Technical Information
Bulletin No. 2

PREPARATION AND ASSEMBLY OF

TRIUMPH

T100, TR5, T110 AND TR6 ENGINES FOR MAXIMUM PERFORMANCE

A number of special high performance components are available for the above Triumph machines which may be fitted to increase the power output. This Bulletin tabulates and co-relates all the necessary technical information that is available, so that the owner who wishes to increase the performance of his machine may do so, starting from a point experience has shown to be the best. These alterations are not suitable for machines which are to be retained for normal road use.
If he follows the sequence outlined he will achieve the optimum for the particular chosen condition, after which the maximum will be gained by his own experience and endeavours.

WORKSHOP TOOLS

It will be assumed that the following items are in the owner's possession and that he has both the experience and necessary workshop facilities :—

Piston ring clips.
Engine timing disc and pointer.
Dial test indicator, preferably, or a set of feeler gauges.
Camwheel remover and replacer Z.89.
Crankshaft pinion remover Z.121.
Clutch and magneto gear remover DA.50/1. (part of the standard Tool Kit).
Triumph Instruction Manual for Twin Cylinder Models (appropriate for the year of the machine's manufacture).

For all dismantling and assembly procedure follow the instructions as detailed in the Instruction Manual. The procedure detailed hereafter is in respect of the non-standard high performance equipment only.

SECTION 1 ENGINE

Strip out completely and examine for wear, fatigue, misuse and any signs of damage. Remember that if you intend increasing the performance of the machine, all the components will be subjected to higher loads and the trouble and patience required to achieve this condition will be wasted if a suspect item is refitted and subsequently gives trouble. Fit new gaskets and washers throughout.

(a) Crankcase

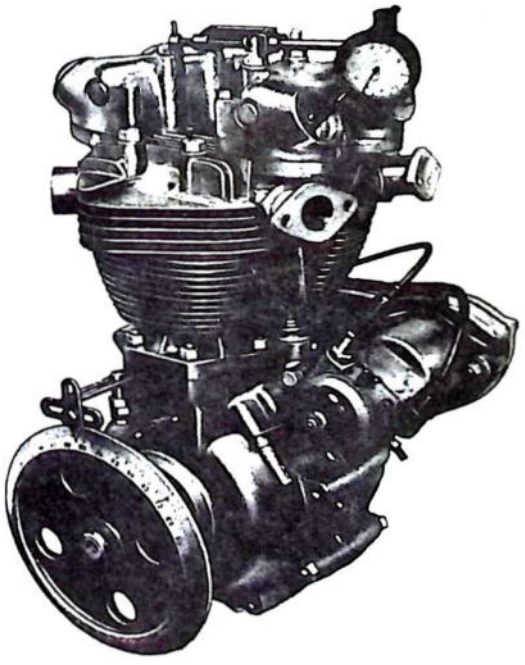
Rebuild with new con rod and flywheel bolts and nuts, clean out the sludge tube if the machine has completed a considerable road mileage (or fit a service sludge tube if an early 1⅛" dia. journal flywheel and a tube is not already fitted—Engine Nos. 47038 - 56536).
Fit E.3134 camshafts, used only in conjunction with E.3059R tappets (cam followers), to inlet and exhaust, and align and bolt up the crankcase halves. Fit the piston rings, using non chrome, plain top, taper second and standard scraper. Refit the cylinder barrel and cylinder head (after modification as described below) and leave the rocker boxes for the moment. The push rod cover tubes should be fitted where the tubes are located by the cylinder head, but it is not yet necessary in the cases where they are held in position by the rocker boxes. Fit the magneto. The engine is now ready for timing. It should be unnecessary to repeat that the engine should have been assembled after all the components have been individually cleaned and oiled, and oil liberally used during the assembly process.

