

FORMULA TKM 2-STROKE RUNNING INSTRUCTIONS

BT82 (Direct Drive / Horstman Clutched and TAG)

The TKM BT82 engine will give many hours of reliable and consistent performance if it is looked after and treated in the proper manner. But it must be remembered that while it is a very reliable power unit, it is also a powerful racing engine and must therefore be treated with the respect such an engine deserves.

The information given in this guide is based on many years experience with the engine both in racing and on the test bed. **We stress that use of excess revs and/or insufficient carb settings with less than 0.125 (1/8) high jet opening will lead to reduced engine life.**

Running-in must be carried out on a track and not stationary as engine will overheat!

It should be carried out for a period of 1 hour. Build up your speed gradually in 20 minute periods. At all times there should be a small puff of blue smoke from the exhaust when accelerating out of corners. If not, turn out the high jet accordingly.

Petrol Oil Mix Although we recommend Super Unleaded petrol for peak performance, it is quite acceptable to use premium unleaded. Do not use Lead Replacement fuel which is illegal. Fuel should be mixed at 16:1 Shell Advance Racing M oil. Mix 5 litres of fuel with 310ml of oil.

Plugs For normal racing, use the Denso W27ES-ZU spark plug. If running in very hot weather and at high load it may be advisable to use the W31ES-ZU plug. Plug gap for both is 0.025".

The factory recommended rev limit for sustained running is 14,800rpm. You are strongly advised not to exceed 15,750rpm as an absolute maximum. Although higher revs can be achieved this will be at the expense of power, and will substantially reduce engine life. The TAG version engine with PVL TKM CDI box has a built in rev limiter which acts as a safety should you lose a drive chain which can cause crank misalignment or other damage.

Carburettor The carburettor should always err on the side of richness for maximum performance and engine life. Settings are different between the junior and senior engine because of the use of the restrictor plate on the junior engine. Recommended starting settings:
Junior 120 kg Black 19.5mm Restrictor
Low Jet 2.05 & High Jet 0.4 Turns out

Junior 128 kg Gold 20.5mm Restrictor

Low Jet 1.95 & High Jet 0.4 Turns out

Junior 135 kg Blue 22.0mm Restrictor

Low Jet 1.9 & High Jet 0.4 Turns out

Junior 142 kg Purple 24.0mm Restrictor

Low jet 1.85 & High Jet 0.4 Turns out

Junior 148 kg No Restrictor

Low jet 1.85 & High Jet 0.4 Turns out

Junior Extreme 138 kg Purple 24.0mm Res

Low Jet 1.85 & High Jet 0.4 Turns out

Senior Extreme 144 kg Blue 22.0mm Res

Low Jet 1.9 & High Jet 0.4 Turns out

Senior Extreme 148 kg No Restrictor

Low Jet 1.85 & High Jet 0.4 Turns out

For engines fitted with TAG or Horstman clutches you may have to reduce your advised low jet setting by up to 0.3 to 0.5 turns in and increase your high jet setting by the same 0.3 to 0.5 turns out to get your engine to tick over correctly when engine is hot or cold.

These are safe starting points which will give a slightly rich (safe) mixture. If the engine is too rich, then by using small amounts turn in the high jet until the carburation is correct. This will probably be between 0.4 and 0.2 of a turn out.

You can check the mixture by removing the cylinder head and inspecting the piston crown. Dry black is perfect. Dark to light grey is too lean and could lead to engine damage. Very wet and oily is too rich and will cause lack of power and possible fouling of the spark plug.

It is very important to keep your entire fuel system meticulously clean. If carb problems do occur they are often as a result of minute particles of dirt upsetting its fine tolerances.

Your petrol cans should be kept clean inside and swilled out occasionally. Filter your fuel through a funnel into the tank and make sure that the funnel is clean - keep it in a plastic bag when not in use. You should have an in-line filter in the fuel pipe. Replace the in-line filter from time to time.

The carb must be spotless. If you have a problem strip and clean it through thoroughly, ideally using an airline, and finally put a little WD40 spray on the needle valve tip.

It is very important that the 'pop-off' setting for the needle valve is correct. When tested with a carb pressure tester the needle should release at 10-12 psi and hold steady at no lower than 5psi.

Adjust pressure by carefully bending internal paddle lever arm up or down to suit.

