Blue. All parts must be clinically clean and the valve stem should be oiled. The valve or seat face can then be spotted with the smallest dab of blue. A lapping simulation of say only two seconds will distribute the coloured media. If seating is accurate both mating faces will exhibit full blue rings. Inaccurate seating will result in one face showing a broken circle indicating that face is not concentric with the guide bore. DO NOT use excessive "Blue" as too thick an application will mislead you. In fact too little is better as you should witness a finite grey line on both faces. Alternatively valve seat concentricity can be checked by vacuum testing, however this relies on specialist equipment.

FINE LAPPING PASTE: If because of circumstances you are forced to use lapping paste, then only employ a fine grade. Duration of lapping should not exceed say four seconds as the paste will begin to cut a groove into the faces of the machined parts.

COARSE LAPPING PASTE: In whatever eventuality coarse lapping paste must not be used particularly to true up seats. Any concentricity errors must be corrected by a professional machine shop i.e. your local engine remanufacturer. Coarse lapping paste will abraid annular grooves of some severity into the machined faces. As the valve expands the lapped seat faces actually move away from one another. The annular valleys and peaks are then impacted at continually variable points commensurate with the expansion of the valve. If we liken the peaks and valleys to a screw thread, then it can be understood that the the peak ridges will not sustain the high impact forces and breakaway of metal will result. Breakaway flakes of metal will thermally adhere to the valve seat and visa-versa. Similarly the rough surface of the lapped finish will attract adhesion of combusted carbon deposits. The effect of these metal or carbon deposits means the valve can no longer close at these points and the assumed air tight seal is broken. Several effects on the valve can then progress:-

1) The valve head will attempt to close but will do so at an imposed angle. This actually constrains the valve to an undesired angle within the valve guide and equal and opposite side loading of the valve stem and guide bore will result. This will lead to rapid valve guide wear, primarily at each end.

2) The valve head will attempt to close twice i.e. first contact on the foreign entrapped contaminant and then second contact at 180 degrees opposite. In this scenario, edge loading of the valve head is doubled and in extreme circumstances the valve head can suffer a fatigue break adjacent to the throat and stem meeting point.

3) The loss of air tight seal means Hot combustion gases can escape past the valve seat faces and "Hot Spots" will be generated. The margin (edge) of an exhaust valve is momentarily exposed to temperatures as high as 1650 degrees centigrade and actually glows cherry red. Hot spots can accordingly melt the metal and gutter path failures can result.

SUMMARY: The following diagrams illustrates that during head expansion up to normal operating temperature that a lapped in valve face will disengage from the valve seat face. We can therefore conclude that the lapped seats are ineffectual in the long term and that consequential valve face deterioration and breakdown can result.

FIG:A
COLD ENGINE
Valve lap line parallel with chamber face and valve seat.

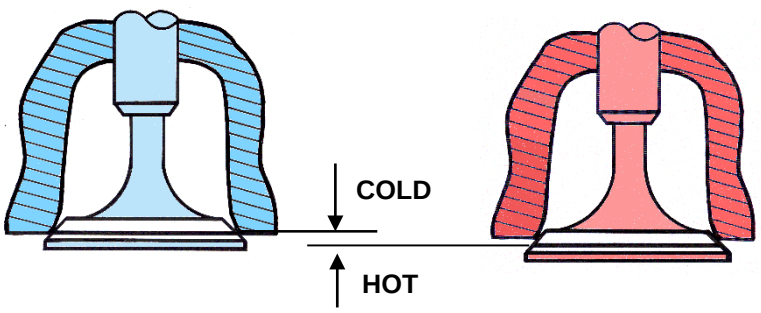
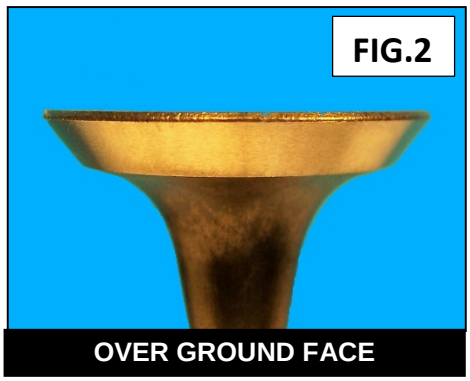


FIG:B
HOT ENGINE
Valve lap line has expanded away from the chamber face and valve seat.

