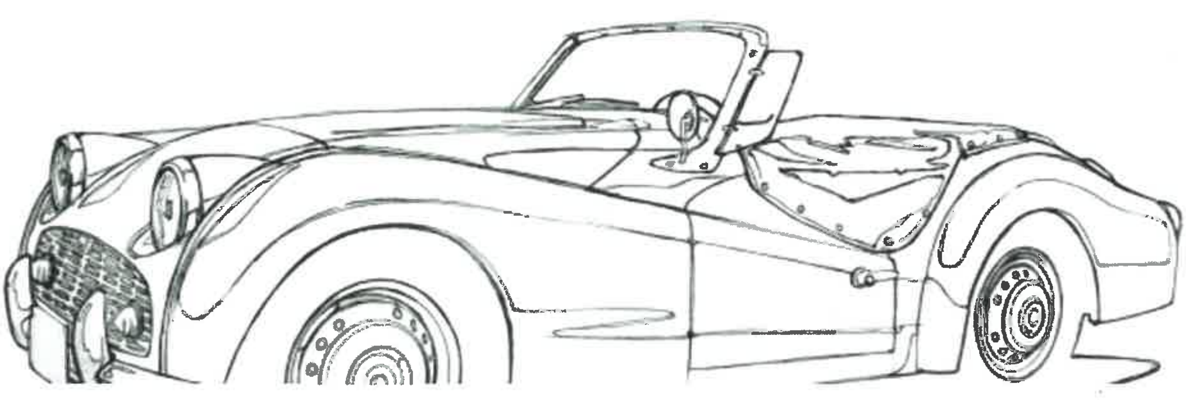
Technical Tips 3

TR Register Australia inc



Technical Tips 3

This is the third edition of technical articles collected and published for the benefit of members of TR Register Australia inc.

These technical tips are to be read in conjunction with formal technical articles available in published books and on the web, they are tips from other TR enthusiasts who have encountered problems while working on their TRs and have recorded their solutions. The Committee does not endorse these tips but simply offers them as member's experiences.

The Committee wishes to thank the various authors for their time and commitment to record and share their knowledge for the benefit of others.

The internet contains a vast amount of information on various home websites and forums and sometimes this information is cumbersome, irrelevant or too formal and it is refreshing to read these tips as direct, informal solutions to problems we face every day with restoring and maintaining our 60 year old cars.

Some of these articles may refer to overseas suppliers or out-of-date prices, but the main content of the articles is still very relevant.

These Technical Tips, as with all other TR Register services, produced and sold on a non-profit basis for use by our members.

The TR Register Committee wishes to thank you for your support and wish you many miles of trouble free motoring whilst enjoying this booklet.

Gavin Rea
Treasurer
On behalf of the
TR Register Australia Committee

Contents

General Specifications

What colour are your TR bits painted?

There has been much discussion on the colouring of various items but this is the best I have been able to ascertain from speaking with various original owners, vehicle experts and show buffs.

Engine Bay & Mechanicals

Black-flat (use a high temp scratch resistant paint for engine and mechanical components)

- Engine block and cover plates
- Water pump housing
- Generator (main housing) - end housing is bare metal
- Starter
- Brake/clutch canister and cap
- Pedal box
- Radiator
- Half round clips for brake and clutch pipes
- Springs & suspension plates & tie rods
- Differential housing
- Rear leaf springs
- Bumper mount irons
- Steering box, outer shaft and mounting brackets
- Wiper motor mounting plate
- Horns
- Fan (except for blades which are natural polished aluminum)

Mat Black

- Rear brake drums - (Hi-temp)

Black Glossy

- Air cleaners
- Oil filler cap (Was also available in silver fleck paint)

Unpainted Bare Metal finish (polished if you prefer it that way -
If God wanted it to be chromed he would have done it that way at the factory :) Don't chrome, use a high speed metal polishing wheel and buff to a high reflective luster. If you wish you can apply a protective clear coat to the polished bare metal!)

- Fan blade
- Front calipers
- Brake lines
- Starter solenoid
- Flasher unit
- Fuel pump
- Wiper motor gearbox & front and back wiper housings
- Distributor housing
- Thermostat housing
- Brake and clutch cylinders
- Carburetors & float bowls
- Oil filter mounting
- Coil and coil mounting plate
- Radiator cap
- Body number plate (brass)
- Tie rod ends

Silver Hi-Temperature paint

- Intake Manifold
- exhaust system & muffler

Chromed

- Valve cover, TR2 satin black
- brake lever
- Windscreen frame, windscreen mounting arms and those 2 small triangular corner plates that hold down the bottom windscreen rubber
- Bumpers, bumperettes and upper support brackets for front bumper
- Hood & trunk hinges
- Exterior door handles
- Door latch plate
- Dutz fasteners
- lift the dot studs and snaps
- Tailpipe
- Headlamp covers
- gauge and switch rings

Painted body colour

- Engine compartment
- Retaining bolts for wings and nuts & bolts on firewall
- Retaining bars for radiator
- Hood and trunk props
- Spring bracket
- Heater hose brackets through firewall
- Dutz Brackets
- Door hinges

Painted Light Teal (color similar to 1979-80 Chrysler SG4) DuPont Centari acrylic enamel # 45727A

- Oil filter sleeve housing

Dark Green

- Circular turn valve handle on heater water flow valve

Medium-dark Grey Metallic

- Housing for wiper motor (There were various colours for this housing, best to ask)

Silver metallic

- Wheel rims spoke wheels
- Side curtain leg irons

Interior

Painted with black crackle paint

- Gauge mounting plate
- Heater louver cover (bottom of heater)

Flat Black

- Hood stick frame
- Small bracket for windscreen vibration rubber
- Rear view mirror

Dull Silver

- Sidescreen curtain mounting brackets

Trunk

Flat Black

- Board covering gas tank

Chassis Frame

- Frame colours are generally black but many frames were painted by the factory with excess paints that were lying around at the time so it is not unusual to find original frame colours of blue, red, orange brown etc...... When repainting a frame to original, it is best to scrap off the dirt and grime to see what colour is residing underneath. It may surprise you to find your original frame painted in one of these weird colours which have no bearing to the original body colour.

Here Are A Couple Of Basic Tips:

Front Bumper - The repro bumpers which are currently available have a flare on either end and don't "fit" exactly the same way as the original. If you look at 2 cars side by side there is a noticeable difference as the repro flares outward on either end.

Door pulls - Door pulls are supplied as bicycle cables ...... save yourself the cost of a special order and just get a length of black bicycle cable (with a lead stop on both ends) and cut to size - a 5 or 6 ft cable is sufficient for both doors

Front Grill - the repro front grill has a duller finish than an original grill. Originals are chromed aluminum. Original grills are very hard to come by but if you do have an original grill try to straighten it out and salvage it

Lift the dot studs - The original small male studs are slightly different than the repro. If you have original studs try to have them re-chromed, if not order replacements from Roadster factory as theirs are the next best thing. Same applies for the windscreen studs

Flasher units - These cars use a different flasher unit that what you will find in most auto parts stores. Heavy duty Triton units will work fine if you can find them.

<u>**General to all models**</u>

Water pump - The original water pump is no longer available and the repro pump does not have grease fitting as the sealed bearings don't require it to be greased. The body of the new pump casting is more "beefy" on the flanges and is slightly different on the front face. There is some extra metal on the casting which will interfere with the rotation of the old style pulley, so you will have to grind down a small amount bit of casting if using an old pulley with a repro pump.

Tip: Some folks will drill and tap a hole in the new style repro pump and install the grease nipple. If you do that the new and old style pumps are almost indistinguishable to the discerning eye.

Lift the dot snaps - these should run vertically on your tops and tonneau's with the narrow end pointed upwards

Interior kits - Kits are available in many colour combinations but may not be correct for your year and model. If you are replacing an interior and wish to go to a different colour, make sure that it was originally available for that year.

Carpet sets - The original cars came with a simple loop pile carpet. Many parts suppliers offer better quality carpet sets. If you want original, stick with simple. Originally they covered the area behind the seats, under the seats and the tunnel. The floor in front of the seats was covered with a rubber mat which extended up onto the firewall about a foot, and was secured by two clips at the top. The rubber mat covers the edges of the tunnel carpet.

Boot carpet kits - these are great to have to protect your boot but don't glue them in place if you are planning to show the car. The only thing that should be in there is the "Hardura" trunk floor mat

Exterior paint colours - If you are repainting your car, there is nothing wrong with changing the colour, but try to stick with an originally available colour. Many colours were not available in any given year so you should consult Bill Piggott's "Original TR 2/3/3A" for what was offered and make sure it also goes with the then available interior colour. Original paint on these cars was Enamel which cracked after 5-10 years so you are much better off painting your car with modern day durable type clear coat paint.

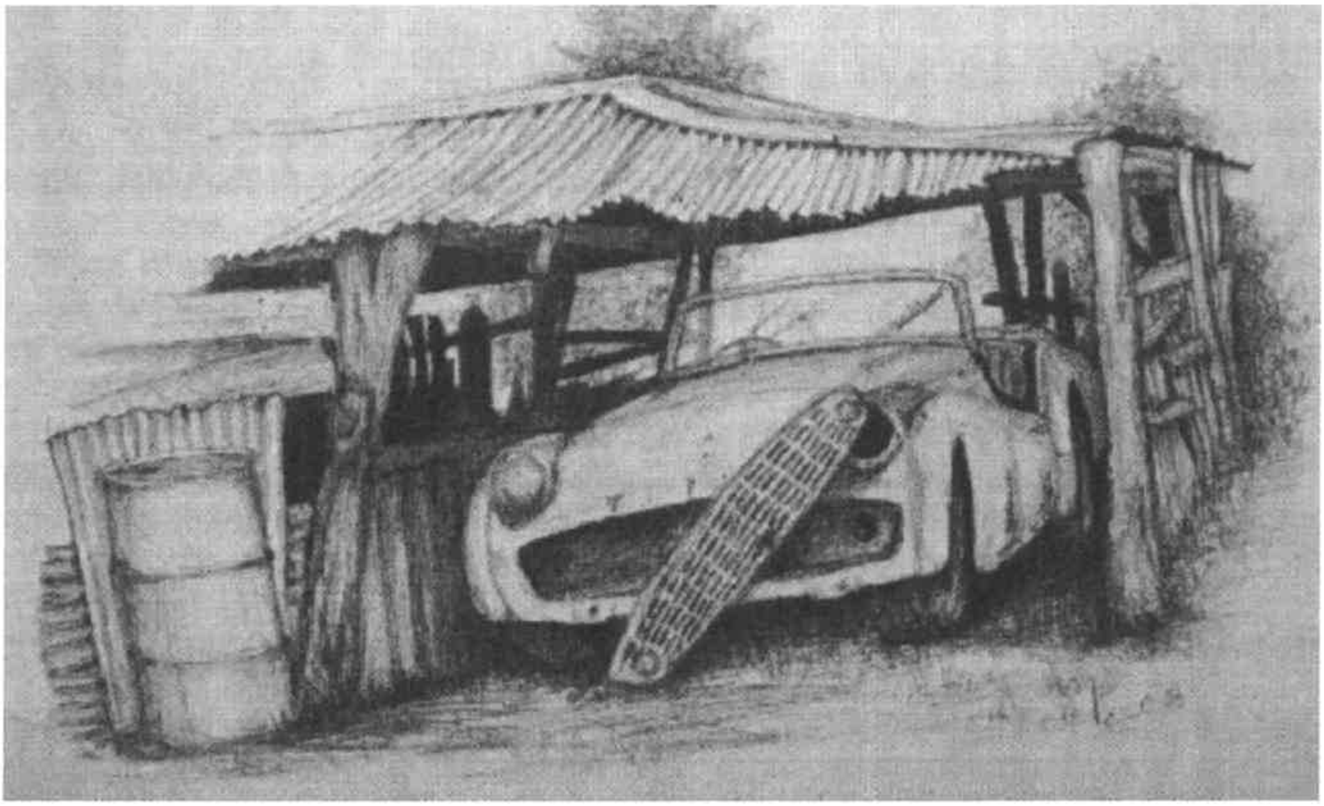
Screws - All screws are slotted type except those that hold the front grill in place. Don't order a bunch of screws and small hardware items from the parts suppliers, you will pay 5 or 10 times what the item will cost you at a local Bunnings. (Same applies on bolts and nuts)

Bolts and nuts - with the exception of motor bolts, all bolts are fine thread imperial type. Remember to use grade 5 bolts on all steering and suspension components!

