PREPARING THE

1973

TRIUMPH

750 TWIN ENGINE

FOR USE IN DIRT TRACK, T. T.

AND ROAD RACE COMPETITION

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FORWARD

During the latter part of 1949 Triumph revolutionized the world of motorcycling by introducing the first 650cc vertical twin, marketed as the 1950 Triumph Thunderbird.

For the next 23 years Triumph produced 650cc models known around the world not only as the Thunderbird, but in later years as the TR6 and the T120.

In 1970 a limited production version of a 750cc twin was built and has been successfully campaigned around the American dirt track circuit for the past two years. During 1972 Triumph decided to discontinue production on the 650cc models and concentrate their efforts on two new 750cc twin cylinder models, currently marketed as the TR7 . . . a single carburetor version . . . and the T140, which features dual carburetors.

Since 1949, Triumph racing engineers and tuners have devoted thousands of hours to the development of this famous 650/750 twin engine, and a great amount of tuning information has been made available for competition use over the years.

During the winter of 1972, Danny Macias, Racing Manager for Triumph in the U.S., was given the assignment of developing the new "short rod" 750cc twin engine for competition use.

Throughout the winter, Danny and two racing technicians have devoted endless hours of development time and dyno time in an effort to prove or disprove the theories and tuning secrets of all the great tuners in the past.

They were also asked to develop a simple, straightforward, step-by-step procedure for the preparation of Triumph twin engines to be used in dirt track, T.T., and road race competition. If you will follow the information contained in this booklet, using reasonable mechanical exactness, you should end up with a racing engine capable of delivering between 62 and 64 b.h.p. to the rear wheel and a solid torque range giving flexible power for all types of competition.

Good luck . . . Good racing!

E. W. 'Pete' Colman
Vice President - Engineering (U.S.A.)

PARTS LIST

Part Description	Part Number
Camshaft, Norris	CD4026
Carburetor, Concentric, 32mm (Left) - Amal	L932
Carburetor, Concentric, 32mm (Right - Amal	R932
Clutch Plate (Standard)	T1362
Clutch Plate (U.S.A.)	T1362AT
Clutch Spring (Standard)	T1560
Clutch Spring (U.S.A.)	T1560T
Contact Set, Bendix - C/W Plate	CD450
Contact Set, Bendix - Only	CD481
Gasket, Head, 75mm	E13332
Gasket, Head, 76mm	71-3681
Gasket, Cylinder Base	E6309
Gasket, Primary	E11463
Gasket, Rocker Box	E12599
Megaphone (Right Hand)	E3479/027R/H
Megaphone (Left Hand)	E3479/028L/H
Mounting Flange	E9550
Mounting Flange	E9551
Piston (Standard)	CD4017
Piston (Plus .010")	CD4018
Piston (Plus .030")	CD4019
Piston (Plus .040")	CD4020
Piston Ring (Standard)	CD4021
Piston Ring (Plus .010")	CD4022
Piston Ring (Plus .020")	CD4023
Piston Ring (Plus .030")	CD4024
Piston Ring (Plus .040")	CD4025
Push Rod	E2620
Radiator, Oil	F9315
Seal, Push Rod Tube (Top)	E11283
Seal, Push Rod Tube (Bottom)	E7310
Seal, Push Rod Tube (Bottom)	E4752
Sprocket, Countershaft (18-tooth)	T4398
Sprocket, Countershaft (19-tooth)	T4397
Stud, Cylinder Head (3/8")	S2201
Stud, Cylinder Head (5/16")	S2200
Tappet (1 1/8" R.)	E8801
Valve Collar	CD224
Valve, Exhaust (Standard)	E2904
Valve, Exhaust (Austinetic)	E2904KE
Valve, Inlet (Standard)	E4603
Valve, Inlet (Austinetic)	E4603KE
Valve Guide (Bronze Inlet)	E13294
Valve Guide (Bronze Exhaust)	E13295
Valve Guide (Cast Iron Inlet)	E2899
Valve Guide (Cast Iron Exhaust)	E2900
Valve Spring	CD71
Velocity Stack (For Air Filter)	TG300101
Velocity Stack (No Air Filter)	TG300102

I N D E X

ENGINE DETAILS

Both the TR7 and T140 engines are easily adaptable for competition; and while some T. T. specialists may prefer to use the single carburetor TR7 engine, most riders will prefer the T140 because of the additional power delivered by the twin carburetor configuration.