Exhaust The exhaust pipe flex length before installation should be somewhere between 60-100mm. The suggested starting point is 80mm. The longer the length, the more bottom end power and the shorter then the more top end power. When using an exhaust flex ring note this will effectively add 5mm to the flex length. TAG engines only use the bigger 45mm O/D flex.

You should at all times use the approved TKM carb induction box. The foam filter incorporated into this helps reduce engine wear but does not reduce power if kept clean. If dirty, wash in Jizer or similar. Thoroughly rinse with clean water and dry. In wet conditions you are strongly advised to protect the air inlet to prevent water being sucked in. If the filter is waterlogged after you have been driving more protection is needed.

To guard against damage of the anodising on the head and barrel (which must remain) and the PVL TKM Logo markings **do not use heat or strong chemical cleaners including oven cleaners on these parts.**

If using a clutch you should beware of revving the engine while stationary since this will place undue strain on the clutch and may cause it to over-heat. On the Horstman clutched specification engines a special sprocket and securing nut is available if you wish to use the engine in direct drive format where permitted.

Horstman Clutched engine only

On Off Switch Fitting to PVL Ignition

(PVL is black in colour as fitted to all new engines)

Connect a red wire from the switch to the short spare red lead on the PVL coil. Then take a black wire and connect it from the other switch terminal to the coil earth mount on the engine. Do not earth this wire to the kart chassis. Ensure both wires are of a suitable quality multi-strand type and tape or cable tie them to the kart chassis and steering column so they do not snag. You must allow sufficient length for steering wheel movement (and removal).

On Off Switch Fitting to Motoplat Ignition

(Motoplat is red in colour as fitted to older engines)

Leave the black coil wire as standard but take a new wire off the blue wire terminal on the coil and connect it to the 'in' side of the switch. Then run another wire from the other side of the switch to the coil earth mount on the engine. Ensure you use quality multi-strand wire and tape or cable tie them to the kart chassis. Allow length for steering movement.

TAG On Off Push Buttons.

The simple to use and fit push buttons are advised to be fitted in conjunction with the Tal-Ko supplied steering wheel bracket making sure that once in position the wiring cannot chafe or foul when steering is turned from side to side.

The RED STOP button has 2 POSITIONS. When the RED button is in the PUSHED IN position the engine will turn over by pressing the GREEN ON /START button and produce a spark at the spark plug and will start providing everything is ready such as fuel up to carb etc. By pressing the RED button once it will spring out to the OFF / STOP position and engine will stop running (DO NOT HOLD RED BUTTON DOWN). Engine will not turn over to start unless RED button is in the PUSHED IN position.

Battery The standard battery supplied with the engine is FIAMM FG20722 12V 7.2Ah with an option of the heavier duty battery FIAMM FGH20902 12V 9Ah or the far superior high tec LI PO lightweight 14.8V 4 cell high power option. It is always strongly recommended to fully charge all types of battery with correct remote charger before each event even though the TAG engine does re-charge as it is running.

Setting Ignition Timing

Using a metric dial gauge and adaptor, screw into spark plug hole with cylinder head attached to engine. Turn the engine to Top Dead Centre (piston at top). Ensure the gauge does not bottom out, adjusting as necessary. Set dial of gauge to '0'. Looking at the engine from ignition side turn the crankshaft clockwise to the desired reading on the gauge – eg 1.9mm. Check if the line on the ignition back-plate and rotor are exactly aligned. If not loosen the three bolts securing the ignition and rotate until aligned. Tighten bolts, re-check alignment.

Timing settings are:

Motoplat: 2.0 – 3.0mm BTDC

PVL: 1.5 – 2.1mm BTDC

PVL TAG: 3.0 – 4.0mm BTDC

WARNING - The crankshaft is in three pieces and can be damaged by failing to adopt the correct procedure when tightening or removing the clutch / sprocket / ignition securing nuts.

You must never hold the nut at the other end of the crankshaft to tighten or remove the crank nuts. Use the special tools to hold either the clutch hub, sprocket or ignition rotor while you use a spanner on the nut. This is vital to prevent crank misalignment.

TAG IGNITION ROTOR – Only use the PVL manufactured extractor for the removal of this part or damage may occur with resulting failure of rotor. Hold rotor with hand only to do up or undo securing nut with impact gun or damage will occur to rotor.

Always ensure tapers are clean and dry and use the correct torque value of 28 lbs/ft on securing nut.