Rebuilding carburetors, brake cylinders and shock absorbers - This is best left up to professionals unless you know what you are doing.

Motor head rebuilds - When rebuilding plan on installing hardened "stelite" faced valves with Silicone - bronze guides and hardened exhaust seats. This will allow you to skip having to add a lead additive with every tank of gas.

Fuel and brake lines - If you know what you are doing, get a small pipe bender, cutter and a double flaring kit and make your own lines. Brake lines are 1/8 ID pipe, (pipes to master cylinders are 3/16') fuel lines are 1/4". Make sure to double flare all ends and use white silicone sealant on threads to prevent leaks and TIGHTEN UP THOSE FITTINGS. Nothing more heartbreaking than finding brake fluid leaking on fresh paint. Rubber hoses for gas lines connections are 1/4" ID.



FACTORY STANDARDS

COMPILED BY BILL REDINGER

ORIGINAL EQUIPMENT ACCESSORIES: 1957 TR3

Soft top model	$2625.00
Hard Top Model	2790.00
Accessories:	
Heater	39.50
Wire wheels (5)	110.00
Chrome wire wheels (5)	199.75
Whitewall tires (5)	19.00
Overdrive	160.00
Adjustable steering	19.75
Rear seat	62.50
Windshield washer	17.25
Fitted trunk suitcase	48.00
Radio	125.00
Tonneau cover	35.00
Michelin X tires (5)	10.50
Soft top kit for hardtop	99.75

Competition equipment:	
Racing windshield (each)	21.50
Skid plate	6.75
Competition rear shocks	4.00
Competition front springs	4.00
Alfin brake drums (2)	76.00
Aluminum engine sump	19.75
Dunlop high speed tires (5)	23.75

All prices quoted F.O.B. ports of entry. Some prices higher at west coast. Prices were applicable only when ordered as original equipment. Information supplied by Bill Redinger.

TR2 ENGINE TEST (PRODUCTION)

Dual Drive Running-in Stands.

Description of Operation	*Time (Mins)*
Load engine on stand	8
Slave at 1000 rpm	20
Change over	16
Fire at 1000 rpm.	20
Unload engine	8
	72

Brake Test. Engine fitted with air cleaner and dummy sump. Fan belt not fitted. Shop exhaust system.

Room temperature taken and B.H.P. corrected to 60° F., 29.92 Hg.

Every Engine	
Load engine	10
Run at 1000 rpm light	15
Run at 1000 rpm under load	10
Run at 1500 rpm light	15
Run at 1500 rpm under load	10
Run at 2000 rpm light	10
Run at 2000 rpm under load	5
Run at 3000 rpm light	10
Run at 3000 rpm under load	5
Run at 4000 rpm light	10
Run at 4000 rpm under load	5

Allow engine to cool, adjust carburetor, take power readings at:-

1000 rpm acceptable average B.H.P.	(17)
1500 rpm acceptable average B.H.P.	(29)
2000 rpm acceptable average B.H.P.	(40)
2500 rpm acceptable average B.H.P.	(52)
3000 rpm acceptable average B.H.P.	(63)
3500 rpm acceptable average B.H.P.	(73)
4000 rpm acceptable average B.H.P.	(81)
(Take readings up and down)	
Unload engine	10
	180

Total time — floor t[illegible]or *(all engines) 252 minutes.*

Maintenance

Minor Mechanical Checklist to Ensure Cars Roadworthiness

- Drain engine oil, replace oil filter element and fill engine with oil
- Change sparkplugs (TR2-3 - Champion L.10.S TR4 - Lodge CNY) plug gap on a TR3 motor is 0.032" for a TR4 motor it is 0.025"
- Change condenser and points.
- Add a drop of lightweight oil to distributor shaft beneath rotor
- Check distributor cap for cracking or corrosion of contact stems - replace cap if necessary.
- Check distributor wires for brittleness -change wires if necessary
- Check that wires are on correct plugs (firing order is 1,3,4,2,,,#1 is at the front end of the motor (remember distributor rotates counterclockwise)
- Check fan belt for fraying or brittleness -change if necessary. Loosen generator adjustment bolt and apply pressure downward onto generator with a crowbar until there is approx. 1/2" of play when pushing against the middle of the belt with finger. Tighten bolt.
- Close fuel valve or clamp fuel intake rubber hose line before fuel pump with vice grip. Detach glass fuel bowl located on underside of fuel pump casting and clean out sediment from bowl and screen
- Replace any inline fuel filters if installed.
- Unscrew carb float bowl lids, drain fuel and empty sediment, check float needle valve operation and check float gap level
- Detach & clean air filters (if metal type soak in varsol or degreaser)
- Check rubber fuel lines for brittleness and leaks especially near clamps (change if necessary)
- Flush radiator with radiator flush and replace coolant with new antifreeze/water (mixture of 50% antifreeze and 50% water)
- Check all radiator hoses for brittleness and leaks
- Top up brake fluid Check all brake and clutch lines for corrosion and bleed all 4 brakes and clutch.
- Top up carburetor dampers with lightweight damper oil
- Check transmission oil fluid level
- Time engine:
  1) Set vacuum advance to zero mark on distributor and loosen distributor clamp bolt.) Remove #1 spark plug and turn the engine over by hand so that the No1 piston is coming up to Top Dead Centre (T.D.C.) on the compression stroke. (you stick your finger into the #1 spark plug hole and feel the pressure develop in the cylinder)
  2) Continue turning the engine by hand until the timing mark on your bottom pulley is aligned with the timing pointer. (the timing mark on the pulley is a tiny hole toward the outside edge) You will then be at T.D.C.
  3) Turn the knurled Vernier nut on the distributors vacuum advance so that it is at the first division (i.e. zero)
  4) Rotate your distributor to the highest point on the cam and set your point gap to 0.015", tighten the points and tighten the distributor holding bolt
  5) Turn the Vernier nut of the vacuum advance and set the indicator to 8 degrees for TR3 motor or 5.5 degrees for TR4 (each division corresponds to 4 degrees)
  Voila! But remember that even after you time according to the manual, plan on doing some fine tuning of the distributor position on the road. It is an imprecise science :)
- Synchronize carbs, adjust jet mixture and set to proper Idle RPM (600-700 RPM
- Check tyre pressure; verify lug nuts are tight on each wheel. In the case of wire wheels ensure that spokes are all tight. Change any spokes that are damaged.
- Check ball joints, tie rods and steering for excessive play
- Check universal joints for excessive play
- Check fluid level in differential
- Grease all ball joint, king pin and steering joint grease nipples (and water pump if original type)
- Check suspension - replace broken coil or leaf springs and worn shock absorbers
- Verify exhaust system - replace broken manifold studs, corroded exhaust pipes or muffler
- Adjust handbrake
- Verify turn signals, brake and headlamps for proper operation.

This is all great. Now how do I actually change my oil?

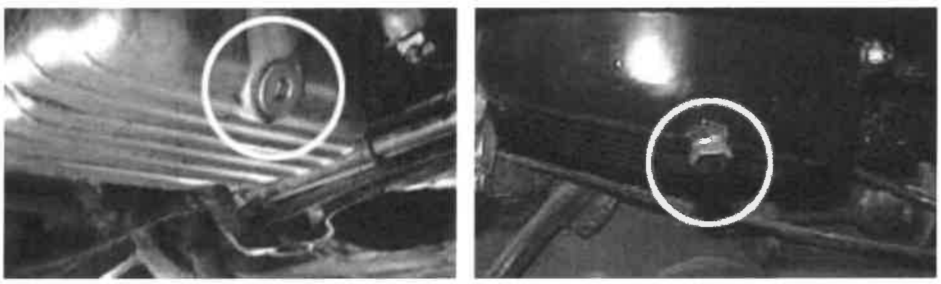
A good number of readers will get to this point in the page and think "this is easy - I could do this!", and for the most part, you can. Below is a generic, idiots-guide to changing the oil in your engine. It's not specific to any particular car but ought to cover most engines.

Before you start, you'll need the following:

New oil (duh!), a drain pan, an oil funnel, rags, a socket wrench set and / or hex wrench set (Allen wrenches) , an oil filter remover, a new crush washer, nitrile gloves (not latex - mineral oil eats latex gloves) , engineer / shop manual, if one is available

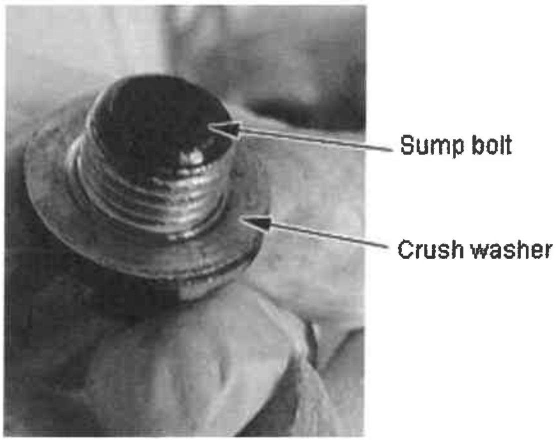
1. Start your engine and run it for a couple of minutes to get some heat into the oil
2. Leave the engine to stand for 5 or 10 minutes. When you started it, it heated the oil but it also filled the oilways. You want the oil to drain back to the sump.
3. Take the dipstick out or loosen it off and break the seal where it plugs into the engine dipstick tube. This prevents a vacuum building up behind the oil when you start to drain it.
4. Get your drain pan / oil container and stuff it under the sump. Make sure it's sitting under the sump drain plug. I really like the combined drainer / container types. They look like regular oil containers but if you lay them on their side, there's a pop-out plug. When you drain the oil, it runs into the side of the container, then you can put the plug back in and use the same container to take the oil away.

5. Put your rubber gloves on. Try to use the disposable type. Your mum / wife will never forgive you if you use the washing-up gloves. Remember - used oil is toxic and carcinogenic. If you get it on your skin, it could cause problems. Use your socket wrench or Allen wrench to loosen the sump plug just slightly. Once it's loose, remove it by hand.



6. Be amazed as the black syrup runs out of the engine and into your container. Be more amazed how, if it's windy, those last dregs just won't hit the container no matter where you put it. They will however go all over the road/garage floor/cat.
7. Remove the old crush washer from the sump plug and throw it away. Replace it with a new one. Use some of the oil from the drain container on the end of a rag to wipe around the drain hole in the sump. This will help clean any mess away and leave you with a smooth surface. Screw the sump plug back in by hand until its finger tight and then use your wrench to crush the washer. This

can vary from a quarter turn to a half turn. Don't overdo it or you'll strip the threads. Similarly, don't leave it too loose or it will fall out. If in doubt, use a torque wrench set to the value indicated in your shop manual.