This new series of engines has the same outward appearance as all Triumph engines over the years. It is best described as a vertical twin cylinder OHV engine, having a bore of 76mm, a stroke of 82mm, and a standard displacement of 744cc.

The standard engines are fitted with 30mm carburetors and have a compression ratio of 8.6:1. The gearbox incorporates newly designed heavy-duty five speed gears and a 20-tooth gearbox sprocket.

In preparing this series of engines for competition, you may use all of the standard engine parts except the valve springs, valve collars, pistons, rings, camshafts and two tappets.

PREPARING FOR COMPETITION

The first step in the preparation for competition requires a complete disassembly of the engine and gearbox.

After disassembly, all parts should be thoroughly cleaned and inspected. Some successful tuners recommend that all steel parts be magnafluxed before use to insure freedom from cracks, and that all aluminum parts be zygloed or X-rayed before installation in the engine.

Most of the cracks discovered during either of these examinations are surface cracks and can be removed by polishing or shotpeening. Shotpeening will also increase the strength of certain parts and is a recommended procedure.

Cleanliness in the preparation of a racing engine is of utmost importance, and all parts should be surgically clean at the time of reassembly.

FOR COMPLETE DISASSEMBLY OR REASSEMBLY DETAILS -- REFER TO THE TRIUMPH 'B' RANGE WORKSHOP MANUAL.

PREPARATION OF THE CYLINDER HEAD

Porting. The basic port shapes of the 1973 cylinder head are correct; however, it is recommended that any uneven surfaces be removed and the ports polished.

While some tuners recommend the expense of flow bench testing and and reshaping of the ports, our development tests have shown no great improvement after this work is done. However, if you desire further work, you might send the head to C. R. Axtell in Burbank, California, or Jerry Branch in Long Beach, California, to have this work accomplished.

Valve Guides. The standard valve guides are manufactured of aluminum bronze, and some tuners prefer the standard guides, while others prefer the use of cast iron. Either guide may be used with good results. However, the upper end of the standard guides must be shortened 1/16" to allow for the increased lift of a high-performance camshaft.

Upon the installation of new valve guides, the clearance between the top of the valve guide and the valve collar should always be checked to eliminate a potential failure at this point.

Valves. While valves from other manufacturers are used by some tuners, we found that the standard Triumph valves incorporate a good shape for maximum flow and the proper materials for a reasonable life expectancy.

We do recommend that the valve stems be hard-chromed for longer life and that the clearance between the valve stem and the valve guide be not less than .002" or more than .003". Measurement of the clearance is quite hard to determine, but if excessive elongation of the valve guide hole is noted, guides should be replaced.

Inlet Valves (Std.)	Part No. E4603
Inlet Valves (Austinetic) - Alternate	Part No. E4603KE
Exhaust Valves (Std.)	Part No. E2904
Exhaust Valves (Austinetic) - Alternate	Part No. E2904KE

Valve Springs and Valve Collars. Twenty-five years ago one of the nation's top tuners, Tim Witham, was preparing racing engines for Johnson Motors, Inc., the western U.S. Triumph distributor at that time. Tim found a requirement for special valve springs, and in a cooperative effort between "Jomo" and Tim, special springs were developed. Since that time these springs have been marketed under various names, such as Jomo, Tri-Cor, and S & W, and are the only springs recommended for use.

The springs should be fitted in conjunction with special top collars, and during installation spacers should be placed between the cylinder head and the bottom spring cups so as to give an outer spring length of 1 1/4" with the valve on the seat. As a safety precaution -- to prevent valve float -- the inner spring should be packed as follows:

Determine the exact lift at the valve of the racing cam installed in the engine. Squeeze inner valve spring in a vise until the spring becomes coilbound; then release the spring tension so that a .015" feeler may be placed between two adjacent coils.

Now measure the length of the spring in this position and add the measurement of the valve lift to that figure. The inner spring should then be packed to this length.

Valve Springs (4 pairs)	Part No. CD71
Valve Collars (1 set)	Part No. CD224

Spark Plug Length. The length of the threaded spark plug hole in the standard Triumph cylinder head has been established to accept a standard length spark plug. However, the length of the threads must be modified so as to correspond with the spark plug and plug gasket that you will be using in competition.

A racing spark plug and gasket of the type that you select should then be screwed into the hole and properly torqued. Then turn the cylinder head over and note if any threaded portion of the hole remains exposed. If even one thread is exposed to the heat of the combustion chamber, you will not obtain maximum performance, so the combustion chamber must then be reshaped and blended at the spark plug hole so as to eliminate any protruding threads.