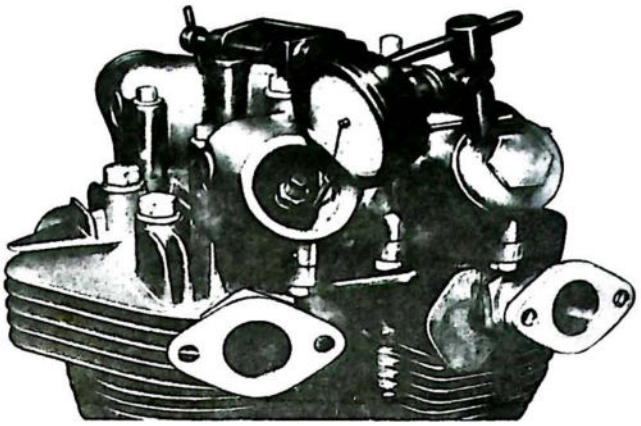
(b) Cylinder Head

The engine performance is far more dependent on the port shape and size, rather than finish. The port section should be almost constant, free from sharp corners, bumps or waviness and the finish should be good. It has been found that a mirror finish is not absolutely necessary. Final port finishing, after the shape has been satisfactorily achieved, should be done with the carburetter adaptors in place and the ports blended in as a whole. The optimum size of inlet valves are fitted as standard equipment but should larger valves be fitted for special purposes the valve cutaways should be increased in the piston crown, taking care to blend away sharp corners to obviate "hot spots." Also the auxiliary spheres in the head may need blending.
The exhaust ports do not need any alteration other than blending out. Grind in the valves and fit new interference racing springs E.3001 outers, E.3002 inners.
The inlet guides may be shortened (with a resultant shortening of life in consequence) and streamlined to reduce port obstruction to a minimum. This is not necessary on the exhaust valve guides, for unless the section is adequate to carry away the heat a temperature build up can occur and the stem and guide will suffer.
When fitting the T110 cylinder head make sure that the inner edges of the bores in the copper gasket are rounded and that no sharp corners are existing to introduce pre-ignition.
The T100 cylinder barrel liner spigot was reduced in 1955 (Eng. No. 70930) from $\frac{3}{16}$" depth to $\frac{1}{8}$", and if a later type head is subsequently fitted the barrel must be turned down to suit.

(c) Valve Timing

It is essential to use the three keyway camshaft wheels E.1486R to enable accurate timing to be achieved, and these should be assembled with the proper tool, otherwise damage to the camshaft, camwheel or crankcase bush will occur.
First and foremost, a degree timing disc must be bolted to the driveshaft and T.D.C. accurately established, using a D.T.I. dial test indicator through the plug hole on the crown of the piston. Fix a pointer at 360° with the pistons at the top of their travel and adjust accurately until the indicated piston travel either side of T.D.C. gives an equal number of degrees either side of 360°. Once this has been achieved, fit the crankshaft timing pinion and intermediate wheel. If a D.T.I. is not available, T.D.C. can be established using a marked stick through the plug hole on to the piston crown, rotating the engine as before so that the pistons travel down the stroke either side of T.D.C. to a mark chosen on the timing stick at about 1" of piston travel from T.D.C. Adjust the timing disc to read equally either side of 360° with the stick down to this mark.
Similarly, where reference is made later to 0.020" lift with zero valve adjustment, and no D.T.I. is used, then set the adjustment at 0.025" with the other valve on the same cam fully open, and the 0.020" point referred to is when a 0.005" feeler is just "nipped up." This alternative drill applies right through the procedure.





METHOD 1. Initial Valve Timing

Fit the exhaust rocker box with one push rod and adjust the valve adjuster to 0.020" (0.50 mm.) clearance on the cam base circle.

Set the engine rotating forward, that is, in its normal correct direction of rotation, to 35° A.T.C. Rotate the camshaft in the opposite direction until all the play in the push rod and rocker gear is taken up ; fit the exhaust camwheel, lining up the nearest keyway to give a mesh without disturbing the setting of the cam. Mark the keyway used on the camwheel, for if the wheel has to be removed to equalise between the cylinders later, and no mark is made, the previous careful work can be lost.