8. Now get your oil filter remover out. Push the oil drain container under the oil filter - when you spin it off, there will be *a lot* of oil comes out. Use the filter remover to grip the oil filter and spin it off anticlockwise. 99.9% of oil filters take some muscle to get going. This is why a filter remover is a must-have. Stabbing the filter with a screwdriver and using brute force may work, but you'll be finding oil all over yourself for weeks to come if you use that method. Apart from that, some cars have aluminium inserts that protrude out of the engine block into the body of the filter, so firing a screw driver into the filter near its base (the strongest part) may shear that aluminium bit off the engine block. That Would Be Bad. If you really can't lay hands on a filter wrench, try sandpaper - wrap it around the filter, sand-side-in and grip the paper backing - you might be able to spin the filter off like that.
   Once the filter is finger-loose, spin it off by hand. (these things below are filter removers)

9. Clean off the face of the oil filter mount on the side of the engine block using a rag. Use a little oil on a rag to wipe around the seal of the new filter and spin it on by hand. Once it's locked against the side of the engine block, another quarter-turn by hand is normally enough to secure it in place.
10. Pull the drain container out from under the car and use a rag to wipe down any excess oil that has spilled down the side of the engine block. Pay attention around the sump plug and the filter. These are places you'll be checking later for leaks so the cleaner they are now, the better.
11. Use a little WD40 on the oil container and an old rag to clean the remaining oil down into the container. Put the plug back in and make sure it fits snug. That's your waste oil. Don't drink it.
12. Up to the top of the again engine now. Put the dipstick back in. Find the oil filler cap and take it off. It might say "OIL" or it might say "710". It is not a "710 cap" as one person once asked for. "710" is "OIL" upside-down. Some people need to be told....
13. Look in your shop manual for the system capacity with filter change. This will be more than the capacity *without* a filter change. A lot of oil containers now come with capacity marks on the side of them. Put your oil funnel into the oil filler hole and pour in the right amount of oil. Do it slowly. If you do it quick, you'll get airlocks and the funnel will burp oil in your face.
14. Once you're happy you've got enough oil in there (check it with the dipstick if you're not sure), remove the funnel, replace the oil cap and replace the dipstick.

15. Pull the main high tension wire from the distributor cap or in some way disable the engine so that you can crank it over but it WILL NOT start. (Note: you might want to pull out the fuel pump fuse too - if you crank the engine without it starting, it will still be pumping fuel - that could cause a backfire or damage the catalyst). Crank it over until the low pressure light goes off, and another 15-20 seconds for good measure. You are pumping new oil into the empty filter and then expelling all the air from the oil lines and cavities.
16. Replace the high tension lead (and fuel pump fuse) and start the engine and let it idle for a minute or so. Stop the engine. I don't want you crawling under a car to look for leaks when the engine is running. There are so many things that can go wrong with spinning fan blades, belts, human hair, clothes, fingers and the odd dodgy auto-gearbox that will slip into "D" and run you over.
17. *With the engine off* have a look at the side of the engine block around the oil filter. Check the area around the sump drain too. Both should be as clean as you left them with no sign of leaks. If there's a leak, a little tightening of the drain plug or filter should cure it.

One reader suggested and additional step before (9) above. When he changes his filter, he fills the new one up with clean oil and waits for it to soak into the filter itself. Once he's satisfied that the filter is soaked, he pours the excess oil out of the filter and *then* screws it on to the engine.

Job well done. Now you should have hands that smell of talcum powder and rubber (from the gloves), a couple of greasy, slippery tools and a container full of old oil. Oh, and a crush washer and filter. If you've got more than this, you took something off that I didn't tell you to. If you turned the engine off before checking for leaks, you should also have a full complement of fingers, hair (if you had it to start with) and you should still be fully clothed. Congratulations. You've changed your engine oil.

Extracting Broken Bolts and Studs

OOPS!

You suddenly find yourself with a wrench in one hand with part of the bolt or stud you were trying to extract, and the rest of it still in the manifold/head/block/suspension bit? Congratulations - you're about to have an adventure.

I've been there. After you've worked on old cars for long enough, it's inevitable. The most recent occasion was on my TR4A, where someone had used a piece of threaded carbon steel rod to replace an exhaust manifold stud. You can get the remains of the stud out without removing the head.

You will need:

1. patience
2. Dremel tool with small grinder bit (carbide is best)
3. patience
4. heat wrench (propane, MAPP or oxy-acetylene torch)
5. patience
6. reversible drill
7. patience
8. collection of ezi-outs and left handed drill bits to match, plus drill stops
9. patience
10. a drilling template
11. patience
12. sharp punch and hammer
13. patience
14. penetrating oil
15. patience
16. a properly sized tap
17. patience
18. a little luck

A scribe and a small round file may help. You might want some extra patience, too. If you get frustrated in the middle, take a break and come back to it the next day.

Extra credit trick for those with the appropriate tools and skills: if there's any of the piece sticking above the surface, try welding a nut, one size smaller than the threaded portion, to the broken stub. Weld the inside. The heat from welding may break the corrosion bond, and the nut gives you something to grab and turn. Be careful.

The starting trick is to get a hole drilled into the centre of the stud. This is the point of the drill template - I made mine by copying the holes in a manifold gasket. Make the hole you're going to drill just larger than your starting drill bit size - I usually start at 1/8 and work up, but it will depend on what left handed bits you can find. You can make the template out of plywood; aluminum plate is better. You want adequate thickness to make sure that the drill bit is at an exact right angle to the manifold face. If the item is broken off significantly above or below the surface, you may be able to buy/make a bushing that surrounds the stub (or fits the hole) and use the ID of the bushing as the starting drill size.

Drill. Use the drill stops! You don't want to drill deeper than the broken piece. Make a good centre punch to try to keep the bit from wandering (especially if you don't have a drill template). Chances are that you won't get the hole dead centre, because gaskets aren't made perfectly; do the best you can. Go up in size until you are in danger of cutting into the threads in the head; inspect often with a mirror and flashlight (tip: point the flashlight into the mirror).

If you're very lucky, the heat and vibration of drilling will break the bond. This is why you want left-handed bits - if this works, you'll pull the piece out, rather than driving it further in.

Use the EZ out. There are two sorts - straight fluted and twist fluted. I prefer the straight ones, because all the force is used to turn the broken stud, rather than twisting the Ezi out in further. But the twist ones are more amenable to weird hole sizes. Chances are that you won't get anywhere with the EZ out, but try it anyway. Don't break it off, whatever you do.

Heat the area with the heat wrench, spray on some WD-40, and wait. Repeat several times. This might help, it might not. Try the Ezi out again. Repeat until you're frustrated and ready to go on to the next step, or, if you're terribly lucky, the blasted thing comes out. (It may take several days of this cycle to succeed. If you're not in a hurry, this is the safest way. The hotter the torch the better - try to get the part red hot.)

There is a new generation of tools that combine left handed drill bit and ezout and even claim to centre themselves. They're very expensive, so I haven't tried them yet. They just might make this job a little easier.

I will usually try a small impact wrench at this point: find an 8-point socket that fits over the square end of the ezout and blast away. This sometimes works. Don't be surprised if it doesn't. And, again, try not to break the ezout.

If you're now to the point where the next larger drill bit will start removing threads, you have to proceed carefully. Using mirror, flashlight and dremel tool, grind outward from the hole you've drilled. Eventually, you will start to see the ridges of the thread cut into the head poke through the stud material. You can get away with removing a small amount of the crest of the thread - this will make the stud fit a bit poorer, but probably won't matter much. At this point, you can try using the hammer and punch to rotate the fractional piece of the stud in the threads.

You can also take the file to the hole and enlarge it, and then try the two above methods.

Finally, you can use the file (or a small grinding point on a Dremel) to remove the first couple of threads of the stud (using the scribe to pick the pieces out of the troughs of the manifold thread).

When you have achieved this state, you can start using the tap to remove the remaining metal. Best is a tap with a tapered start, so you can get some purchase in the hole you've drilled; once you've removed a bunch of the metal, you can switch to a plug-style or bottoming tap to clean out the deeper grooves. Chances are that the trapped material will break off in complete rings, which you want to remove - pull the tap and use a sharp object to try to clear these out before tapping more. You want to reverse the tap often in order to clear the shards. Use the tap to essentially tap a new hole - you want to go about 1/8 turn at a time, cleaning the tap every time. You'll probably lose the first couple of threads in the manifold, but that shouldn't matter much.

I spent three or four evenings in the process of removing a broken stud from Sarah's head. It was not pleasant, but it beat the hassle and expense of removing the head.

I have spent weeks getting a stuck tapered plug out of a cylinder head. Like it says in the list above, patience is important.

Oops again...

So you broke off the EZ out? Now you're in bad shape. Take the part in question to a machine that has a plasma cutter or an EDM (Electrical Discharge Machining) machine and get them to remove the remains. They'll cut that sucker out in nothing flat, very precisely. It probably won't even cost much, but you *will* have to remove the part in question.

If you're good with a welder and brave, you can try welding a piece of stock to the broken bit to give yourself some purchase to turn it all.

How to avoid this

When you get it all done: make sure you use anti-seize on the new studs before you install them, so you (or the person you sell the car to!) won't have to go through this the next time. On an exhaust parts, use brass or stainless steel nuts and lock washers, so they don't corrode in place (TRF sells the brass nuts, as do most auto parts stores; go to a marine supply for the stainless kit). ARP is starting to manufacture stainless studs for British applications, but I don't think they have any for Triumph yet.

Chrome Plated Parts:

Construction, Cleaning and Preservation

I have been dismayed by the degradation of some chromed pieces on cars in near regular use and cars sitting awaiting their turn for restoration, even though they sit in a garage and are exposed to neither sun nor rain. Having asked around some on how best to clean and preserve these pieces, I thought I would pass along my observations and see what others can add to the subject. I knew that the wrong solvent on glass can cause cracks to propagate and was worried that the wrong treatment of chrome could accelerate its demise.

Our metal parts are usually either painted or plated to prevent rust or corrosion. Steel parts are mostly iron and if left bare will rust with water contact. Bare aluminum parts with oxidize and form a dull then white powdery exterior when left exposed to the elements. Both materials can be electrochemically plated with other metals less susceptible to corrosion from the elements. When steel parts are chromed they are not just plated with chrome as the chrome will not "stick" well to the steel directly. Usually parts are first plated with copper which sticks to steel, then nickel is plated to the copper as chrome will not survive long when plated on copper. The nickel coating can actually be fairly thick compared to the chrome or copper. Finally chrome is plated over the nickel. Some of the early pre-war cars left off the chrome outer coating and were just nickel plated over copper. Both plating processes involve submerging the part in baths with free ions of either copper, nickel or chrome. An electric current is used to force the metal ions into plating out on the part. The electric current is applied between your part and an electrode in the bath. This means your part needs to have an electrical connection somewhere and at this connection a spot will be visible after plating. It can be attached on the back of a part or in a non-important area. If you have unusual parts plated you might specify where to make the connection or risk a flaw in the plating in the wrong spot. The plating is generally very uniform in thickness and thus any surface irregularities in the part are seen in the final product. Chrome and to a lesser extent nickel are very hard metals and scratches generally cannot be buffed out once they are plated. Copper is softer and some buffing is possible after plating and before application of the nickel and chrome plating. Deeper scratches must be polished out or filled in prior to nickel plating. Preparation of the part for plating is sometimes 90% of the work in plating parts. This is where you can save some money if you can get much of the surface preparation done before handing the part to the plater. The expense of electricity and the metal ions in the bath is small compared to the labor of preparation of you part for a good finish.

The steps in plating parts are:

Stripping: Plating needs a bare surface so any old chrome, nickel or copper plating, as well as any paint or other coating will need to be stripped. Removal of the old plating may need to be done by the plating house. Polishing: The part needs to be polished to ensure a good finish. Any flaws will be visible in the final product. This is done by sanding the part with various grades of sandpaper, working from a very rough to very fine sandpaper. For severe pits lead or brass can be used to fill the pits or scratches and then polished.

Electroplating: The standard for chrome plating is triple-plated chrome, which typically means that the part is first plated with copper, then nickel, and then chrome. More steps can be added by applying additional protective layers such as copper, nickel, a second copper coating, a second nickel coating, and then chrome. This allows another polishing step on copper to remove blemishes. The copper can be buffed to a brilliant shine and any flaws fixed before nickel plating. There are two types of chrome plating used, hexavalent chrome and trivalent chrome. Hexavalent chrome produces a brighter, show-quality finish; trivalent is slightly darker chrome plating. Hexavalent plating is more dangerous to the people doing the work so most are now using Trivalent plating. The difference is only visible to me if you put one from each type next to each other. The lesson here is to do all the chrome in the same process if you are really picky on the match.

Final Inspection and Buffing: If close inspection shows any blisters, waves or other imperfections the part may need re-chroming. This is essential for long-term durability; even the tiniest blister can grow and spread after a few years, ruining the piece.

