The majority of these tips have appeared in club newsletters over the years. Please note that you use them at your own risk as neither the Bristol Austin 7 Club nor the authors can be responsible for the results of trying to follow the instructions given.

Compression ratios

The information below was obtained from measurements made on five cylinder heads in December 2001.

Four cylinder heads are late type – 1937-8. The earlier head is dated November 1934. One of the late heads had been shaved; the other four had a top to joint-face thickness of 1.500” or 1.510”.

This should always be a useful check dimension when deciding if metal has already been skimmed from a head.

The volume of each of the combustion chambers in all heads was measured using a burette and paraffin. Measurements were also made of all other items likely to affect the total volume of the combustion chamber at TDC, including used gaskets of different thicknesses. The results are detailed below and should be useful for anyone wishing make their own estimates of compression ratio.

“Height” of pistons and valves will vary from engine to engine and can also have a considerable affect on compression ratio.

Compression ratio: -

1 Standard late head, +60 thou pistons

1.1 Gasket thickness 0.031” and pistons 0.020” below top of block 6.08:1

1.2 Gasket thickness 0.031” and pistons reach top of block 6.27:1

1.3 Gasket thickness 0.040” and pistons 0.020” below top of block 5.95 :1

2 Shaved late head, +60 thou pistons

2.1 As in 1.1 with 50 thou shaved off head 6.91:1

2.2 As in 2.1 but with 60 thou shaved off 7.12:1

2.3 As in 1.1 using head number 2 7.49:1

3 Standard head

3.1 Late head, standard bore, otherwise as in 1.1 5.83:1

3.2 Earlier head, standard bore, and 0.060” thick gasket 5.22:1

Method

Spark plugs were fitted in place, the cylinder head was inverted and a piece of thick Perspex clamped over the combustion chamber. The tight fitting Perspex ensured there was no meniscus error. It had previously had two holes drilled in it; one for the insertion of fluid and the other to allow for the expulsion of air.

Using a spirit level, the head was packed level and paraffin was run into the chamber from a burette. The reading on the burette gave the volume of the chamber:- “C”.

A used “late” cylinder head gasket was placed on a piece of squared paper and the profile of the cylinder and valve area traced on to the paper. This was re-peated with the earlier type of gasket. By adding up the squares their areas were obtained and, by measuring their thickness, their contribution to the volume in the chamber was determined:- “G”. Used gaskets were measured to obtain their thickness when bolted down.

The valves may protrude above the top of the block, so this was measured and multiplied by the area of the two valves. This volume “V”, has to be subtracted from the above.

The pistons will lie just below the top of the block (or even reach a few thou above, if the block has been skimmed, or no joint is used). This volume “P” will be the area of the piston multiplied by its distance below the top.

The swept volume is the cross-sectional area of the piston multiplied by the 76mm stroke of the crank:- “S”

The compression ratio is the ratio between the total volume at the bottom of the stroke and the total volume at top dead centre, with the valves closed.

Total volume at bottom of stroke V1 = C + G - V + P + S

Total volume at top of stroke V2 = C + G - V + P

Compression ratio = V1 : V2

Measurements

As well as measuring the chamber volumes, the thickness of the cylinder heads were measured and also the depth of the chamber at two points. With the late heads, these were in the flat area above the valves, and at the lowest point adjacent to the tapping for the spark plug. The earlier head was measured above the valves and in the flat area above the piston. These measurements are intended as a cross-check to see if metal has been removed and to check the variation between chambers.

As well as coming in two types, to suit the early and late heads, cylinder head gaskets are (or were) available in several different thicknesses. These are tabulated below. The Payen AA760 is currently available from stockists; others listed may turn up at autojumbles etc.

The cylinder bores were not measured, so nominal sizes are used. Height of valves and TDC of pistons can vary considerably between engines. The figures given are for my engine; they almost cancel each other out.

Head thickness and chamber depth										
Head No.	Date Made	Average Thickness	Depth over valves +/- 0.002”				Depth over Pistons +/-0.002”			
			Cylinder Number				Cylinder Number			
			1	2	3	4	1	2	3	4
1	25/06/1937	1.5	0.382	0.396	0.388	0.387	0.595	0.604	0.593	0.595
2	21/09/1937	1.405	0.287	0.285	0.285	0.285	0.495	0.493	0.494	0.495
3	9/11/1938	1.51	0.386	0.384	0.384	0.386	0.601	0.593	0.599	0.605
4	15/11/1938	1.51	0.378	0.373	0.377	0.384	0.607	0.59	0.607	0.604
5	03/11/1934	1.51	0.363	0.362	0.362	0.362	0.151	0.154	0.151	0.149