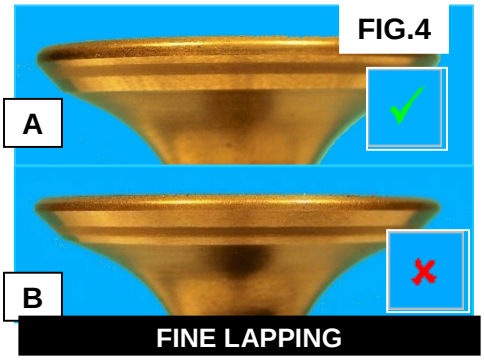
VALVE REPLACEMENT & SERVICE SUMMARY

MACHINEABLE VALVE

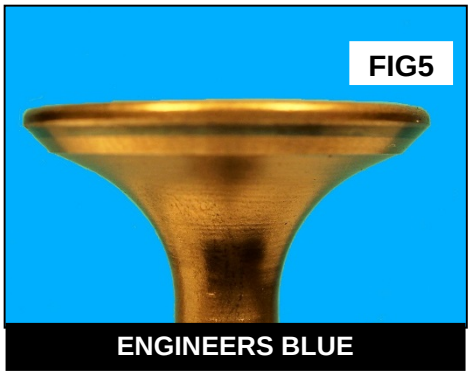


OVER GROUND FACE

COARSE LAPPING



FINE LAPPING



ENGINEERS BLUE

1) Inspect valve guides for wear/chipped ends and cracks.
2) Valve guide fitting by specialist engine shops only.
3) Valve seat machining by specialist engine shops only. Machine seats to one half degree less than that of the valve with seat width circa 0.75mm/0.030". Relieve chamber face (30 degrees) and throat (60 degrees) as necessary.

4) A reservicable valve must have the following features;
a) Thick margin as in Fig 1. b) Minimal or no stem wear.
c) Undamaged cotter beads & grooves. d) Minimal or no stem end wear. e) Valves must not be straightened.
f) Refaced valve must have total face concentricity of within 0.025mm/0.001". The valve in Fig 2. Has been over ground making the margin too thin. This part would be scrapped.

5) Prior to seat prooving reclean guide and valve .
6) Lubricate guide bore to accommodate lapping action.
7) DO NOT use coarse lapping paste. The valve face in Fig 3 has been totally destroyed and the seat is far too wide.
8) Fine lapping paste is again to be discouraged, however in aftermarket repairs it can be accepted as long as lapping duration is held to within four seconds. The surface damage will be minimal and valve peening will seal the surface quite quickly. Note the lapping ring in Fig 4 image 'A' is to the ideal width and is approximately one third down the valve face. Conversely the lapping ring in image 'B' although the correct width is too far down the seat and when the head expands the seating would bottom out to the throat of the valve.

9) Proove seats with "Engineers Blue" (see Fig 5). This image depicts the ideal proofing of a valve seat. The proof ring is 0.75mm/0.030" wide and is one third down valve face. Note the "Engineers Blue" is transparently thin. The corresponding valve seat face on the head will also be only 0.75mm/0.030" and will be similar to the quality and specification of the original engine manufacturer. Assuming correct engine tuning this valve would provide a good maximum life.

10) Prior to final assembly reclean all parts.
11) Lubricate guide bore & valve stem with high viscosity oil or black graphite grease. DO NOT use A.T.F. or white grease.

12) Where fitted, always use new valve stem seals installed over cotter protection sleeves. Press home with the correct hollow driver.

13) DO NOT re-employ valve springs that are out of square.
14) Ensure valve springs seat squarely into any recess locations.

15) Ensure valve caps are in good condition & check particularly for radial cracks.

16) DO NOT strike cotters in an attempt to hammer home. A smear of graphite grease will locate them onto the valve stem.

17) DO NOT strike stem ends with steel hammers to "settle" the cotters. Do so with a light blow from plastic faced hammer.

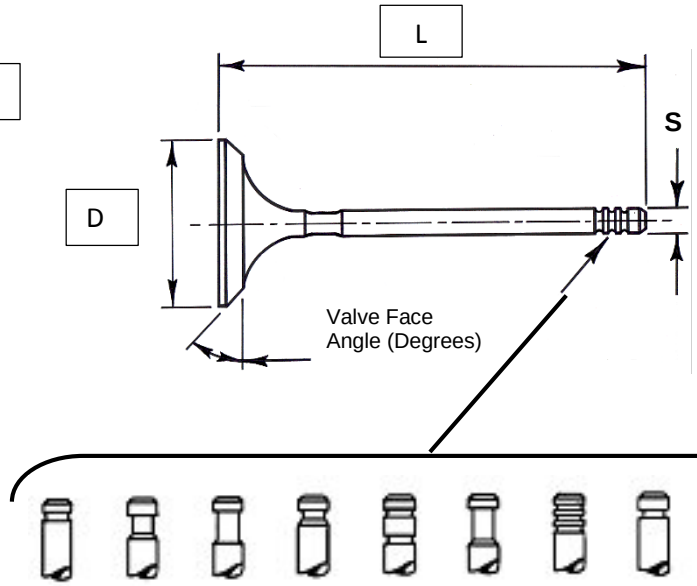
18) Attain oil pressure & visual flow of oil before firing engine.
19) Allow a sensible running in period for all new components.

GLOSSARY OF PRODUCTS AND TERMS.