Plating Plastics

It always amazed me that chrome could be plated to plastics. If there is interest, I'll look into this more. It is interesting to note that plastic parts can be re-plated and apparently the cost is not outrageous. It's still going to be better to buy NOS if available.

Maintenance and preservation of Chrome parts on your car

The spotting and deterioration of the chrome finish is apparently a result of electrolyte getting into micro cracks or flaws in the chrome plating and causing electrolysis between the dissimilar metals in the plating process or rust of the base metal. The electrolyte in most cases is water or salty water. Battery acid would be a disaster. The goal for preservation of the plating is to minimize any flaws in the plating and to keep anything that could consider and electrolyte out of the flaws. This means water, particularly salty water is the enemy and anything that prevents water from getting to the chrome is the cure. I found a note from The Henry Ford Museum which recommends,

"Clean bright work once, and then protect it with a coating. Every time a metal surface is polished, material is removed, so it is important that the metal surfaces are thoroughly protected to maximize the time between each polishing. All elements to be polished should be removed and disassembled to prevent polish residues from collecting in recesses and to simplify the coating procedure. The cleaning and coating of one brass headlamp can take as long as three days. Use a mild polish such as Autosol, and then clean off polish residues with acetone and mineral spirits before coating. Watch out for intentionally painted areas, particularly in stamped lettering. Never use a buffing wheel or any powered abrasive methods to clean bright work. Nickel-plated surfaces can be very thin and are probably worn thin from previous polishing. Coat all brass and nickel surfaces with an acrylic such as Incralac for the best aging properties. Since this work requires the use of solvents, as well as experience in identifying materials and how to best treat them, consult a conservator. All chromed surfaces should be polished (if needed), cleaned with acetone and mineral spirits, and then coated with a microcrystalline wax such as Renaissance Wax. Apply a heavy coat of wax then allow it to dry without buffing. Use a hot air gun to slowly and evenly heat the part. When the wax begins to melt, spread it around the surface and let the part cool down. The heating process drives off moisture that may be trapped in corrosion pits and allows the wax to flow into these pits to form a sealing plug. After the part cools, buff off the excess wax with a cotton cloth. Only do this to pieces that are away from paint and plastic and can handle the heat from a hot air gun. If there are significant areas of iron corrosion under the chrome, a corrosion inhibiting wax/oil solution, such as CRC-350, should be applied before waxing to saturate and stop the corrosion."

The consensus of most advice I could find for preservation was to keep the chrome parts clean and dry. Some recommend wax but only if the wax has very low or no water in the mix or it is heated during application. Some groups still say not to wax. I suspect this is due to trapping water under the wax; this is cured by the hot air gun step. I think I will try this. All agreed that the plated surface is not as rugged as it would appear; do not buff the chrome, clean by hand with mild soap and water or Autosol, avoiding harsh cleaners, abrasives and commercial car washes, small scratches should be touched up with clear paint to keep corrosion from getting started. I'm not sure how this clear paint will look but it was recommended so I am passing it on.

There were several groups that reviewed all available cleaners, polishers and clothes for cleaning and polishing and they all seem to agree that the paste form of Autosol is the best cleaner, Silvo metal polish is the best polish and chamois or possibly pure cotton is the best cloth to use on your chrome. I need to get very busy on the '49 Roadster, its chrome is dirty and showing my lack of care. I hope this helps.

10 Best Tools of All Time

Forget the Snap-On Tools truck; it's never been there when you need it. Besides there are only 10 things in this world you need to fix any car, any place, any time.

1. **Duct Tape** - Not just a tool, a veritable Swiss Army knife in stickum and plastic. Its safety wire, body material, radiator hose, upholstery, insulation, tow rope, and more in an easy to carry package. Sure, there's prejudice surrounding duct tape in concours competitions, but in the real world, everything from LeMans winning Porches to Atlas rockets use it by the yard.
2. **Vice Grips** - Equally adept as a wrench, hammer, pliers, baling wire twister, breaker-off of frozen bolts and wiggle-it-til-it falls-off tool. The heavy artillery of your tool box, vice grips is the only tool designed expressly to fix things screwed up beyond repair.
3. **Spray Lubricants** - A considerably cheaper alternative to new doors, alternator, and other squeaky items. Slicker than pig phlegm, repeated soakings will allow the main hull bolts of the Andrea Doria to be removed by hand. Strangely enough, an integral part of these sprays is the infamous little red tube that flies out of the nozzle if you look at it cross eyed (one of the 10 worst tools of all time).
4. **Margarine Tubs with Clear Lids** - If you spend all you time under the hood looking for a frendle pin that caromed off the petal valve when you knocked both off the air cleaner, it's because you eat butter. Real mechanics consume pounds of tasteless vegetable oil replicas just so they can use the empty tubs for parts containers afterward. (some of course chuck the butter-colored goo altogether or use it to repack wheel bearings.) Unlike air cleaners and radiator lips, margarine tubs aren't connected by a time/space wormhole to the Parallel Universe of Lost Frendle Pins.
5. **Big Rock at the Side of the Road** - Block up a tyre. Smack corroded battery terminals. Pound out a dent. Bop noisy know-it-all types on the noodle. Scientists have yet to develop a hammer that packs the raw banging power of granite or limestone. This is the only tool with which a "made in India" emblem is not synonymous with the user's maiming.
6. **Zip Ties** - After 20 years of lashing down stray hose and wiring with old bread ties, some genius brought a slightly slicked up version to the auto parts market. Fifteen zip ties can transform a hulking mass of amateur

quality wiring from a working model of the Brazilian Rain Forest into something remotely resembling a wiring harness. Of course it works both ways. When buying a used car, subtract $100 for each zip tie under the hood.

7. **Ridiculously Large Standard Screwdriver** - Let's admit it. There's nothing better for prying, chiseling, lifting, breaking, splitting or mutilating than a huge flat bladed screwdriver particularly when wielded with gusto and a big hammer. This is also the tool of choice for all filters so insanely located that they can only be removed by driving a stage in one side and out the other. If you break the screwdriver --and you will just like Dad and you shop teacher said--who cares if it has a lifetime guarantee.
8. **Bailing Wire** - Commonly known as Holden muffler brackets, bailing wire holds anything that's too hot for tape or ties. Like duct tape, it's not recommended for concours contenders since it works so well you'll never need to replace it with the right thing again. Bailing wire is a sentimental favorite in some circles, particularly with the MG, Triumph, and flathead Ford set.
9. **Bonking Stick** - This monstrous tuning fork with devilish pointy ends is technically known as a tie-rod-separator, but how often do you separate tie-rod ends? Once every decade if you're lucky. Other than medieval combat, its real use is the all-purpose application of undue force, not unlike that of the huge flat-bladed screwdriver. Nature doesn't know the bent metal panel or frozen exhaust pipe that can stand up to a good bonking stick. (Can also be used to separate Tie-rod ends in a pinch, of course, but does a lousy job of it).
10. A credit card and a mobile phone - See tip #1 above

To avoid grease from the wheel hubs leaking out along the spokes, RTV silicone sealant can be used on the inside of the wheel hub. First, remove the wheel from the car and thoroughly clean out all the old grease from inside the center hub. Be sure to finish by wiping the inner surface with a solvent to remove all residual grease. Now spread a thin coating of RTV silicone on the inside of the hub, outboard of the splines, making sure that the ends of the spokes are covered. The wheel can now be re-greased and mounted again. The silicone coating will prevent grease from leaking out onto the spokes, keeping your wheels cleaner.

A squeaky fan belt can be silenced, at least for a while, by wiping the tapered sides of the belt with liquid soap.

A good way to protect the rubber seals at the top and bottom of your windscreen is to rub a little glycerine on them, wiping off the excess with a lint-free cloth. The glycerine will not promote decay of the rubber, as some tire and vinyl cleaners will do.

A clutch that releases at the very top of the pedal is a clear indication that the clutch return spring may be broken. Replace only with an original-type spring, as it must have the correct amount of tension to function properly.

Allen Key	Journeyman locksmith at the TR factory
Bleeding	An English expletive: "The bleeding brakes don't work" - also applies to your fingers when trying to fix said brakes
Clevis	Distant relative of Elvis Presley, famous for his system of hand-brake links
Core plug	A test sample to determine an engine's soundness, taken by drilling a plug from the block with a special hollow drill bit
Damper	Weather forecasting term used to describe the sudden shower that catches you with the top down
Dry Sump	A condition often found in TRS - caused by bashing the sump on a paving stone
Dynamo	The individual in a car club that seems to be the only one to get any work done
Electrode	Any metal tool held near a battery, especially a screwdriver, when you least expect it
Field Coils	Ignition parts found by farmers in their roadside fields, usually thrown there by irate Lucas victims
Grommet	A cosmetic rubber ring used to hide missing insulation on wires where they pass through a metal sheet
End Float	The axial movement you feel when your solid axle car traverses a whoopdedoo
Halfshafts	The parts you are left with after you hear a loud snap followed by a grinding noise from the rear axle
Impeller	The final reason to undertake a project long delayed: "Bearing failure finally impelled me to rebuild the motor".
Kingpin	A gang leader, usually ends up in prison
Oil Bath	The dousing you get when changing the oil filter
Pinion	A small pine tree whose wood is used to build Morgan cowl supports
Ratchet	Deposits left in abandoned garages by large rodents
Semi-floating	Typical driving position during a heavy rainstorm

HARDENING & TEMPERING

A specialist job to be sure, but there are times when odd hardened or stiffened parts are wanted. Without the right tools to check what you have done please don't do any safety critical parts. Basically for centre punches, link rods, etc. heat them with your blow torch, propane or whatever until the part is cherry red all over. The size of component will determine what you can do with your limited heating capacity. Hold at that condition for a few moments then quench into oil for preference or water or brine solution. Oil gives a slower quench than water, which in turn is slower than a high brine concentration. By quenching in a media which will cool the part very quickly you could cause cracks.

Having done this you should 'temper back' the part. To do this, first polish the item with emery cloth - a scale will have built up - this will enable you to see the pretty colours forming on the surface. Now in a more gentle flame heat the part again. You will notice a yellow or straw colour form on the surface, this will gradually turn to maroon and then blue.

What you are doing is removing the brittleness formed by the original quench. Basically straw is what you want for a centre punch tip, whilst blue is making it softer and is better for, say the body of the punch, where toughness is required. Having reached the colour you are after, straw being hardest and blue softest, quench again.

Not all steels are hardenable, mild steel which is low in carbon will not react or remains soft, but for small parts steel called silver steel for round bars and ground stock for sheet does. You can easily get up to 1" dia. x 13" long silver steel and sheets of ground stock 1" x 6" x 18" long, all are precision ground, available in metric sizes too and are expensive because they are fine quality steels.

It is doubtful if you will need to do much hardening and tempering but occasionally odd little pins will be needed. I had to make a replacement pin about ½" long and 3/16" dia. for the selector rods on my Meadows Box, so by hardening it I was sure it would wear very little.

For larger components you may need to get more heat onto the job which can be done by making a simple furnace using firebricks. You can get them about 6" square to make a little playing card type box. Place the object inside and train the blow torch on it from the outside, this will concentrate the heat. Simple pliers will be needed to handle the part from the furnace to the quenching bath.

As already mentioned mild steel does not react to normal hardening and tempering, but there are means that the average mechanic can employ to put on a hard outer case. Basically you are trying to enrich the outer surface of the steel with extra carbon which converts the softer outer casing into a hard wear resisting surface. Proprietory brands of powder are available - KASENIT being one - whereby you heat the item to cherry red condition and plunge it into the tin. The case produced is not very thick but does produce a tougher surface, which for certain items can prove very useful.

Martin Wyatt

OILS AND OIL CHANGES

This article was prompted by a recent question on the forum and it is not a short story. The question basically asked that if the oil looks good, do I really need to change it every year? First, what makes me the authority on oil change practices? Well, I do not claim to be an authority, but my past work experience has given me a reasonable insight into this subject albeit on aero and diesel engines. The principles are basically the same and I still have a number of contacts that I trust to tell the true story.