Volume of combustion chambers ± 0.1ml “C”							
Head No.	Cylinder No.				Average Volume		Comments
	1	2	3	4	mls	ins3	Average Volume “C” used in compression ratio calcs taken as 35ml or 2.136in3
1	34.7	34.9	34.6	34.8	34.75	2.121	
2	26.6	26.6	26.6	26.6	26.6	1.623	Shaved head
3	35.2	34.5	34.9	35.2	34.95	2.132	
4	35.7	35	35	35.5	35.3	2.154	
5	37.6	37.6	37.6	37	37.45	2.285	Earlier 1943 head

Measurement of cylinder head gaskets & Vol “G”

Type Thickness ins Area ins2 Volume(G) ins3

Early0.0446.890.3030.0550.3790.060.413Late0.031*7.120.2210.040.2850.050.356

Swept volume on a 76mm stroke “S”

Nominal Piston DiameterStrokeSwept Vol

(S)

ins32.276mm

or

2.99211.412.2211.582.2311.682.2411.792.26122.2812.22

Measurement of valves “V”

Valves usually protrude above the top of the cylinder block. The average height was determined as 0.050”.

Taking the valve diameter to be 1”, the volume occupied by two valve heads “V” would be 0.0785 ins3.

Measurement of piston “P”

Assuming the piston to be 2.260” diameter and to reach to within 0.020” of the top of the block, the “extra volume at TDC “P” would be 0.082 ins3.

Calculation of compression ratio

There are countless permutations of the above variables. A typical calculation is given below, which is for my engine which has + 60 thou pistons (usually the maximum oversize) and a thin gasket (0.031”). Hopefully there is enough data for those that are interested, to make their own estimate of the compression ratio of their engine. Please contact me if you disagree with my calcs or want more details. I failed to see how the early head is rated at 4.9 : 1, so there’s scope for comment/correction there!

Standard late head, +60 thou pistons, 31 thou gasket and valve height as above

Total vol at bottom of stroke, V1= C + G + S + P - V

= 2.136 + 0.221+12.00+ 0.082 - 0.078

=14.361 ins3

Total vol at top of stroke, V2= C + G + P – V

= 14.361 – 12.00

= 2.361 ins3

Compression Ratio, V1 : V2 = 6.08 : 1

Comments and Conclusions

The need to get out and do some measuring of compression ratios came about when two engines were partly stripped and I found myself checking through several spare heads, one of which had obviously been shaved. How much had been taken off? What was the thickness of a standard head anyway and how consistent was this from head to head? The considered opinion, when asking around, was that the thickness was 1½", but it remained unclear what tolerance went with this figure.

The LM (Bill) Williams book on "Austin 7 Specials" is a really good reference. It confirms that we should expect to see a ratio of 5.8 to 1 in a 1937 onwards head, that no more than 9" should be removed and that the compression ratio should not be pushed beyond 7 to 1 (unless you are in for a whole raft of mods!). It's strange to think that there must be hundreds of articles on every topic to do with A7s and yet only too often you can finish up scratching around for a dimension or something else that must be buried in the archives. Hence my interest in finding out a good datum against which to measure my shaved head.

It is now easy to see that nearly 3/32" has been shaved off and that some care with extra joints, or whatever, would be needed if this head were to be used on a standard engine. I don't think I'll bother!

It also came as a surprise (should have known better!) to find that there are (have been?) so many thicknesses of gaskets around – as found in that box of used bits that need dumping. Happily the latest acquisition is of the thinner type, but it's worth a check when purchasing/installing to see if that gasket will somehow affect performance.

The swept volume goes up considerably the more a block is bored oversize. There is little change in the volume at TDC. Consequently the compression ratio goes up each time a block is bored out. There is sometimes a need to skim the cylinder block to remove distortion/corrosion. The affect of this, and also that of

leaving out the crankcase to block joint, will cause the piston to reach further up the bore. This also increases the compression ratio.

If you are thinking of doing your own measurements with a burette, the Perspex “cover” is essential. My thanks to Chris Lewis for giving me this tip.

I think it’s pretty well known, but still worth repeating, that nothing good happens if you shave an early head. It has to be a 1937 and onwards head or one of the specials that become available now and then. These were well described in the Association Magazines 1989A, 1991D and 1994C.

Finally, it is important that the crank, big ends, mains and oil pump are in good condition if the compression ratio is to be increased. If an engine has been fully restored it is probably best to run it in with a standard head until it feels free.