Specialist Tools

Tal-Ko offer a range of special tools to assist in carrying out engine work to the correct standards. These are available direct from Tal-Ko or from official dealers. Prices ex VAT are:

Sprocket holding spanner	£ 8.95
Sprocket extractor	£ 17.95
Motoplat extractor	£ 10.60
PVL extractor	£ 17.50
PVL TAG extractor	£ 25.50
PVL holding spanner	£ 14.50
Clutch holding spanner (Horstman)	£ 10.50
Clutch holding spanner (TAG)	£ 29.95
Clutch extractor (Horstman)	£ 18.50
Clutch extractor (TAG)	£ 25.50
Carb pressure tester	£ 32.50
Carb paddle height gauge	£ 4.25
Con-rod checking mandrels	£ 77.17
Dial gauge & fixture block	£131.95
Head gauge 001 Fiche check	£ 39.95
Head gauge 001/11 Fiche check	£ 39.95
Head gauge 001/13 Fiche check	£ 39.95
Head gauge 002 Fiche check	£ 19.50
Head Gauge 001/E <i>Extreme</i>	£ 39.95
Dummy Gudgeon Pin	£ 3.95
Ignition Dial Gauge + adaptor	£ 39.95
Head volume check oil 250mg	£ 5.50
Set of 7 port measuring gauges	£110.00
Volume measuring plug 003	£ 6.50

The engine torque settings are as follows:

Cylinder Head brass nuts	13 lbs/ft
Cylinder Head small cap head	8 lbs/ft
Crankcase bolts	10 lbs/ft
Carb mount bolts (ally flange)	6 lbs/ft
Engine Mount bolts	20 lbs/ft
Ignition bolts	5 lbs/ft
Crank ignition nut	50 lbs/ft
Crank ignition nut TAG	28 lbs/ft
Crank sprocket 10/11T nut Direct Drive	45 lbs/ft
Crank sprocket 9T nut Direct Drive	28 lbs/ft
Exhaust bend nuts	20 lbs/ft
Spark plug	22 lbs/ft
Horstman clutch starter nut	15 lbs/ft
Horstman clutch hub nut	45 lbs/ft
Horstman clutch green nuts	2-3 lbs/ft
TAG clutch crank nut	15 lbs/ft
TAG clutch hub nut	50 lbs/ft
TAG Sprocket fix bolts	8 lbs/ft
TAG Starter Gear fix bolts	15 lbs/ft

Recommended Engine Clearances

Tal-Ko strongly advises the following. Use of abnormal settings may cause excess wear, damage and loss of power:

Piston to bore clearance	0.09 – 0.11mm
Crankshaft end-float	0.12 – 0.17mm
Piston / head squish	Min 0.76mm
Piston ring gap	Min 0.10mm
	Max 0.50mm

CLUTCH FITTING & SERVICE Horstman & TAG

INSTALLATION

Insert Woodruff Key into crankshaft.

Slide clutch Drive Hub assembly onto taper of crankshaft. The tapers should be clean and dry. Be sure the keyway in the Drive Hub is aligned with the Woodruff key.

Install the Coned Safety Washer with the dome facing outwards from the engine, and tighten the securing nut to correct torque. Loctite 248 can be used on this nut. Do not over tighten since this may cause cracking of the drive hub.

Install the Internal Thrust Washer with inner radiused edge facing towards the engine. Due to manufacturing tolerances, three sizes of the Internal Thrust Washer are available. It is important to install the washer that provides proper clearance to allow the sprocket drum to spin free after the crank Starter Nut is tight. The end float clearance for the drum is recommended as 0.25mm - 0.38mm.

Apply small amount of quality grease to the thrust washer and to the Roller Bearing and then slide the bearing onto the crankshaft.

Slide the Horstman Drum onto the shaft over the bearing, ensuring the drive lugs on the friction disc locate in the slots on the drum. TAG Drum just slides on over clutch shoes.

Install the External Thrust Washer with its inner radiused edge facing the engine and apply a little grease.

Place the Horstman Starter Nut or TAG crank nut on the end and tighten to 15 lbs/ft. The Horstman and the TAG clutch spanner holding tools are designed to prevent the crankshaft from turning while tightening the Starter nut. Do not hold other side of crank to do these nuts up! Once tight check that the drum spins freely and check its end float clearance with a feeler gauge. Different thickness internal thrust washers are available to adjust end float.