The real question is, how long does the oil stay in a fit condition to do its job satisfactorily. If we know that, then we can determine when it should be changed. Basically, the factors affecting oil life are, quality of the oil, quality and quantity of the additive package, oil quantity (including consumption), driving conditions and primarily the amount of fuel used.
If we understand the function of the engine oil then we can better understand the issue. The main functions are, lubrication, sealing, cleaning, cooling, anti-corrosion, and (on more modern engines and our overdrives) hydraulics.
A pure mineral oil will perform all these functions but not well enough to give acceptable engine performance and life, even in the TR.

That brings us to the 35% or so of additives we find in modern mineral oils. The engine manufacturers tend to drive the development of engine oils. If they want to introduce a particular feature that current oils cannot handle, the introduction is delayed until an additive company develops a suitable additive the oil companies can use in their products. Today with the quest for low emissions and fuel consumption, and lower maintenance costs, the oil companies have had to go to fully synthetic oils. Natural mineral oils simply will not cut it and all oils are synthetic to an extent if you include the additives.

Back to the oil's functions:
Lubrication. This is the most obvious of all. There are two main types of lubrications, fluid film (egg main and rod bearings), and boundary layer (e.g. Piston, rockers, cam). Fluid film relies on oil being pumped in to the bearing to keep the two components apart. Boundary layer can be achieved by spray, splash and mist. There is contact between the components with this type of lubrication and some wear will occur.
Sealing. Oil sprayed up the cylinder walls provides sealing of the piston rings, also helps seal the engine in conjunction with the various oil seals.
Cleaning. As a normal function of the engine, parts wear. These wear particles are washed away by the oil. Also the oil burns around the top of the piston and this carbon needs to be cleaned away to stop the rings from sticking. There is also Dutzt that enters the engine through the oil filler and breather.
Cooling. While the coolant cools the cylinder walls and head, it is the oil that cools the internals (pistons, crank, cam, rockers etc.) This heat is carried away by the oil and normally cooled by air flow over the sump.
Anti-corrosion. The oil maintains a film over the internal parts (and the under body on most TRs) to prevent corrosion. There is also the combustion by-products collected in the oil that can form acids that will cause corrosion on the various bearings and components. Chemicals in the additive help neutralise these acids.
Hydraulics. Not an issue with the TR engine but your everyday car will probably have variable valve timing and/or hydraulic tappets. If you use engine oil in the gearbox, then it is used to operate the overdrive.

As mentioned before, a straight mineral oil cannot perform these functions satisfactorily so the oil is modified to achieve the desired characteristics. In general it is not the oil companies that develop the additive packages, it is companies that specialise in this technology. The oil companies select the additive package that will give the desired performance with their base stock oil at the price they are prepared to pay, and there is the rub.

To provide a standard for consumers, oils are given a rating by various standards organisation such as the API (American Petroleum Institute). This is one of the ratings you see on the oil containers such as CD, SF, etc. Engine manufacturers will then specify a standard of oil that is recommended for their products. As engine technology develops, new ratings are introduced that may or may not also meet older ratings. This also applies to transmission and hydraulic oils.
Now we come to one of the contentious issues. Do all oils with the same rating, perform the same? As the layman you would expect so but that is not the case. All it means is that the oil is blended with an additive package that meets the minimum standard for that rating. It says nothing about the quality of the base oil, and that varies widely, the quality and quantity of additive used, or by how much the additive package met the standards.
In general, oils are not tested to determine how well or even if they do meet a certain standard. Basically, if the additive package meets it then that claim is extended to the oil that uses it. I know that if the particular oil I use is to

be changed/upgraded, it is tested by a number of race teams before being released on to the market. This is not testing to meet a standard but real life testing.

So we get oils that only just meet the standards and ones that not only meet but greatly exceed the standard. The additive package cost far more than the oil itself so you can see where I am heading here. Get some low grade oil, drop a little low cost additive and presto, you have an oil you can sell that meets the standard.
Alternatively you get a good base oil, add a big dollop of a good additive package and it is still rated under the same standard. Which one would you think is best for your engine?

We have all heard that oils do not wear out and that is basically correct but the additives do. Take the long chain molecules that improves viscosity performance. They get sheared and destroyed in service and as there is only a finite number, eventually get used up so we need to add some more. Then there are the dispersants that keep the contaminants (wear particles, carbon, etc.) in suspension. Eventually the oil will become saturated and the contaminants will drop out and we get the sludge build up we used to see with the old oils. All the additives will deplete or change form as they do their job so we need to replace them.

We could just add some more additives but we still need to get rid of the used package and all the contaminants held in the oil so the manufacturer sets a recommended oil change period. The filter only takes out the larger contaminants and the smaller ones are kept in suspension until the oil is drained. This is normally based on average driving conditions, for the TR back in the 50's this was 6000miles.

Now that we have discussed why we need to change the oil, we need to talk about when. If we accept that the additive package depletes in use, we need to work out how fast this happens. Basically the degradation of the package is directly related to the amount of fuel used. For every litre of fuel burned, a set amount of contaminants are produced and additives are destroyed doing their job.

Therefore the more additives we have, the longer the oil will last. In this regard the TR is well provided with a 6.25ltr sump. Engines today generally have smaller sumps but use synthetic oils that can still provide extended oil change periods. If we think back to when the TR was built, oils were not in the same league as today's oils and the engines were not designed to take advantage of all the benefits of modern oils.

.We should now compare driving back in the 50's with today's driving. Regardless of our memories of 100mph adventures, the average speed was much lower given the roads then and now. Now we tend to use fuel faster, and remember, fuel use relates to oil life.

Next is the type of driving we do. Typically we do short trips with the oil rarely getting up to what would be regarded as normal temperature. The problem with this is that the moisture and fuel that collects in the sump as part of the engines normal operation, will not boil off. This is the reason why cars that are not driven on long trips for some time, suddenly appear to use excessive oil when taken on a trip. It's not that it suddenly uses oil, it uses oil all the time but the water and fuel is not being boiled off and builds up over a period of time Remember, the engine temp gauge does not indicate the oil temp. Also, these fluids in the sump use up the additives designed to provide corrosion protection. This is why a lot of manufactures will give a shorter change period for stop start driving.

Both average speed and type of driving can reduce the oil's life. Remember, the faster you use fuel, the faster the oil reaches its use by date. The other factor that reduces the change period is operating in Dutzty environments. Remember the oil has to keep this Dutzt in suspension till the oil change. I would suggest to you that Australia is a little Dutztier than England and our TRs are certainly not well sealed, either to keep Dutzt out or the oil in.

If we go back to the question raised at the start, the oil looks good, why change it? You can see there are a number of factors to take into consideration. If oil is doing its job then it will get dirty as it gets older. You cannot see the degradation to the additives. The type of driving and the environment will affect the oil's condition. The quality of the oil is important also. It can also be said that oil is probably the cheapest thing you will ever put in your TR.

My recommendations, and remember they are my personal recommendations, are. First, buy a good quality mineral based oil in the range of 25w50. Don't waste your money on synthetic oil, you cannot extend the change period sufficiently to make it worthwhile. I have pulled engines down that I know have been serviced regularly and used a specialist "classic" engine oil that had sludge in the sump and rockers, and carbon build up on the pistons. This indicates to me that at the very least, the dispersion additive and/or viscosity improver was not up to the job. Don't always believe the hype.

If the car is in regular use then I would change the oil about every 6000km. For irregular usage I would shorten that to 5000km. My car is driven hard and I change around 4000km. I would not leave the oil in the engine longer than 1 year without a good long run every month or so. Annual services can be recommended by manufacturers as a means of ensuring other components are serviced on a regular basis (e.g. oil and air filters).

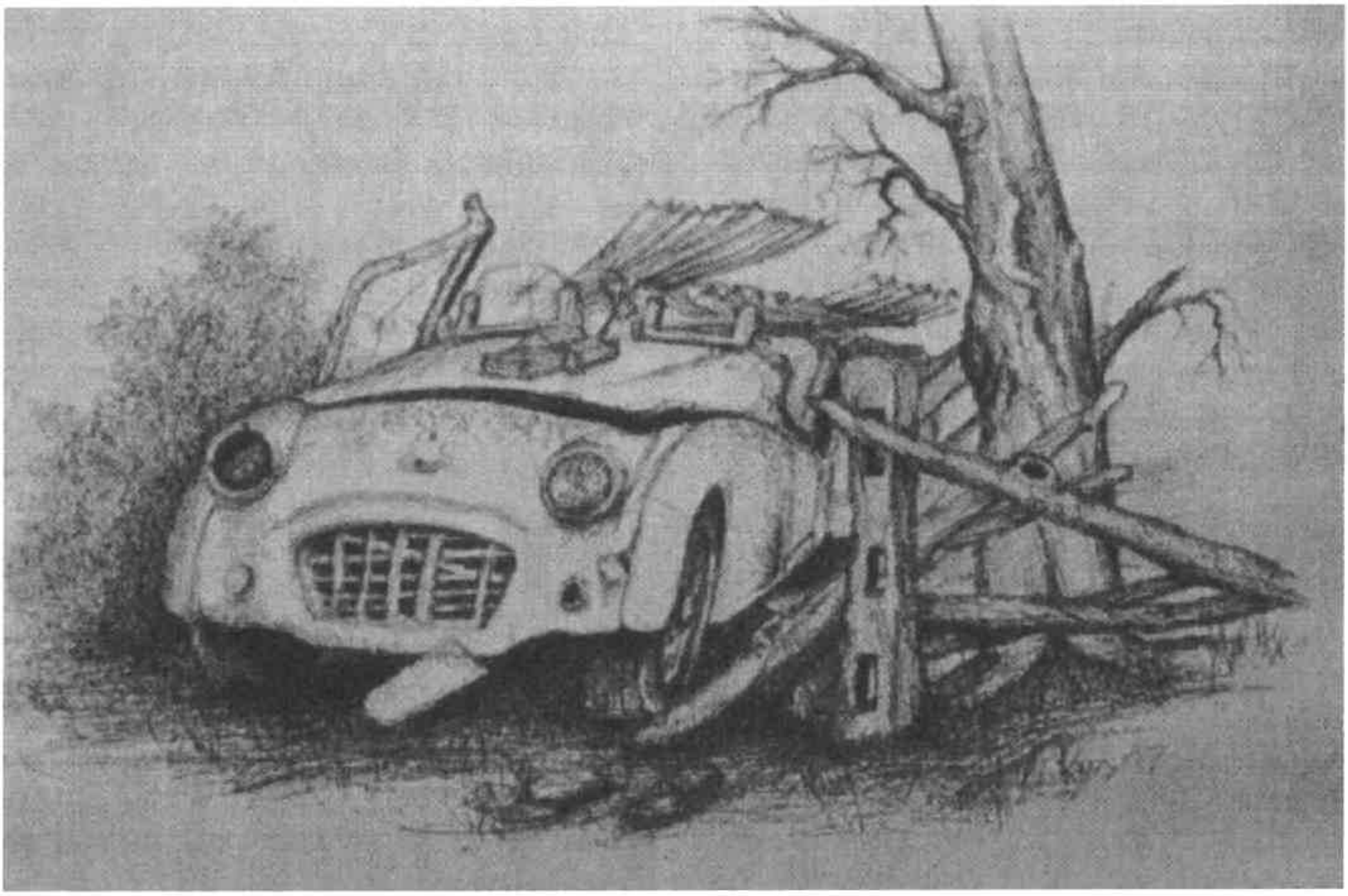
For the owners of TR2s there is another factor to consider and that is the oil filter arrangement on the early TR engines. These engines were only fitted with a bypass oil filter whereas the latter engines have a full flow filter. The bypass filter only filters oil that is dumped from the relief valve as opposed to a full flow which filters 100% of the oil pump output.

This means that the oil in the early engines needs to carry more of the smaller particles until oil change. This takes away some of the safety leeway that we build into our service recommendations.

Lastly, there has been a lot of chat about phosphorous and cam follower wear. For info on this, refer to the article on the subject in the TR Register Australia website Forum. The author is Neil McTavish of Castrol and submitted by Tr2 on April 22 2010.

