These notes on calculating the compression ratio of TR2-4A engines were written by Ian Cornish and illustrated by Neil Revington in the early 1970's for publication in the TR Registers newsletter. From these articles a compilation booklet was produced called 'Technicalities'. Whilst the article was written for TR2-4A, Ian revisited the article in 2021 and added references to TR250, 5 and 6 as well as TR7-8 as the principles are the same for those cars, and many other cars too of course.

COMPRESSION RATIOS

Ian Cornish

In Newsletter 13 (Spring 1973), I published an article on this subject, it re-appeared the Technicalities booklet (1976) and later in Section P2 of the Technicalities CD. A lot of water has flowed under the bridge since then, and I thought it was time for an update because bore sizes have increased and a greater variety of gasket materials have become available.

This article is intended for the competent DIY person with a road-going TR. It is not for those who use their TR for serious competition, undertaking work such as skimming the top of the block to achieve zero Deck Height and habitually using 6000 rpm - they need to do their own research!

The Compression Ratio (CR) is the ratio of the total volume of the chamber at bottom dead centre (BDC) to the total volume at top dead centre (TDC). The cubic capacity of the TR 4-pot wet-lineredengine in various standard liner and/or piston sizes is given in the table below. The volume contained within one cylinder between BDC and TDC (which I have called the Cylinder Volume) is therefore one quarter of the cubic capacity, and if we take the volume contained within the block, gasket and head at TDC as a value V (clearance volume) we obtain:

Compression Ratio CR = ((Cylinder Volume) + V)/V

or, Clearance Volume V = (Cylinder Volume)/(CR -1)

Now, the Clearance Volume has three components (see Neil Revington's figure drawn for the Technicalities booklet in 1976):

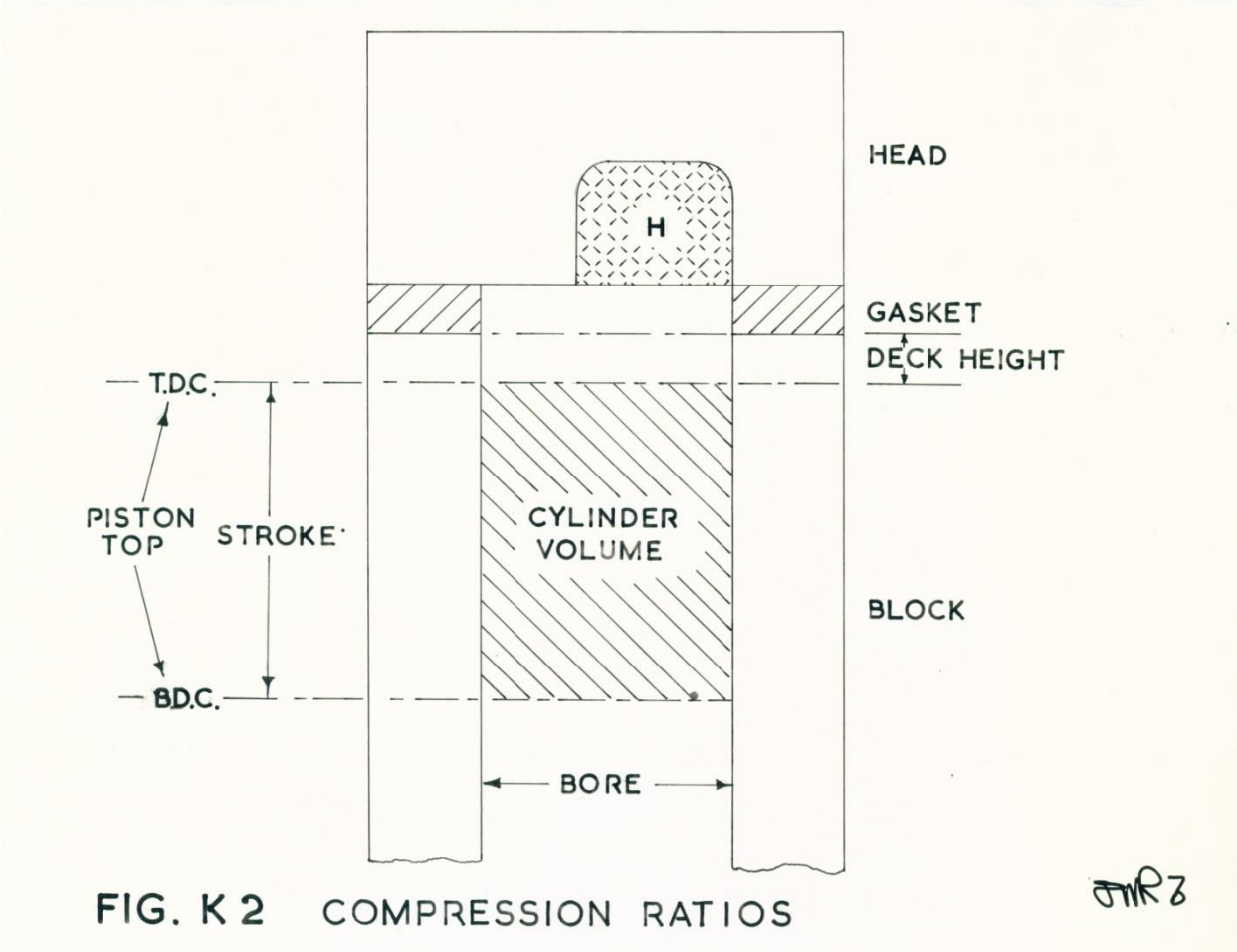

FIG. K 2 COMPRESSION RATIOS

a) The volume contained between the top of the piston and the top of the block (not liner) at TDC. This volume is the product of the Deck Height and the piston area, and since the Deck Height is usually between zero and 0.005" (zero to 0.1mm), this volume, which I have called the Deck Volume D, is between zero and 0.6cm^3. I have used 0.004" (0.1mm) for the table. For competition work it should be measured and allowed for, also the pistons should be within 0.001".