***ENGINE VALVES*:** In the majority of engines the inlet valve is the one with the largest head diameter. The exception to the rule is on engines with three valves per cylinder, whereby the inlet valves are smaller than the single exhaust valve. With the added complications of continual specification changes we recommend that before supplying valves that the basic technical information is compared with the old units being replaced i.e.

1) Head diameter (mm) **D** **2)** Stem diameter (mm) **S** **3)** Overall Length (mm) **L** **4)** Valve Face Angle **5)** Cotter style

INFORMATION

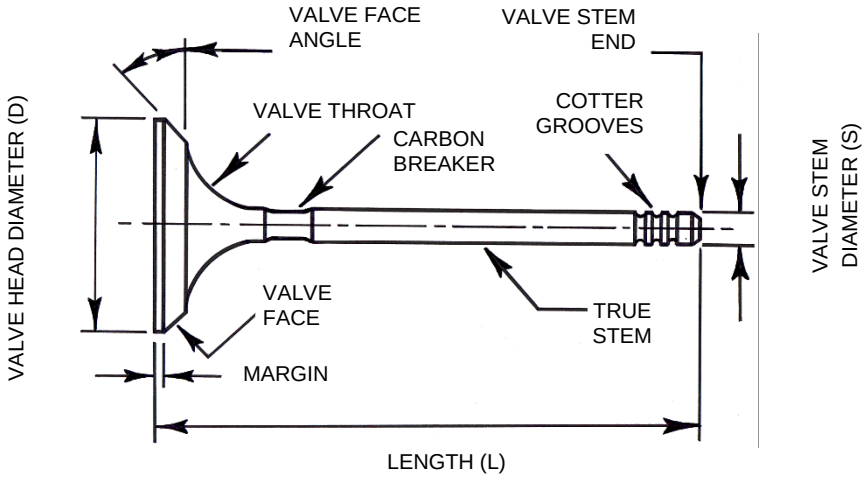


D	x	S	x	L
Head Dia	x	Stem Dia	x	Length (mm)

COTTER STYLES

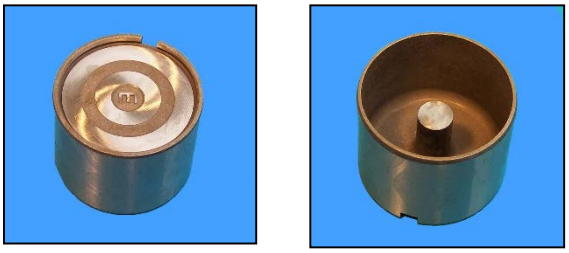
***ENGINE VALVE GUIDES*:** Due to modern materials, improved engine designs and indeed space age lubricants, valve guide replacement is becoming less, however in our stocking we still cater for most of the classics of the 60's-80's. In reality most engine repair workshops now repair worn valve guides by lining them with a "thin wall" bronze liner. This is a very effective repair and in some cases is better than the original valve guide bore. Standard valve guide replacement should only be carried out by qualified engineers with facilities to ream or hone bores to correct any distortive factors implied when fitting. Cracked or broken valve guides must always be replaced and in all cases valve seats must always be refaced. This is because the centre line of a new guide will never be the same as the unit being removed.

VALVE COMPONENT TERMS.

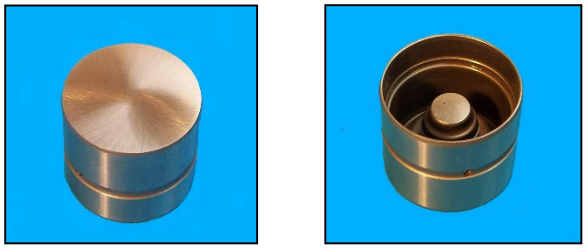


In both Ford and Renault we try and help you determine the valve type by the design of the camshaft followers. This can help speed ordering especially if the engine has not been stripped. Below are images of the relevant camshaft followers.

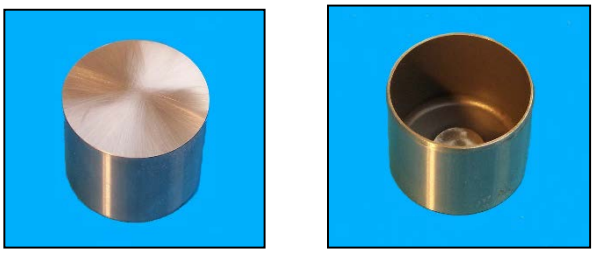
FORD



SHIMMED

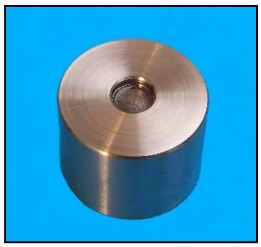


HYDRAULIC



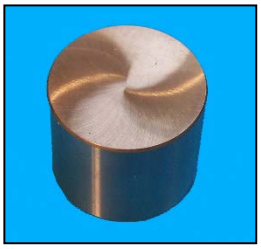
SHIMLESS

RENAULT



DIMPLE SHIM

CASTELLATED



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