I hope this helps explain the oil change storey and not simply confused you.
Remember, if ever in doubt, follow the manufactures recommendation.

Brian Richards



Body

TR2/3 Windshield Stanchions

There are three versions of the windscreen stanchion.

a. The original Dutz type with a locating plate attached to the body.

b. The next (Do not know when this was introduced but suspect it was at TS60000) where the stanchion was the same as the earlier ones but the two mounting holes were slightly smaller. A mounting plate then fits between the stanchion and body with the assembly being attached by two screws.

c. Next came the 'cheaper' version. The plate was dispensed with and the mounting surface of the stanchion was not machined to suit the plate but simply left as a cast surface . The stanchion then sat directly on the painted body and attached by the same two screws.

Screws Loose?

A common problem on the TR 2, 3 and earlier 3A models is the lift-a-dot pegs all around the cockpit of the car becoming loose and falling out. This generally happens because the holes, most of which go through wood, become enlarged. They car be repaired by a couple of methods.

1. Wooden matchsticks or toothpicks can be coated with white glue and then a couple stuffed into the hole. Break off the excess length so that the ends are flush with the hole. Allow to dry for an hour or so, then the pegs can be screwed back into the holes where they will fit very solidly. Sometimes it's helpful to drill a small "pilot hole" a short distance into the center to help the peg get started.

2. An alternate method is to take a small piece of steel wool and wrap it around the threads of the peg. This should tighten up the fit of the peg as well.

***Blocked TR Boot Drains* - by Neville Turbit**

I have had a problem for a long time. In fact my partner might even say the word "problem" should be plural rather than singular. For years I have suffered from soggy boot. My problem however is now solved. You know what happens when it rains or you wash the car. The boot channel fills with water and the drains don't do their job. They are either kinked or fill with dirt. This is what my one looked like yesterday. I managed the double. Kinked and blocked with dirt.

One of the problems – or at least it is with my car is that the diameter of the drain pipe is 11.5mm and the hole in the guard for the drain pipe is about 12mm. Up to this point, I used 12mm thin walled tubing and heated up one end to push it over the drain pipe. I suppose I could have drilled out the hole in the guard but the kinking was always a problem anyway.

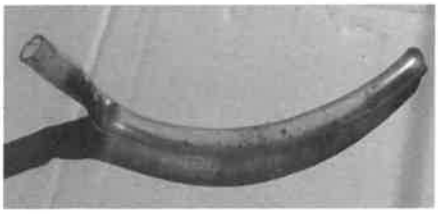
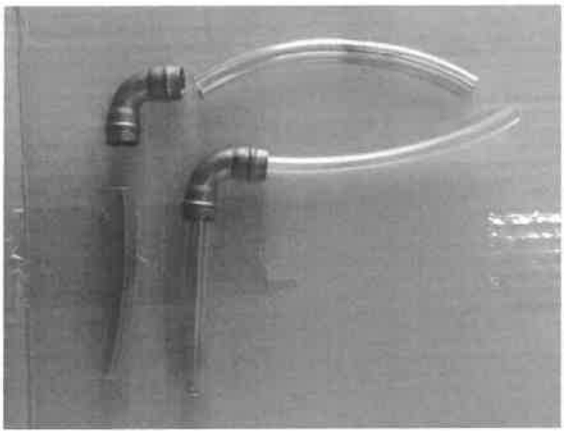
So now I have a solution. I scrounged around the garage, and came up with some right angle copper pipe fittings. The internal diameter is half inch. I used some 14mm tubing I had lying around to go into one end, and some 12 mm tubing in the other side. Push the 12mm plastic tube in, past the ridge, which would usually be the stop for the copper pipe. It is about 12mm inside diameter. Just apply some Sikaflex to the fittings and allow to dry.

Just for completeness, here are the tubing sizes.

- 12mm x 135mm about 1.6mm wall thickness
- 14mm x 90mm about 1.6mm wall thickness

After the Sikaflex dried, I installed the two drains and held the top hose in place with a hose clamp. Washed the car and the water just ran away. This is a rough picture of the result in situ. It is hard to take a picture with your phone in the corner of the boot, but it will give you an idea of how it fits.

Incidentally, a good tip for heating up plastic hoses to make them easier to fit is to use a heat gun for about 5-10 seconds. Works like a charm.
I hope this helps someone else fix their soggy boot.

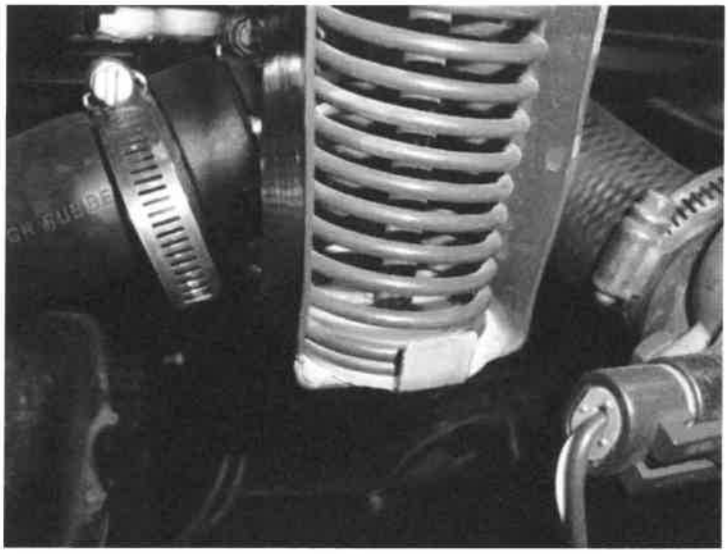

Bonnet Rattle by Brian Richards

At the 2011 concourse I spoke with a number of members who suffered from the dreaded TR bonnet rattle. As a lot of you know, this can be very annoying and there have been many attempts to fix it, mostly involving a rubber washer fitted over the plunger that lifts the bonnet to the safety catch when the Dutz are released. This is done in the belief that it is that part of the mechanism that is causing the problem.

I have found that while the problem does involve the plunger, it is the plunger moving at the bottom of the U shaped spring holder that causes the rattle. This being the case, no amount of work at the top will fix the problem. I have been able to completely eliminate the rattle by working on the lower part of the plunger, not the top.

It is a simple fix and involves fitting a plastic (nylon in my case but any durable material will work) bush that prevents the plunger from contacting the steel spring holder. It is the plunger contacting the spring holder at this point that causes the rattle. Yes, it is caused by the bonnet moving and causing the plunger to move but it is at the bottom of the plunger the noise is created, not the top where most people concentrate their efforts.

This can be done in any number of ways but this is how I did it. First I made a thin steel washer with two tags pointing out opposite each other. The size of the washer is such that it just fits into the spring holder with the hole where the plunger fits, about 2-3mm larger than the plunger. The two tags are folded up so that the spring and spring holder hold it in the centre of the spring.



A plastic washer is then cut to just fit inside the new steel washer and under the spring but the hole for the plunger is just big enough to allow the plunger to move freely. Now the hole in the spring holder where the plunger slides is enlarged to about 2mm larger than the plunger. Reassemble the mechanism with the steel washer, tangs pointing up, and the plastic washer inside it and under the spring.

The steel washer holds the plastic washer in place and the plastic washer prevents the plunger from contacting the spring holder............no rattle.

LEFT HAND TO RIGHT HAND DASH CONVERSION

By Rob Noonan.

Step 1. Start with the glove box side. Mark and cut along the dotted line shown in diagram 1.This cut should be on the face just where the metal begins to turn in. Use a good pair of tin snips. It's best to have a variety of types, ie straight, curved, left hand, right hand and use work gloves.

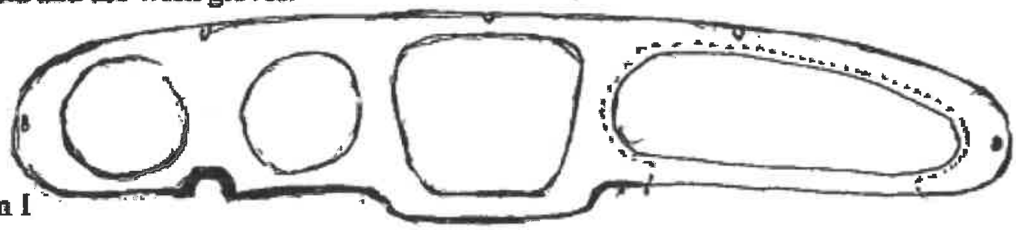


Diagram 1

Step 2. Turn the cut out piece of metal over and using your hands reshape it to fit back into the place where it came from, making a RHD glove box opening.

Step 3. Make two thick paper templates, one of the hole that you have just cut out and mark the mounting holes for reference. It should look like diagram 2. The other template being the tacho / speedo side, it should look like diagram 3.

Diagram 2

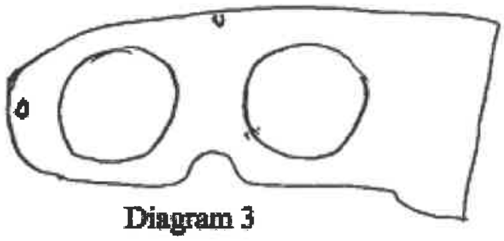


Diagram 3

Step 4. Turning the glove box template over. Place it on the left hand side and locate its position by using the mounting holes. Mark and cut out the glove box hole.

Step 5. Weld or braze on the backside, the reshaped glove box opening from step 2 into the left side.

Step 6. Using the glove box hole template (diagram 2) again mark and cut out a new piece of sheet metal (body sheet metal 1mm thick is best) Weld this in to fill in the RH side of the dash. The bottom edge will need to be rolled using a piece of pipe and a hammer.

Step 7. Use the template shown in diagram 3 but turned over, mark and cut the holes for the tacho and speedo. Also the hump for the steering column which will need to be cut out of the remains from step 4. and welded into its correct position.

Step 8. Remove the ply board from the glove box door and drill out the rivets to remove the hinge. Turn the door around and refit the hinge using small nuts and bolts. Refit the ply board backwards after it has been recovered.

Some useful tips; 1. Weld by tacking many spots diagonally around the work and then further welding in later. This will greatly reduce distortion. 2. If welding joins are good only a small amount of spray putty will be required. 3. Recover using contact adhesive and use a hair drier to soften the vinyl if necessary.

Tips on fitting the front apron to a TR

When fitting body panels to a TR, the front apron is perhaps the one approached with greatest trepidation; I have found the following procedure to work well for me –

Preparation

The cross brace and brackets should be removed from the apron; the brace is placed in the inner guard brackets with one mounting bolt loosely locating it at one end.
Check that the threads of all captive nuts are clear – it is good practice to quickly pass a ¼ unf bottom tap through each nut; the tap may be held in the jaws of a reversible rechargeable drill but should be started by hand turning of the chuck.
Loosen guard to inner guard bolts from front to scuttle – leave every 4th bolt lightly nipped; check that all necessary bolts, washers, lock washers, and nuts, are available.

Procedure

Check fit of bonnet which should be equally spaced and parallel to the front guards at the sides and have enough clearance at the back edge to avoid hitting the scuttle and the closed vent lid (where applicable); the bonnet is adjusted by loosening the 4 underbonnet hinge nuts and leaving them lightly nipped while adjusting, lift the bonnet and ensure it is securely stayed.

If necessary, spread the front guards slightly; if stainless steel cover trims are fitted, the tabs should be taped over to prevent paint damage and the front bows gently tied back to each side clear of the guard's mating edges.

Get an assistant to help lift the apron into position, position the flange over the cross brace; start all apron/guard body bolts and leave loose;
Taking care not to scratch the paintwork, adjust the cover trim tabs so they are positioned just above each bolt (hold each tab in place with a small piece of masking tape placed lightly under the trim); gently position the cover trim over the joint and work the tabs down into the slot, hold the trim down with strips of tape; lower bonnet and check gap to apron; adjust apron until gap is about 1/8 inch; nip up the apron body bolts lightly and recheck the bonnet to apron gap; adjust apron if necessary; remove tab locating tapes; lift bonnet and secure.