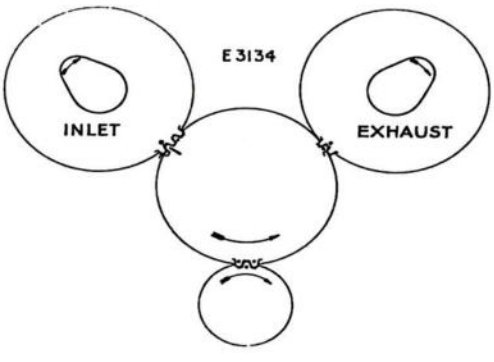
Remove the exhaust rocker box and push rod and fit the inlet in a similar manner, using the previous cylinder as reference when fitting the push rod. It is pointed out that the push rod cover tube need not be fitted during this preliminary setting up unless it is the type normally assembled together with the cylinder head (1956/7 T110, etc.).

Again rotate the engine forward to 35° B.T.C. and set the valve adjuster to 0.020" (50 mm.). Rotating the camshaft in the same direction, assemble the camwheel to the shaft as before. Mark the keyway chosen on the camwheel.

This method of initial assembly ensures that the exhaust closing—inlet opening overlap is correct and this is the condition to aim for if either cam open period proves to be short and the theoretical figures cannot be achieved.

METHOD 2

Alternatively, if the fitter is more adept, the camwheels can be assembled initially with the shafts as shown in the accompanying drawing during crankcase assembly, and the engine subsequently fully built including the final assembly of the push rods, cover tubes and rocker boxes. Again the keyways selected (this time to the appropriate marks on the wheels) should be marked to make handling easier if and when final vernier adjustment of the timing is made. This method probably requires more time to obtain final accuracy than the step by step method described earlier.



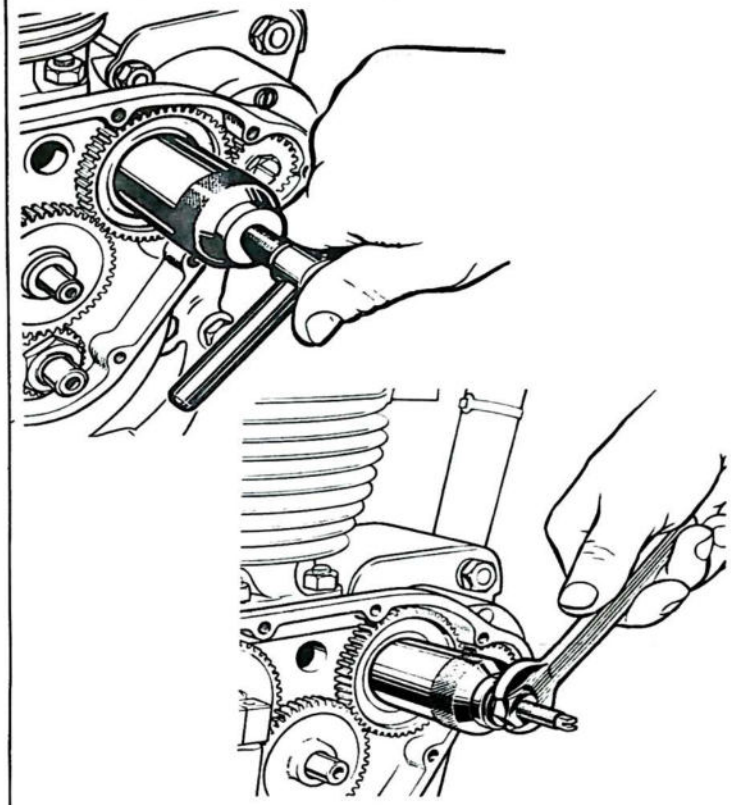
The valve adjusters should now be set at zero, with only a sliding fit between the rockers and the valve tips. Fit a dial test indicator firmly to the cylinder head. It is most essential that the D.T.I. is rigid and secure, otherwise erroneous results will be achieved. If a D.T.I. is not available, set the adjusters at 0.025" on the base of the cam (*i.e.*, the other valve on the cam fully open) as referred to earlier, and carry out the same drill using a 5 thou. feeler gauge, the point of " nip " being the equivalent of 0.020" lift zero clearance.