Rocker Arms. Standard rocker arms may be used, but some tuners recommend that the rocker arms be lightened slightly in order to obtain increased r.p.m.'s with less danger of valve float.

We do not recommend removing too much material from the rocker arms, but if you will study the illustration of the rocker arm, you will observe the portion that we recommend for removal. You should always be careful to eliminate any rough or uneven sections of the rocker arm, and after the rocker arms have been shaped properly, they should be shotpeened for added strength.

In order to reduce weight further, the tappet adjuster screw may be lightened by drilling a 1/8" hole 1/2" deep. The adjuster may be shortened and the adjusting flats removed if desired, and two screw driver slots may be added for adjusting purposes if this modification is accomplished.

PREPARATION OF CARBURETORS/ INDUCTION TRACKS/AIR FUNNELS

Induction track length and the selection of carburetors has always been a subject of discussion. Some tuners believe that the Amal GP carburetor is best . . . some use the Mikuni carburetors . . . while others believe that best results may be obtained by use of the Amal concentric carburetor.

We recommend the use of two 32mm Amal Concentric carburetors, fitted with our special velocity stacks.

We further recommend that the distance between the cylinder head flange and the carburetor flange be set at a minimum of 4" and a maximum of 4 1/2" by use of specially fabricated induction tracks.

Modifying E9550/ E9551 Mounting Flanges. We recommend the modification of mounting flanges originally fitted to 1971 and early 1972 T120 models. A quantity of four flanges will be required, as two must be bolted against the cylinder head, while the other two facing in the opposite direction are bolted to the carburetor, with the threaded ends of the flanges connected by a 1 3/8" high pressure hose.

In modifying the flanges, it will be necessary to "sweat" the bolts from the two flanges that are to be bolted to the cylinder head. It will also be necessary to plug the threaded equalizer holes in all four flanges, as an equalizer is not required.

Remove the standard manifold adapters from the head, and secure the two modified flanges to the head by use of studs and nuts. You may push two short lengths of 1 3/8" hose over the threaded portion of the adapters . . . then cover the hose with slotted thin wall tubing (procured from your local plumbing supplier), and then clamp the tubing and hose to the flange attached to the head.

You may now insert the two remaining flanges, which must also be secured by hose clamps. To this flange you may attach the carburetor and the velocity stacks.

Two types of velocity stacks are available for use with or without air filters; however, the use of the velocity stacks in conjunction with the concentric carburetors is a "must."

Amal 32mm Carburetors	Part No. L932 (left side) Part No. R932 (right side)
Velocity Stacks for Air Filter	Part No. TG300101
Velocity Stacks - No Air Filter	Part No. TG300102

PREPARATION OF THE CYLINDER/PISTONS/RINGS

When reboring the cylinder, care should be taken to insure that the cylinder bores are parallel with each other and perpendicular to the cylinder base. Any errors in reboring can result in a loss of power and subsequent failure.

Before reboring the cylinder, the pistons being prepared for use should be "miked," and the measurement of the largest diameter noted at the bottom of the piston should be recorded.

Cylinders should then be bored to give a minimum of .005" clearance between the skirt measurement and the bore. The bore should then be shot-peened to insure quick seating of the rings.

Some early production engines were manufactured with a bore of 75mm; however, the registered bore approved by the A.M.A. is 76mm, and according to the rules the cylinder may then be rebored to a maximum of 76mm plus .045". Care must be taken not to bore the cylinder larger than the maximum allowable limit, which in inches is 3.032" (plus .005" more for wear).

76mm	=	2.992"	Bore Size
76mm plus .010"	=	3.002"	" "
76mm plus .020"	=	3.012"	" "
76mm plus .030"	=	3.022"	" "
76mm plus .040"	=	3.032"	" "

A special piston has been developed by the Racing Department and is available from stock under the following part numbers: (Compression Ratio 10.5:1)

Racing Piston (Standard)	CD4017	Supplied without rings
Racing Piston (plus .010")	CD4018	
Racing Piston (plus .030")	CD4019	
Racing Piston (plus .040")	CD4020	

Piston rings (racing) can be ordered under the following part numbers:

CD4021	(Standard)	CD4024	(plus .030")
CD4022	(plus .010")	CD4025	(plus .040")
CD4023	(plus .020")		

Extreme caution should be taken to insure that there is an adequate ring gap to prevent the end of the rings from butting together Piston rings do expand in length when brought up to temperature, and if the rings are installed with too small a ring gap, butting will occur, and the rings are subject to breakage.