Moderately tighten every second underguard body bolt starting with the second bolt from the top; at the same time, push down on the cover trim (over the bolt) with the palm of the hand; when both sides are done, loosen the top apron body bolt on each side and adjust the match of the guard to apron – if the apron needs to come up, a piece of 2 x 1 lath can be wedged between apron and inner guard; nip up the top bolt, then the second bolt (hold down cover strip while tightening); continue tightening bolts down to the front, then repeat the procedure on the other side.

Tighten all guar)inner guard bolts; bolt cross brace to inner guard brackets (pass a phillips head screwdriver with ¼ inch round shaft through the bracket and brace to align adjacent bolt holes – leave bolts loose; lower bonnet and check match to apron.

The shape of the apron top edge can be altered (within limits) by fitting ¼ inch packing washers between the top edge flange and the cross brace; these washers can be positioned using the above screwdriver technique and are held by the mounting bolts; if there is a gap between the flange and the cross brace and no shape adjustment is necessary, then use only enough packing washers to lightly spring the flange.

Fit all cross brace to apron bolts + packing washers as necessary (also fit washers under bolt heads); fit the bonnet spring and/or prop bracket assembly; tighten all cross brace bolts.

Fitting Radiator Bolts

This trick makes it a little easier to remove & fit the bottom radiator bolts. Cut a screwdriver slot in the threaded end of the machine screw. Once it is loosened with a spanner , it can be removed & replaced with a screwdriver. Tighten finally with a spanner. Use anti-seize on the thread to keep it free to turn. Rick Fletcher

Engine

Camshafts

Here is a discussion regarding some of the issues involved in selecting a new camshaft for your TR3/3A engine. The same issue apply to the earlier engines, but variation in intake port design may alter the balance point for trade-offs.

First, do you really need to change your cam? Maybe not. The engine designers did a good job with balancing the trade-offs of the camshaft. Certainly they knew how to make a "hot" cam, but chose the one they did for very good reasons. A "hot" cam works at higher RPM, but sacrifices low RPM flexibility (i.e. low idle speed and grunt at low rpm in higher gears. However, the hotter cam allows more power at the upper rpm range. Unlike some modern short stroke engine designs, our Triumphs are not able to get safely past what is now considered a mid-range rpm range. So, the really hot cams that allow good power over 6000 rpm are not really useful here. The cams we will be working with are in the range of stock to mild to moderate. The choice of cam will also be influenced by what other modifications have been made to the engine to allow the cam to work the way it was intended. It is almost like buying a person with a bad heart a racing bicycle. Even though the bicycle can go very fast, the person using it cannot sustain the effort to make it go!

What does a "hot" cam do differently from a "stock" one? It does nothing differently at all; it just does it at a different time. Time is of the essence, particularly with cams. The cams open and close the valves which allow the mixture to be drawn into the engine and the spent exhaust to leave the engine. At low rpm, it is not hard to get the mixture into, and the exhaust out of, the engine. As the rpm gets higher it is progressively more difficult to get the gases in and out due to drag throughout the system. At high rpm you have to wait proportionally longer to get the gasses in and out. This wait is the time that the intake or exhaust valves are open. That is the entire issue. Higher RPM requires longer valve duration for good performance than low RPM. In addition, when optimized for one range, it is not as good for the other range.

As I said above, the use of the hotter cams requires other modifications to the engine to put the cam to good use. Specifically, you may need a "better flowing" head. This requires that the ports and valves be treated to reduce low resistance. This will allow the gases to move more easily so you get a larger volume in and out of the engine in the same period of time. Again, there is a trade-off here. Very large ports allow huge slugs of gas to be expelled without having a lot of drag induced by very high flow speeds.
Unfortunately, the flow can be too slow as well, so large ports can allow the gas to flow so slowly that problems can occur. When these problems occur it may be impossible to obtain a low idle speed.

Another modification that a hot cam often requires is a higher compression head. With excessively low compression it may not be possible to get the combustion efficiency that the engine requires.

So, is it reasonably possible to get a "better" cam without having to modify the rest of the engine? The answer is a qualified yes. Certainly you can get some more performance from the engine, but will the cost of the cam removal and reinstallation be worth the 6-10hp difference? Only you can answer that one. I, unfortunately, subscribe to the "more is better", or "in for a penny, in for a pound" philosophy.

I have not yet made the dive into the engine, but since my engine rebuild will require at least new valve guides, why not shave the head to increase the compression, and explore the cost of "porting and flowing" the head? Once I spring for that cost, it would make sense to install larger intake valves. Larger intake valves require that the head gasket and block be relieved around the edge of the valve orifice. Since the engine has quite a few miles on it, and the pistons and liners are aging fast, maybe I should put in 89mm pistons to increase displacement from 2138cc to 2187cc. Certainly after all these modifications the carburettors themselves are causing a restriction, and some other carbs would be necessary. Maybe 2" (instead of the stock 1.75") SU's, but Webers or Weber-look alikes are better. Webers make sense here because I have lost some of the low-end anyway with a "hot" cam. Needless to say, I now need a better exhaust manifold

You can see where this is going. Since I am not looking for a ton of horsepower), I will stick to a milder cam where I do not have to worry too much about porting, flowing, new manifolds and the like. I will run a moderately increased compression, and moderately improve the head to go with the moderate cam I will install. This will be only moderately expensive (I hope).

Which cam is which?

VINTAGE/Old Style cams

TYPE	Duration	Inlet/Exhaust	Lift	Comments
Stock	254	17-57/57-17	0.375	
"D"	284	33-71/71-33	0.393	Race/Street 10:1 compression required
"F"	300	39-81/81-39	0.432	Full Race, 11.7:1 comp., 4000-6000
G-3	309	51-79/79-51	0.499	Racing only, 11.7:1 comp., 4200-6500
SAH #26 264		22-62/62-22	0.388	Mild Cam
Piper	268	24-64/64-24	0.387	Mild Cam
Derrington 280		30-70/70-30	0.435	Near limit for street use(see Elgin 7010-9)

MODERN Cams (none listed here are asymmetrical (probably because they are regrinds of the stock symmetrical cam :)

Elgin 6710-18	268	24-64/64-24?	0.404	Pulls Hard, good power (a "1/4 grind")
Elgin ????-?	274	27-67/67-27?	?	Effectively a "2/4 grind"
Elgin 7010-9	280	30-70/70-30	0.375	"3/4 grind", Streetable with 87mm and header
BFE #260 260		? - ?/? - ? 0.408	"mild" cam	
BFE #149 282		? - ?/? -? 0.425	Slight lope @ idle, but low lift rate, so not as hot as others	

The following may not be available for the 4 cyl. TRs

Elgin 71508-18	286	33-73/73-33?	0.436	Req. stronger springs, higher comp, header
Elgin 7508-12	300	40-80/80-40?	0.461	Race only. Prepared head, 12:1 comp, etc.
Elgin 7706-9	308	44-84/84-44?	0.446	Race only, best over 5000 rpm

How do all these variations make a difference? Well, they vary the time that the valves open and close. To understand why the timing is important, you have to understand a little of what is happening inside the manifolds and cylinder.

In a model of engine function where the intake and exhaust gases have no momentum nor and drag, then all you need to do is open the intake valve at the beginning of the intake stroke and then close it at the end of the intake stroke, then compress the mixture, fire when the piston hits the top and then open the exhaust valve when the piston is at the bottom.

In the real world the gases do have momentum and drag. We can use momentum to our advantage so the engine does not have to do all the work pumping the gases in and out. Using momentum, the gases will (to a certain extent) blow themselves in and suck themselves out.

For the intake stroke, we can use the partial vacuum created by the exhaust gases as they are shooting out of the cylinder to help suck in the new mixture. In order to do this, we need to open the intake valve before the exhaust valve is closed, and we can even open it before the piston has come to the top of the exhaust stroke! At higher revs we need to open the valves earlier and keep them open proportionally longer in order for the same amount of gas to be moved. At low revs, prolonged valve overlap will cause some if the new mixture to be sucked out with the exhaust, causing no end of problems, and reducing performance. This is the first instance of why a cam timed for high revs does not work well at low revs.

Now a little later into the intake stroke the exhaust valve has closed and the mixture is being sucked into the cylinder as the piston moves downward. When the piston hits the bottom of the intake stroke, the incoming mass of mixture has momentum driving it into the cylinder, so we can keep the valve open even after the cylinder has begun its upward compression stroke and allow momentum to drive even more mixture into the cylinder. The length of the intake runners will help in this matter as the echo of the intake valve closing on the last stroke can come back and compress even more gas into the cylinder. The echo is a wave of gas bouncing back from the carburettor end of the intake runner just as a wave bounces off a wall in a swimming pool. Again, at higher revs we need to keep the valve open proportionally longer in the cycle to get the full charge of mixture. The added charge of mixture entering the cylinder is a poor man's supercharging.

On the compression stroke the valves are closed, so there is no magic here as far as valves are concerned until near the end of the firing stroke.

After the spark has fired and the mixture combusted, the piston is driven downward and eventually it is time to open the exhaust valve. We can open the exhaust valve before the piston hits the bottom of the stroke without losing much power. The early opening of the valve gives more time for the exhaust to leave the cylinder. The early opening also allows the exhaust to be shot out of the cylinder with a little more force and speed. This is important later in the exhaust stroke. Again, at higher revs it is necessary to open the exhaust valve proportionally earlier, but at lower revs, that will result in noticeable loss of power.

Now the piston is moving upward expelling the exhaust gases. The length of the exhaust runner is important since the blast of exhaust has momentum and can help suck the exhaust out of the cylinder at the end of the exhaust stroke, and can even help suck in some of the new mixture. The length of the runner is important since if it is too short it will develop less suction (extractor effect) than it should. If it is too long then it will cause excessive back pressure. This is how "tuned pipes" work, and why they are a mixed blessing. If you are going the right (high, usually) RPM, then the extractor effect is very useful (as long as your cam is timed appropriately). At lower RPM, the pipes are too short and you lose the extractor effect.

Now we have been through the entire four strokes of the engine, and it is more clear why cam selection is important and such a difficult decision.

What is an "asymmetrical" cam? In the old days, and even today, cams were usually symmetrical. (E.G. the 17-57/57-17 stock TR4 cam) This means that the intake valve opens 17 degrees BTDC of the intake stroke, and closes 57 degrees ABDC of the intake stroke. In this case the exhaust valve opens 57 degrees BBDC of the exhaust stroke and 17 degrees ATDC of the exhaust stroke. Why are the numbers the same? I am not sure, but I suppose it was easier to machine that way (before computer controlled machines) and with an infinite number of possible asymmetric settings, they stuck with the more limited choices of the symmetrical style. Nowadays we have computers! This allows us to make any cam profile we want with very little extra effort. We just type in a different set of numbers into the computer and let it make the machine run. In addition, we have supercomputers to do advanced modelling of the complex flows in the engine. In my description of the 4 strokes above I never said anything about the exact time the valves were supposed to open. There is no special reason why you should open the exhaust valve 17 degrees BBDC just because you opened the intake valve 17 degrees BTDC. As a matter of fact, there is every reason to suspect they should NOT open at the same number. It would be a mighty coincidence if the optimal numbers were the same. More of a coincidence than you having the same phone number (except area code) as your sister living in another state! Advanced computer modelling allows designers to discover the optimal timing of all valve opening and closings. Actually, the most advanced engines have no cam at all, instead, the valves are solenoid actuated and can be opened at varying times based on engine demands. We do not have that luxury.

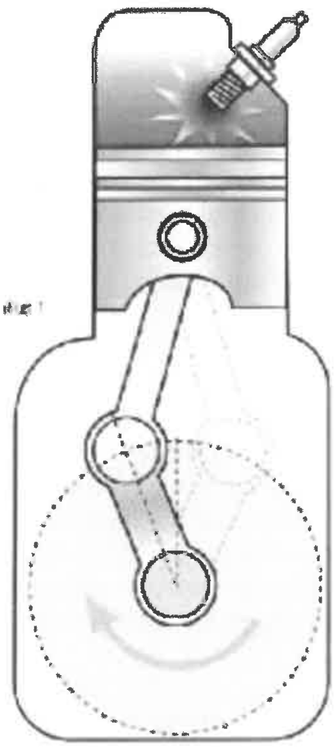
Note: I have found that the asymmetry can be in the ramp profile of the lobe. It can open and close at different speeds. I.E. It can open fast with a steep ramp, and then close more slowly to minimize valve bounce by using a shallower ramp angle.