First check the inlet by rotating the engine " forward " and log the point on the degree disc not where the valve commences to open, but at 0.020" (0.50 mm.) lift. This ensures that the followers are off the base circle and all slack in the rocker gear has been taken up. Still rotating " forward," check the point where 0.020" is reached on closing. It is usually found that the lift of the cam is greater than the range of the D.T.I., and therefore it is advisable to rotate the engine " backwards " until the inlet opens and rises well past the 0.020" mark and then reversing the direction, rotate the engine normally " forward " and log the point where 0.020" is reached as the valve closes.

Then check the other cylinder on the same camshaft.

ADJUSTING THE CAM TIMING AND BALANCING BETWEEN CYLINDERS

The object now is to balance the inlet opening (I.O.) between the cylinders, *i.e.*, choose a nominal to suit both and adjust the camshaft using the camwheel keyways to ensure this position occurs at 35° B.T.C. engine rotating " forwards."

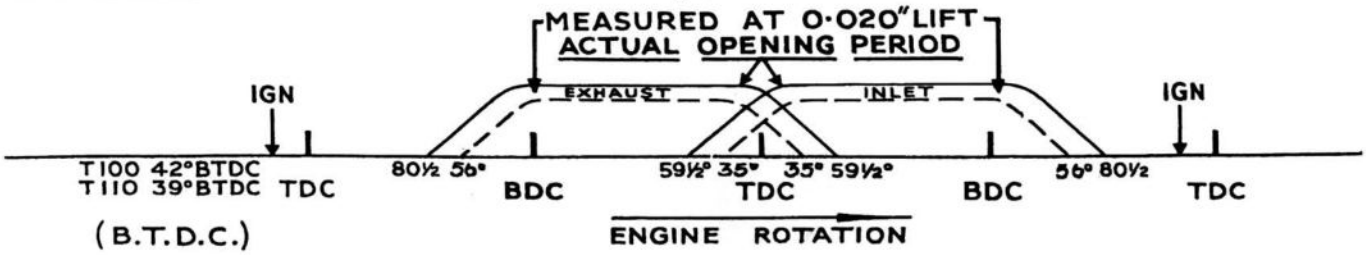


To " adjust " the cam, the camwheel has to be removed and the wheel replaced in such a way that when re-meshed the cam is either advanced or retarded as required. The teeth of the camwheel are pitched at 7° apart (*i.e.*, 15° engine) and the three keyways are equi-spaced, therefore giving 5° engine steps back or forward. When the camwheel is removed and in your hand, rotate the engine the amount it is necessary to " adjust " the timing (making sure the cam does not move once the wheel is removed) and carefully offer up the camwheel and re-mesh in a position where cam keyway and teeth line up and mesh correctly. Remember, if the engine is rotated forward in this operation the cam will be retarded relative to the engine, and vice-versa. Once this has been done, check both cylinders and log the figures, and if successful, remove the previous keyway marks and etch or permanently record the final position, for if at a future date the intermediate wheel is removed, the marks as standard on the wheels will not give any guide to refitting.

It is important that the camshaft is " at rest " when the camwheel is removed. Do not attempt to remove with the valve open and the spring compressed, otherwise the previous settings will be lost if the cam spins to rest.

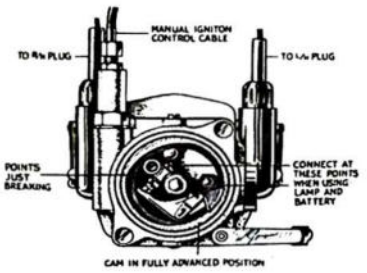
Repeat the above on the exhaust camshaft, aiming at the mean exhaust closing at 35° A.T.C.