b) The volume contained between the two faces of the gasket. This is the product of the gasket thickness (when compressed) and the piston area. The gasket thickness depends upon the type used; the original copper/asbestos type (which gives the manufacturer's stated CR) is approximately 0.050" (1.3mm) thick, while the steel gasket is 0.020" (0.5mm). I have called this the Gasket Volume G and have given values for both types and also for solid copper gaskets. As solid copper gaskets are available in a number of thicknesses, adjustment of CR is facilitated, especially if a head has had to be skimmed to correct warping caused by overheating.

c) The volume contained within the head itself. This I have called the Head Volume H.

It follows that: **V = H + G + D**

or, rearranging it into a more useful formula:

H = V - (G + D)

Hence, by adding the Deck Volume and Gasket Volume (for the correct gasket type) applicable for your bore size, and subtracting them from the Clearance Volume appropriate to the CR that you wish to achieve, you will be left with the required Head Volume.

Remember that steel and solid copper head gaskets must be cut away to suit the bore used and also that the early TR3/3A high port head will not stand for the extreme skimming possible with the TR4 head, because the water jacket is likely to be penetrated if much more than 0.050" is removed. I assume that anyone skimming the head will reshape the inside of the head afterwards in order to gain the full benefit, so one cannot say X-thou off the head will raise the CR from Y to Z. However, as a guide only, every 0.040" (1mm) off will reduce the Head Volume by about 3.5cm^3 (and increase the CR by about 0.5 or 0.6) — assuming that you expect to do some reshaping afterwards. The Head Volume should be measured with a burette, as described in all the best tuning manuals, such as Kastner's Competition Preparation Manual (available from RevingtonTR: Part Number MGL 6211). Measure the Head Volume after valve grinding and on all 4 positions, not just to stop the measuring fluid leaking out, but because grinding-in can change the volume by a surprising amount. Also, use new and fully tightened spark plugs during the measurement. It is important to get the volume in all four chambers the same within about 0.2cm^3 for good results and smooth running.

COMPRESSION RATIO CALCULATOR

Engine stroke mm		92						
Bore mm			83	85	86	87	88	89
Piston Area cm^2			54.1	56.7	58.1	59.4	60.8	62.2
Capacity cm^3			1991	2087	2138	2186	2237	2289
Cylinder volume cm^3			498	522	535	547	559	572
Clearance Volume V cm^3	Compression Ratio (CR)	8.5	66.4	69.6	71.3	72.9	74.5	76.3
		9.0	62.3	65.3	66.9	68.4	69.9	71.5
		9.5	58.6	61.4	62.9	64.4	65.8	67.3
		10.0	55.3	58.0	59.4	60.8	62.1	63.6
		10.5	52.4	54.9	56.3	57.6	58.8	60.2
Deck Volume D cm^3	Assuming 0.004" (0.1mm) Deck Height	0.1	0.5	0.6	0.6	0.6	0.6	0.6
Gasket Volume G cm^3	Cu/As (mm)	1.3	7.0	7.4	7.6	7.7	7.9	8.1
	Steel (mm)	0.5	2.7	2.8	2.9	3.0	3.0	3.1
	Solid copper (mm)	0.5	2.7	2.8	2.9	3.0	3.0	3.1
		1.0	5.4	5.7	5.8	5.9	6.1	6.2
		1.5	8.1	8.5	8.7	8.9	9.1	9.3
		2.0	10.8	11.3	11.6	11.9	12.2	12.4
		2.5	13.5	14.2	14.5	14.9	15.2	15.6
Example: Head Volume H for CR = 10.0 using steel gasket			52.1	54.6	55.9	57.2	58.5	59.9

Note: Clearance Volume V for CR = 8.5 on 1991 cm^3 capacity (standard for TR2/3/3A) is 66.4 cm^3 (Head Volume H = 59.4cm^3).

It is worth mentioning that changing to larger liners alone will raise the CR quite significantly. For example, putting 86mm liners into a TR2/3/3A originally fitted with 83mm liners will raise the CR from 8.5

to 9.0 — because the Cylinder Volume has increased, but not the Head Volume (the small increase in Deck and Gasket Volumes has little effect).

Although they do not have wet liners, the principles outlined herein apply to other TR engines, for which the details are:

Standard TR5 & TR6: 74.7mm bore & 95.0mm stroke. CR (PI) 9.5; CR (carb) 7.75 or 8.61. Allow for 6 cylinders here!

Standard TR7 OHV: 90.3mm bore & 78.0mm stroke. CR 9.25.

The RevingtonTR Team