When installing rings, file ends to permit a minimum ring gap of .012".

Cylinder Head Studs. The four large diameter (3/8") and two small diameter (5/16") cylinder head studs have been manufactured of stainless steel in order to eliminate cylinder head gasket problems. We would recommend against the substitution of studs made from other materials.

Stud (Cylinder Head) 3/8" Part No. S2201

Stud (Cylinder Head) 5/16" Part No. S2200

Tappet Guide Blocks. In order to permit the use of racing camshafts, additional clearance must be provided for the upward movement of the tappets. Modify the tappet guide block to permit the additional movement by the removal of .030" of material from each of the two guide block tangs.

The tappet guide block holes should both be champfered to fit the radius at the base of the tappet in order to insure maximum upward movement of the tappet.

PREPARATION OF CAMSHAFTS, TAPPETS, PUSH RODS AND CONTACT POINTS

Camshafts. Quite a large selection of camshafts are available from various manufacturers, such as Sifton, Harmon & Collins, Harmon, Norris, and others. While several different cam grinds will provide similar torque and horsepower characteristics, we have found the best overall results were produced by the Norris CD4026 cams, in conjunction with 1 1/8" radiused tappets. Norris CD4026 cams: The inlet cam lifts the tappet .380" and the valve .418", while the exhaust cam lifts the tappet .370" and the valve .407". For timing purposes, opening and closing readings should be taken on a dial indicator at the tappet @ .020".

Inlet opens at 60° before top center

Inlet closes at 80° after bottom center

Exhaust opens at 75° before bottom center

Exhaust closes at 55° after top center

Order CD4026 Norris Cams

Tappet Clearance: Set tappets at .010" for running.

Tappets. Our tests indicate that a tappet having a 1 1/8" radius must be used in conjunction with the Norris CD4026 cams.

The engine is equipped with 1 1/8" radiused exhaust tappets. However, the inlet tappets only have a radius of 3/4"; therefore only the exhaust tappets may be used in the engine.

Two additional tappets (Part No. E8801) having the 1 1/8" radius must be installed on the inlet.

Tappets may be lightened by the drilling of a hole in the tappet base at 90° to the present hole.

Tappet (1 1/8" R) Part No. E8801

Push Rods. Several manufacturers produce push rods for Triumph engines; however, we find no problems occurring from the use of standard push rods.

The radiused surfaces of the push rod ends should be polished to insure longer life.

Push Rod Part No. E2620

Timing Gears. Timing gears and idle gears may be lightened if desired by drilling equally spaced 1/2" diameter holes through the center portion of the gear. Do not do any machining on the gear teeth.

Contact Points. We recommend the installation of a ball bearing drive for the contact breaker cam, which may be ordered from Posa Fuel, Alloy Tech, or Gary Nixon Enterprises.

In addition to the ball bearing mounting arrangement, we recommend the use of Bendix contact sets in conjunction with an ARD backing plate.

Both the backing plate and the contact sets may be purchased from Duarte or Baltimore under the following part numbers:

Bendix Contact Set (complete with backing plate) Part No. CD450

Bendix Contact Set (only) Part No. CD481

Auto-Advance Unit. The auto-advance unit mechanism must be removed, as we recommend only the use of fixed ignition for competition purposes.

Ignition Timing. When using the cams and pistons recommended in this booklet --

Set ignition timing at 40° BTC

PREPARATION OF CONNECTING RODS AND CRANKSHAFT BALANCING

In the new Triumph "short rod" engine, the connecting rods are .406" shorter than the earlier-type connecting rod and a larger diameter 3/4" wrist pin is now used.

The connecting rods should be polished or shotpeened, and then zygloed or X-rayed, before installation.

As the piston weight is being changed because of the installation of racing pistons, it now becomes necessary to rebalance the crankshaft.

Many tuners disagree on the percentage factor to be used for competition purposes, and their recommended compromise factors vary from 68% to 85%.

In order to balance the crankshaft, it is necessary to weigh the pistons, complete with wrist pin, circlips and rings, and the connecting rods, complete with inserts, nuts and bolts, to arrive at the total weight; and it is then necessary to weigh each end of the rod individually so that you will know the portion of the rod considered to be reciprocating and the portion of the rod considered to be rotating. These weights are necessary as the balance factor is based upon a percentage of the total reciprocating weights.