When this has been achieved, again permanently mark the camwheels, fit the nuts and continue the assembly of the engine. This procedure and settings apply to both T100 and T110. The limits on the cams are $\pm 2\frac{1}{2}°$, so that if you achieve your settings within these limits your adjustments are as correct as possible.



(d) Ignition Timing

The ignition should be set fully advanced with magneto points adjusted at 0.012" (0.30 mm.) so that the mean position of the point of opening of the two cylinders occur at 42° B.T.C. in the case of the T100 and at 39° B.T.C. for the T110 engine, rotating "forwards." The simplest and surest method is with a bulb and battery, one side of the battery being connected to the fixed contact breaker point and one side of the bulb to the magneto contact breaker moving arm. The other connection is, of course, between the second battery terminal and the bulb. The moment of spark is when the points open and the light goes out, and can be fairly accurately judged whilst rotating the engine slowly and checking the pointer on the degree disc at that particular moment.



CAM IN FULLY ADVANCED POSITION

When you are satisfied the ignition is correct, re-check both cams and ignition to your final satisfaction and ensure that these figures are logged before proceeding.

Continue the assembly of the engine until complete, as described in the Manual, finally setting the valve adjustment to :—

Inlet 0.002" (0.05 mm.).
Exhaust 0.004" (0.10 mm.).

The engine should then be ready for assembly into the frame.

SECTION 2 PRIMARY DRIVE

Various size sprockets are available, both for the engine shaft shock absorber type drive and for later models incorporating the shock absorber in the clutch. For the 1958 models, make sure the replacement sprockets have the crankcase driveshaft oil seal face diameter ground on them, *i.e.*, the portion of the sprocket on which the seal runs, otherwise the seal will be damaged. The choice of drive sprocket size is described in the section on the gearbox. For the five plate clutches, a clutch band is available and this should be spot-welded on in three places. This prevents spreading and consequent chatter and wear on the driving plate dogs.

Always fit an endless "racing specification" chain for speed events to obviate the use of spring links.

Some riders prefer to refit the chainbath and others simply fit a guard to allow cooling air over the sprocket and chain assembly and incorporate an independent chain oiler and this is a matter of choice based on the kind of event for which the machine is to be used.

SECTION 3 GEARBOX

Again the specification of gears and ratios is purely a matter of choice and requirements for the type of going, but generally speaking the following types of gear clusters are best suited to the indicated use :—

Close ratio—road racing and high speed work.
Standard ratio—normal road touring, scrambling, etc.
Wide ratio—trials riding.

In addition certain combinations have been worked out where special gear ratios are required, such as wide ratio with close ratio bottom gear, but these are not necessary for the type of owner who wants to enjoy participation in average sporting events using his own machine. Again it is unnecessary to reiterate that unless the owner is absolutely satisfied with cases, bushes, bearing shafts and gears, etc., it is wasted effort and time to refit them for high powered use.

In using the chart on Page 4 it is best to remember that the ideal is to choose the point where the rider expects to reach his maximum speed in top gear and to achieve his maximum r.p.m. at this point.

Safe maximum r.p.m. can be taken as
7200 r.p.m. T100 pre 1953 and Eng. No. 47038 ;
7500 r.p.m. T100 after 1953 ;
6500 r.p.m. T110.

Generally speaking, the power curves fall away above these r.p.m., and revs: in excess of these have often been achieved and maintained successfully without any resultant distress, and decisions to exceed them must be the responsibility of the rider, who alone can "feel" the potentialities of his motor under the conditions in which he is riding.

SECTION 4 FRAME

(a) Forks

It has been found that for scrambling a stiffer front action is desirable, and it is usual to fit sidecar springs and/or SAE.40 oil.

(b) Rear Suspension

For the swinging arm machines, the standard TR5/TR6 dampers are usually specified (that is, no bump stops) and 90 lb. rate springs fitted. Both the forks and the rear suspension must, of course, be finalised to give a balanced condition best suited to the rider.