It is mandatory to use an ignition switch when racing with the clutch. With the Horstman this is easy to fit using a good quality heavy duty switch with waterproof cover rated at 40 amps. This can be mounted anywhere, though probably the most convenient place is through one of the steering wheel spoke holes. The on-off positions must be clearly marked. Suitable switches are available from Tal-Ko. The TAG system comes with PVL Green & Red push buttons complete with wiring and steering wheel mounting bracket.

STARTING ENGINE & ENTERING TRACK

When starting the Horstman or TAG engine be sure the driver is seated in the kart with the brake depressed in order to prevent any sudden acceleration. Also be sure that you have primed carb with fuel and the switch or push buttons are in correct positions for engine to start. Never remain stationary for longer than required as overheating of the engine may occur! Remember this is an Air Cooled engine and kart must be in motion for cooling of the engine to take place. When you pull off from stationary only use partial throttle to slowly move away until in full motion as stalling could occur!

Horstman Clutch (Only options are 10 & 11T)

The Clutch is designed to permit easy starting with a battery operated hand-held starter. The starter should have a 17mm ½" square drive bi-hexagonal extended socket attached. When the engine starts, the clutch will be in neutral until the engine reaches approximately 6000rpm. At about 6000rpm the clutch will start to engage and the kart will start to move.

TAG Clutch (Only options are 10 & 11T)

The Clutch is designed to permit easy starting with the TAG (touch & go) onboard starter system.

When the engine starts, the clutch will be in neutral until the engine reaches approximately 3400rpm. At about 3500rpm the clutch will start to engage and the kart will start to move.

Since both the Horstman & TAG Clutches engages at a low rpm, driving technique will be the same as a direct drive vehicle.

CARBURETTOR SET UP

When using the clutch the carburettor must be set to allow the engine to tick over. This is done by setting the carb-mounted throttle butterfly adjustment screw and low jet. First using the screw under the carb, set the throttle butterfly slightly open so that you can just get the tip of a 0.6mm feeler gauge between it and the bore of the carb. This is the starting point. You should then start the engine. Tickover should be

adjusted to about 5,000rpm for the Horstman and 3300 rpm for the TAG. Make sure the clutch is not biting which will happen if the tickover is too fast. If so turn out throttle adjustment screw located on side of carb. If too slow the engine will stall. It may be necessary to fine tune the setting of the low jet to get a smooth tickover. If the engine is too rich it will not run smoothly on tickover when hot or cold, turn the low jet in and the high jet out the same amount until correct tickover is achieved.

CLUTCH REMOVAL

Remove the crank Nut. Note: Special Horstman and TAG clutch holding spanners are designed to prevent the crankshaft from turning. Do not hold with the ignition side nut!

Remove the External Thrust Washer, Drum, Roller bearing and internal Thrust Washer. Note the TAG clutch uses a longer roller bearing compared to Horstman clutch.

Remove securing nut & Coned Safety Washer holding the clutch with the designed holding tools available for both Horstman & TAG. You can use an impact gun if required.

Remove the Clutch Drive Hub only using the special designed Clutch Extractor tools.

Remove the Woodruff Key from the crankshaft.

MAINTENANCE & REPAIR

Due to the extreme demands of racing, it is important to properly maintain your clutch in order to obtain maximum performance and reduce risk of clutch breakage or clutch slip.

Roller Bearing

Since the Horstman & TAG Clutch are dry clutches, there is no oil supply for the roller bearing. It is necessary to ensure that the roller bearing and thrust washers are lubricated with quality grease at all times as excessive crank wear could occur. Do not over grease as this could cause clutch slippage! Do not use copper grease! The roller bearing should be replaced whenever the drum or sprocket is replaced.

Sprocket/Drum Assembly

Oiling the chain before each track session will increase the life of the sprocket. A worn or chipped chain should be replaced as it will quickly wear out the sprocket. The sprocket should be replaced when the teeth are worn or hooked. For maximum sprocket life use a long chain with the engine set forward. This will maximise the number of teeth engaged. The TAG sprocket is made separate to the clutch drum, unlike the Horstman, and can be replaced without a new drum. A new roller bearing should

be fitted in conjunction with fitting new TAG or Horstman sprockets. This bearing must be greased at all times. The TAG sprocket is fixed in position by 4 off M5 x 10 CSK bolts. Use Loctite 243 on these bolts.