A sample formula is shown below:

One piston, c/w rings, pin, circlips, weighs	=	382 grams
Weight of (2) pistons complete		x 2 764 grams
The small end of the con rod weighs	=	108.5 grams
Weight of (2) con rod small ends.		x 2 217.0 grams
The big end of the con rod weighs	=	370 grams
Weight of (2) con rod big ends		x 2 740 grams

764 grams = 2 pistons, complete
+217 grams = 2 con rod small ends → Total Reciprocating Weight
981 grams
x85% balance factor (We have had good experience with 85%)
833.85 grams
+740.00 grams = 2 con rod big ends (rotating weight)
=1573.85 grams = total balancing weight to be added to crank journals for balancing to 85% (use 1/2 of this weight each)

You will note from the above example that if your piston sets and rod sets correspond to those above, you would require balancing weights totaling 1573.85 grams in order to balance your engine at 85%. By using the above formula, you may substitute your engine piston and rod weights, and whatever percentage factor you desire.

PREPARATION OF THE EXHAUST SYSTEM

Various types of exhaust systems have been fitted with reasonable success, and some tuners recommend the use of 1 3/4" OD exhaust pipes, while others prefer the use of 1 1/2" pipes.

The selection of megaphones has also been one of personal choice, and some have believed that the best results were gained from the use of open megaphones, while others preferred to use the inverted cone.

Exhaust Pipes. Our tests have indicated that exhaust pipes of 1 1/2" OD (1 3/8" ID) offer the best all-around performance. The exhaust pipe, measured on the outside of the bend, should have a length of 32 1/2". This measurement does not include any portion of the exhaust pipe inserted into the cylinder head.

It is recommended that the exhaust pipe be spring-mounted, connecting the pipe to an adapting bracket secured beneath the front cylinder head mounting bolt.

Megaphones. We have had best results with megaphones 14" in length and 4" maximum diameter, with an inverted cone giving a final opening of 2 9/16".

Standard Triumph megaphones E3479/027RH or E3479/028LH are suitable for the job; however, if the standard megaphone is used, a portion of the inverted cone must be removed to increase the final opening to 2 9/16".

Megaphone	Part No. E3479/027R/H
Megaphone	Part No. E3479/028L/H

PREPARATION OF THE GEARBOX/CLUTCH

Gearbox. The standard five-speed gearbox fitted to 1973 TR7 and T140 models have proved to be an excellent selection for both T.T. and dirt track racing. The gearbox was re-engineered for 1973, and all of the gears are considerably stronger than those fitted to 1972 models.

Care should be taken to insure that the gearbox is in good condition before use, and that the gear selection mechanism is indexing properly so as to avoid "missed shifts."

Clutch. The standard clutch will do an excellent job, providing the springs are adjusted to proper and equal tensions, permitting the clutch plates to run freely without wobble.

The spring tension can be adjusted in this manner by use of the kickstarter while the clutch is released, and noting the movement of the clutch plates during rotation.

When the clutch plates move outward at one point during rotation, a slight tightening of the clutch spring at that point will permit it to run true. This operation should be repeated until no wobbling of the clutch plates is noted.

It is also important that the clutch release fully and freely, for a "dragging clutch" will cause problems at the start of a race and also when shifting.

Clutch Plate	(Standard)	Part No. T1362
Clutch Plate	(U.S.A.)	Part No. T1362AT
Clutch Spring	(Standard)	Part No. T1560
Clutch Spring	(U.S.A.)	Part No. T1560T

Countershaft Sprocket. The gearbox is fitted with a 20-tooth countershaft sprocket; however, the use of an 18-tooth sprocket will help to provide the best gear ratios for most race tracks.

18-tooth C/S Sprocket 'B' Range	Part No. T4398
19-tooth C/S Sprocket 'B' Range	Part No. T4397

PREPARATION OF FRAMES/FORKS/ WHEELS/TANKS

There are many suppliers --nationwide -- of frames, forks, wheels, tanks, sprockets, and various other specialty racing parts marketed for Triumph dirt track and T.T. machines. The standard Triumph frame provides excellent handling characteristics for T.T. competition and has, over the years, proved itself as the choice of many of the nation's top T.T. riders.

As the selection of dirt track frames, etc., is vast, and the results based to a certain extent upon personal likes and dislikes of the rider, we would hesitate to go on record recommending that one frame combination is better than any other.

Use of Oil Radiator. For longer engine life, it is essential that oil temperatures be kept at a reasonable level. During our experiments, we found that the use of the standard Triumph Trident oil radiator is the best for dirt track and T.T. competition.

The mounting of the oil radiator is a matter of personal choice, depending upon the type of frame that you have chosen to use.

Oil Radiator	Part No. F9315