(c) Exhaust Equipment

If silencers or megaphones are used it is most essential that they are adequately sway braced between the silencer or megaphone nose clips and the bottom of the frame down tube. Use F.4141 bracing straps.

The type of event to which the machine is to be subjected controls the type of exhaust system, but it can be roughly summarised as under :—

High performance road work — "straight - through" standard absorption type silencers.
Road racing (a) Circuits with good, long straight sections and high speeds—megaphones.
(b) Short twisting circuits — straight throughs with extensions.
(c) Scrambles and cross country work where flexibility is required—straight throughs with extensions.

Using the E.3134 camshafts, the maximum performances are obtained as under :—

Straight throughs with extensions	$1\frac{3}{4}$" outside diameter of exhaust pipe
Straight through absorption silencers	$1\frac{1}{2}$" outside diameter of exhaust pipe
Megaphones	$1\frac{3}{16}$" diameter or $1\frac{1}{2}$" diameter for almost comparable results.

This applies to Tiger and Trophy Models 500 c.c./650 c.c.

SECTION 5 EQUIPMENT

(a) Carburetters

Most racing conditions will demand a twin carburetter specification for ultimate performance, and basic settings for the more widely used set of conditions are appended at the end of the booklet. Once again it is not necessary to reiterate that these are basic settings and jet and slides, etc., have to be tried to suit the particular machines and type of running that is to be encountered and are a matter of test and experience.

The T100 can be fitted with twin 1" type 6 carburetters, as detailed in the Spare Parts List, but later (1957) models have a twin splayed port head available as an extra, fitted with twin monoblocs or twin G.P. carburetters.

It must be remembered that the later splayed port head will not fit the earlier T100's as the cylinder barrel spigot was altered commencing Engine No. 70930, 25.8.55, and therefore earlier barrels must be changed to maintain the pairing or the spigot turned down to .125"/.123" height.

Although machines leave the factory with carburetters bolted on to adaptors fitted directly into the head, and this is perfectly satisfactory for ordinary maximum road performance, out and out racing demands rubber connection between the carburetter and the head to prevent carburetter frothing ; also float bowls remotely mounted on rubber fittings.

Air cleaners are desirable for scrambling, and separate filters should be used for each carburetter, as a common filter chamber feeding both carburetters results in loss of power due to interaction between the cylinders.

(b) Tacho Equipment

There is available a take-off from the dynamo position driving a tacho head—detailed in Spares List, and normally the speedo drive from the gearbox is then blanked off. For events where a speedometer and dynamo are needed, a special timing cover may be fitted, giving an alternative tacho drive from the camwheel. Twin tacho and speedo heads may fitted to a rubber mounted handlebar bracket, suitale for TR5/6 top headlugs. A different instrument head is used in the second type of assembly.

(c) Handlebars

Handlebars are specified as shown in Spares List, or an alternative $\frac{7}{8}$" drop bar (Clubman's) is available under Part No. H.1082.

(d) Wheels

Wheels should be balanced for high speed work, and these balance weights are provided under Part Nos. W1197 ($\frac{1}{2}$ oz.) and W1198 (1 oz.). Mention should be made of the absolute care and attention that must be paid to wheel, tyre and brake maintenance so that they are always in the best possible condition.

SECTION 6 ALCOHOL

In the case of the T100, where an alloy cylinder barrel is provided as standard, a cast-iron barrel (E.3046) should be fitted where alcohol or similar fuel is used and where 12 : 1 C.R. pistons are fitted, not only for the added strength provided at the cylinder base flange, but also due to the thermal requirements of the fuel itself. It will be remembered from the preceding paragraphs that the cast-iron and early alloy barrels were fitted with a different spigot from the present cylinder heads and the new cast-iron barrel would require the spigot reducing in height to .123"/.125" to suit the latest heads.

GENERAL

(a) Polish

As with the inlet ports where the care taken in producing a good shape and blending is more important than a highly polished finish, so it is with the general assembly. Polished flywheels, cams, rods, crankcase internals are not as important as a high degree of care in assembly and installation, and are a waste of time unless every item on the machine is in first class condition and properly fitted.