Friction Disc Horstman

The friction disc has a steel core with ceramic friction material bonded to the surface. It should be inspected after two hours of use. Replace if friction material is cracked or worn below 2.90mm thick. It should give many hours of use.

Clutch Shoes TAG

The 3 clutch Shoes are made from Aluminium with clutch shoe material added to them. When this material wears done or the 10mm pivot mounting holes wear they should be replaced as a set of 3 with new clutch springs. Do not fit miss matched worn shoes with new as performance of clutch will be reduced causing overheating and power loss.

Springs Horstman

The 3 springs are made from stainless steel. They will last many hours and only need to be replaced when broken, damaged or collapsed below 12mm free length. Only change in sets 3.

Springs TAG

The 3 springs are made from steel. They will last many hours and only need to be replaced when broken, worn, and damaged or when new shoes are being fitted. Only change springs in sets of 3 and note they have different ends so only fit correct way round.

Pressure Plate Horstman

The pressure plate is precision ground on the surface that engages the friction disc. This surface should be checked periodically for distortion and wear. Replace when badly distorted or worn.

Drive Hub Horstman

Remove the levers from the drive hub, check for wear in the slotted area. Badly worn slots will cause poor performance.

Drive Hub TAG

It is not necessary to remove the starter ring gear from the clutch hub to service the clutch but this is done by undoing the 3 off M8 x 10 CSK retaining bolts. Starter gear should then just push off by hand. Remove the 3 circlips and washer from the shoe mounting dowel pins and push pins out to enable you to remove shoes and springs. Check for wear both in the shoe dowel pin holes and dowel pins. Badly worn parts will cause poor performance and failure.

Levers Horstman

The pivot hole in the lever is subject to stress due to frictional loading from centrifugal force. This causes the pivot hole to eventually elongate. Inspect the levers for pivot hole wear whenever you rebuild the clutch.

Dowel Pins Horstman

The dowel pins must absorb high stress from the levers. Replace as part of a major clutch service.

CLUTCH ASSEMBLY

Clean parts with disc brake cleaner. Disc brake cleaner comes in an aerosol can and is available at most automotive parts stores. Avoid soaking TAG clutch shoe material with cleaner. **Do not use petrol to clean the clutch!**

Horstman Assembly

Apply small amount anti-seize copper slip to the dowel pins. Slide dowel pins into the levers.

Insert into the drive hub assembly. Insert pressure plate onto the drive hub. Use a small quantity of copper slip on the triangular corners to ease movement.

Place each spring over a corresponding pressure plate stud.

Apply **Blue Loctite 243** to threads of spring retainer. Next screw the green retaining nuts onto each stud until just tight. Torque to 2/3 lbs/ft. Check that the distance from the top of the retaining nut to the drive hub face is 6.25mm +- 0.25mm (See item 4 in Horstman clutch fiche)

Lay the friction disc onto the flat side of the pressure plate.

Place the fixed plate over the drive hub and align the 3 holes in the fixed plate with the drive hub holes.

Apply anti-seize copper slip to screws and insert into the bolt holes in the hub. Tighten screws to 1 lbs/ft. **Note these screws should not be over-tightened or they will be difficult to remove.**

The Horstman Clutch is ready for installation on crankshaft.

Refer back to clutch installation.

Please Note:

If you are having an older type engine (before No 3499) converted to use with a Horstman clutch, only Tal-Ko are permitted to carry out the special machining operation needed to increase clearance on the outer face of the drive side

crankcase of the engine. This work offers no performance advantage. Speak to Tal-Ko for details of this free service.

TAG Assembly

Place clutch spring in the clutch hub spring retaining hole first. Then place other end of spring into the shoe spring retaining hole. This will require a pair of thin nose pliers and the spring and shoe positioned to give best access to clipping spring into this hole and then put shoe in correct location in hub. Remember the spring has different shaped ends so it is vital to fit springs correct way round. Repeat this on all 3 shoes.

When all 3 shoes & springs are located in the hub then insert each shoe mounting dowel pin by gentle pulling shoe out against its spring so the dowel pin slides through. When all 3 shoe dowel pins are in position place each washer & circlip on pin ends. Ensure each circlip is a snug fit in the circlip groove. If in doubt, always fit new circlips without over stretching them to fit.

Refit starter ring gear to clutch using Loctite 243 on the 3 off M8 x 10 CSK retaining bolts.

TAG Clutch is ready for installation on crankshaft.

Refer back to clutch installation.