(b) Blending of Radii

On rotating and other parts liable to high stresses, the removal of sharp corners forming "stress raisers" is important and can prolong the life of an engine by increasing its inherent fatigue resistance, but, also (like the art of "lightening") can easily be carried to excess with resultant lack of section and consequent loss of strength. Generally speaking, light application with a polishing bob or fine grade carborundum stone on suspect sharp edges and corners is sufficient to reduce them to within safe limits.

ENGINE REVOLUTIONS PER MINUTE

M.P.H.	GEAR RATIO 4.4	4.57	4.78	5.0	5.24	5.5	5.7	5.8	6.0	6.25	6.5	6.9	7.06	7.14	7.5	8.0	8.85	9.8	10.6	11 58	12.2	13.9	14.3	15.25	16.0	17.8	18.85
20	1144	1188	1244	1300	1364	1428	1480	1508	1560	1624	1688	1796	1836	1856	1948	2080	2300	2548	2756	3012	3172	3612	3720	3964	4160	4628	4900
25	1430	1485	1555	1625	1705	1785	1850	1885	1950	2030	2110	2245	2295	2320	2435	2600	2875	3185	3445	3765	3965	4515	4650	4955	5200	5785	6125
30	1716	1782	1866	1950	2046	2142	2220	2262	2340	2435	2532	2694	2754	2784	2922	3120	3450	3822	4134	4518	4758	5418	5605	5946	6240	6942	—
35	2002	2079	2177	2275	2387	2499	2590	2639	2730	2842	2954	3143	3213	3248	3409	3640	4025	4459	4823	4271	5551	6321	6510	6937	—	—	
40	2288	2376	2488	2600	2728	2856	2960	3016	3120	3248	3376	3592	3672	3712	3896	4160	4600	5096	5512	6024	6344						
45	2574	2673	2799	2925	3069	3213	3330	3393	3510	3554	3798	4041	4131	4176	4383	4680	5175	5733	6201	3777	7137						
50	2860	2970	3110	3250	3410	3570	3700	3770	3900	4060	4220	4490	4590	4640	4870	5200	5750	6370	6890								
55	3146	3267	3421	3575	3751	3927	4070	4147	4290	4466	4642	4939	5049	5104	5357	5720	6325	7007									
60	3432	3564	3732	3900	4092	4284	4440	4524	4680	4872	5064	5388	5508	5568	5844	6240	6900										
70	4004	4158	4354	4550	4774	4998	5180	5278	5460	5684	5908	6286	6426	6496	6331	6760											
80	4576	5742	4976	5200	5456	5712	5920	6032	6240	6496	6752	7184	7344	7424													
90	5148	5346	5598	5850	6138	6426	6660	6786	7020	7308																	
100	5720	5940	6220	6500	6820	7140	7400	7540																			
110	6292	6534	6842	7150	7502	7854																					

NOTE.—Engine R.P.M. are calculated in conjunction with 3.50 × 19 Rear tyre equipment—780 R.P.Mile—and will deviate slightly from above figures for models not so equipped.
4.00 × 18 Rear Tyre 785 R.P.Mile. 3.25 × 19 Rear Tyre 793 R.P.Mile. 4.00 × 19 Rear Tyre 756 R.P.Mile.

GEAR RATIOS WITH 46 TOOTH WHEEL SPROCKET

GEARS	STANDARD RATIO				WIDE RATIO				CLOSE RATIO			
Engine Sprocket	Top	3rd	2nd	1st	Top	3rd	2nd	1st	Top	3rd	2nd	1st
17	6.46	7.7	10.94	15.8	6.46	9.22	14.30	18.85	6.46	7.06	8.42	11.00
18	6.10	7.28	10.32	14.9	6.10	8.70	13.50	17.80	6.10	6.66	7.95	10.40
19	5.80	6.9	9.8	14.15	5.80	8.25	12.80	16.85	5.80	6.32	7.54	9.84
20	5.50	6.55	9.3	13.4	5.50	7.84	12.18	16.0	5.50	6.00	7.15	9.35
21	5.24	6.24	8.85	12.8	5.24	7.46	11.58	15.25	5.24	5.72	6.81	8.90
22	5.00	5.95	8.45	12.2	5.00	7.13	11.05	14.55	5.00	5.45	6.50	8.50
23	4.78	5.69	8.09	11.69	4.78	6.82	10.60	13.90	4.78	5.23	6.23	8.12
24	4.57	5.45	7.75	11.2	4.57	6.54	10.14	13.35	4.57	5.00	5.96	7.78
25	4.40	5.24	7.45	10.75	4.40	6.26	9.73	12.80	4.40	4.80	5.73	7.46
Gearbox Reduction	1.0	1.19	1.69	2.44	1.00	1.425	2.21	2.915	1.00	1.09	1.30	1.695

CARBURETTER SETTINGS FOR TWIN CARBURETTERS T100 AND T110

Using Camshafts E.3134 and E.3059R Tappets.
I.O. 35° B.T.C.
I.C. 56° A.B.C.
E.O. 56° B.B.C. ± 2½°
E.C. 35° A.T.C. at 0.020" lift, zero valve adjustment.

Exhaust Conditions
A. 1½" straight through 37" pipe length.
B. 1¾" straight through 37" pipe length (best).
C. 1½" Megaphones 31½" pipe length.
D. 1 5/16" Megaphones 31" pipe length (best).

T100	PETROL				80-90 OCTANE								ALCOHOL							
8 or 9 : 1	AMAL Type 6				AMAL MONOBLOC Type 376—1" Choke				AMAL 15 G.P. 1" Choke				AMAL Type 6—12 : 1				AMAL MONOBLOC Type 376—1" Choke			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Choke	1"	1"	1"	–	1"	1"	1"	–	–	–	–	1"	–	–	1"	–	–	–	1"	–
Main Jet	160	170	180	–	210	210	210	–	–	–	–	220	–	–	400-500	–	–	–	540	–
Needle Jet	.109	.109	.109	–	.1065	.1065	.1065	–	–	–	–	.107*	–	–	.113	–	–	–	·120 †	–
Slide	6/4	6/4	6/4	–	376/3	376/3	376/3½	–	–	–	–	6	–	–	6/4	–	–	–	376/3	–
Pilot		——			25	25	25					**			***				‡	

12 : 1 C.R. using " dope " fuel AM1 or similar (with additions of up to 10% alcohol if using alloy cylinder barrel).
Use 90 octane pump fuel for 8 or 9 : 1 CR and 100 octane fuel with 9.5 : 1 only.

* Used with TT needle, Part No. 3971.
† Open up holes in needle seating to allow more fuel in from banjo.
** Ream to .125" in the carburetter body.
*** Bleed holes opened up to .035"—.036".
‡ Open up holes in jet holder.

T110	PETROL				80-90 OCTANE							
	AMAL Type 289				AMAL MONOBLOC Type 376				AMAL MONOBLOC Type 389			
8 or 8.5 : 1	A	B	C	D	A	B	C	D	A	B	C	D
Choke	1⅛"	1⅛"	–	–	1 1/16"	1 1/16"	1 1/16"	–	1⅛"	1⅛"	1⅛"	–
Main Jet	190	200	–	–	210	220	220	–	330	340	340	–
Needle Jet	.109	.109	–	–	.1065	.1065	.1065	–	.1065	.1065	.1065	–
Slide	289/3½	289/3½	–	–	376/3½	376/3½	376/3½	–	389/3	389/3	389/3½	–
Pilot	25	25	–	–	25	25	25	–	25	25	25	–

These settings are intended as a guide only. No fixed settings can be given to satisfy every machine under any given conditions and the rider must finalise his own settings to suit himself.

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