Well, that is it. I hope this explanation helps you understand cams and cam selection a little better. I still have not decided which cam will be the best for me. Probably unless I make a BIG mistake, any cam I choose (even the stock one) will keep me happy.

Triumph Ignition Timing

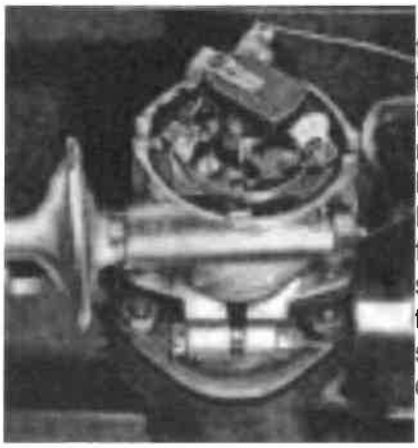
This is an extensive look into the simple task of setting ignition timing on your Triumph TR2, TR3, or TR4. You may ask, "If it's so simple, why does it require two web pages to explain?" The answer to that question is that on page one I will begin by explaining what timing is, why it's important, and how the Triumph method is different from the way timing is "set" for most other makes. On the page two I will cover the actual timing procedure.

Without getting into the whole 4 stroke cycle of the internal combustion engines which power our Triumph sports cars, let's just jump right in and say that timing determines the exact instant that the spark plug will "fire" and light the compressed fuel and air mixture in each cylinder. This point is usually referred to as a certain number of degrees "before top dead centre" (BTDC), a term which may require more explanation for some.



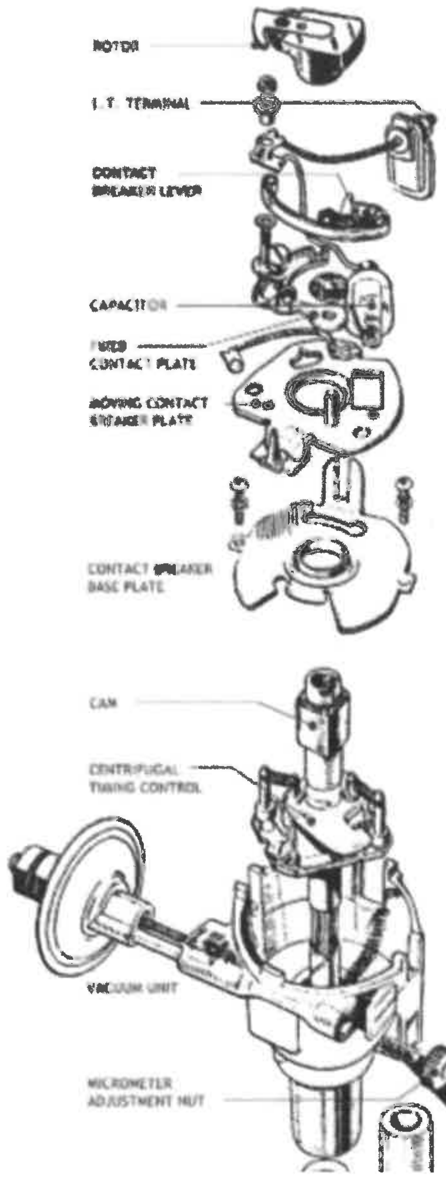
Top Dead Centre (TDC) is the point where the piston has completed its rise to the top of the cylinder, and the fuel/air mixture has been compressed as much as it can possibly be squeezed. Any further rotation of the crankshaft will begin to pull the piston down and away from the spark plug (and cylinder head). What we'd really like to see happen is that the spark plug will fire at this exact moment, causing the fuel and air mixture to burn and expand, driving the piston down to create the power we need and the noise we love to hear. Note that I said that the fuel and air would burn and expand, not explode, as many people believe. It happens very quickly, and if you could see inside the cylinder it might resemble a small explosion, but it is a controlled burn which takes a fraction of a second to complete, thus the need to start the fuel burn a few degrees before the piston reaches the TDC position. The degrees that we're referring to are degrees of rotation of the crankshaft, with 360 degrees being the total number of segments (degrees) that define a circle (and you thought you'd NEVER have a use for that high school Geometry!).

Ideally the full burn should be completed when the piston has moved slightly downwards, or at about 20 degrees after top dead centre (ATDC). The rate of burning for the fuel/air mixture takes a set amount of time, and the time required to complete this burn is fixed and does not change. For this reason, the timing is set so that the spark plug will fire a specific number of degrees before the piston reaches top dead centre (BTDC) on the compression stroke, which allows the mixture to be completely burned at the correct point ATDC. As the engine speed increases, the timing must be "advanced" so that the spark plug will fire a greater number of degrees BTDC, allowing the fuel/air mixture the time necessary to be fully burned at the correct point for maximum power. When working correctly, the distributor will do this automatically as engine speed changes throughout normal driving. All we must do is set the starting point, the "initial timing", and the distributor should do the rest.



Our Triumph TR2-4A distributors are equipped with two separate systems for adjusting the ignition timing to meet changing requirements due to various engine speeds and throttle positions. First there are centrifugal weights inside the distributor which sense increased engine speed, and mechanically advance the timing to larger and larger numbers of degrees BTDC, giving the fuel/air mixture the time it needs to completely burn by the correct point ATDC. This mechanical advance starts working between 450 and 700 RPM and will be fully advanced, adding an extra 22 degrees BTDC, by 2400 RPM. (These figures are for a Lucas 25D4 distributor in a TR4. Other models are similar.) As engine speed slows down, the centrifugal weights don't spin as fast, and the timing "retards" back to a lesser number of degrees BTDC. There's also a vacuum advance chamber on the side of the distributor which can add another 6-10 degrees of advance timing BTDC, depending on throttle position and engine load.

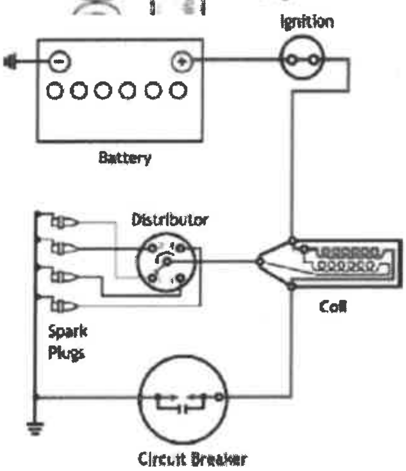
Now after hearing all of this, aren't you glad that we only have to set the "initial" timing? The automatic advance mechanisms of our Triumph distributors were a great improvement over the earliest autos, which usually had a "spark" lever on the steering column that required the driver to continually adjust the timing as engine speeds changed. As good as we've got it; there have been many improvements since our Triumphs first rolled off the assembly line. All of this timing advance and retard stuff is now computer controlled on modern cars, and non-wearing parts inside of today's control boxes means that setting timing is now a ritual reserved for those of us afflicted with "old car disease".



In days past, when setting the timing of a car was a routine procedure, a strobe light affair called a timing light was normally attached to the number 1 spark plug and the timing was adjusted while the engine was running at idle. On most cars, this procedure produced the desired results because the idle speed was lower than the engine speed where the centrifugal weights would start to advance the timing. The Triumph owner however, will not achieve the desired results when setting the timing with a timing light.

If you recall from above, the mechanical advance can begin between 450 and 700 RPM. That's pretty slow for a TR engine to idle, and without knowing exactly where it starts advancing, and by how much, we should probably use some other method to accurately set the initial timing. Fortunately, the engineers at Standard-Triumph specified a method for setting our initial timing with the engine OFF. This is nice in that it can be done in a cool engine compartment, and it keeps fingers and tools away from spinning fan belts and fan blades.

Now click on the link below to go to page 2, where I'll go through the initial timing procedure, and touch on the electrical theory as to why it works.



The first *how* we need to know about to set the initial timing is how we know the exact moment that a spark plug is going to fire. For that answer, I need to explain how the ignition system in our Triumphs works.

It all starts with the 12-volt battery, and electricity's desire to flow from the positive battery terminal to the negative battery terminal. Even though batteries were originally installed in our Triumphs with the positive terminal connected to ground, I'm going to explain this as if your car has been converted to negative ground, because it seems to make more sense (at least to me). In basic terms, electrical current flows from the positive battery terminal to the negative terminal. The engine's ignition system is one of many paths that the electricity can take. The current flows from the positive battery terminal through a wire to the ignition switch, and if the switch is "ON" continues to the "+" terminal of the coil. Of course if the switch is "OFF", then the current flow stops and the ignition system is disabled.

Now the coil is an interesting part, because it has the ability to turn the 12-volt electricity from the battery into the 20-30,000 volts (or more) needed to cause a spark to jump across the spark plug terminals. How does it do that? There are actually two coils (windings) of wire inside a "coil", a *primary* coil around the outside and a separate inner or *secondary* coil. When electricity from the battery flows through the primary windings it produces a magnetic field, which affects the inner (secondary) windings. If the current flow (from the battery) through the primary coil windings is suddenly stopped, the magnetic field collapses, which induces a current in the secondary coil windings. The much larger number of coil windings in the secondary coil cause it to produce the high voltage necessary to jump the spark plug gap, and ignite the fuel/air mixture in your engine.

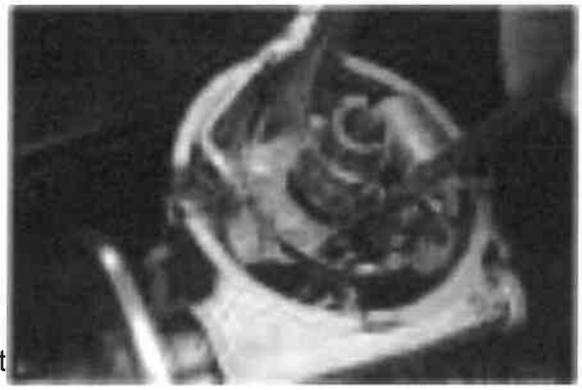
How is it that we are able to stop this flow of electricity through the primary coil windings each time that we want a spark plug to fire? That's the job of the breaker points (usually referred to as simply "points") in the distributor. In our example of a negative ground battery system, a small wire from the "-" side of the coil goes to the distributor and continues inside where it connects to the points. (If your car is positive ground, then the connections to the "+" and "-"terminals of the coil should be reversed.)

The points in our 4 cylinder Triumph engines are mounted inside the distributor (under the distributor cap), and they have a small rubbing block that touches a square lobe on the distributor's shaft. As the distributor shaft turns, the square lobe also turns. When each of the four corners on the lobe move past the rubbing block, the electrical contact points are forced apart (open) and the flow of electricity stops. When a corner of the lobe is not pushing the points open, they touch and the electricity flows through to the engine/chassis/body (ground) and back to the negative battery terminal. By determining the exact moment that the points open and stop the current flow, we are able to know precisely when the coil will produce the powerful spark, and the spark plug will fire. This knowledge will allow us to precisely set the timing.

But before we can actually set the timing, we must be certain that the points are adjusted correctly. The points primarily stop the flow of electricity through the coil's primary windings, but they are also important for allowing the current flow through the coil as well. Current must be able to flow through the primary coil windings long enough to set up the magnetic field, or the high voltage the plugs need won't be created. To assure that the points are both open and closed for adequate amounts of time, the points must be adjusted properly. This is an important first step in setting your engine's timing.

To adjust your points, you will need a screwdriver (or two), and a .015" thick feeler gauge. Remove the distributor cap and rotor to gain access to the points, and then rotate the engine until the rubbing block is resting on the highest point of any corner on the square lobe. To assure proper operation, we want to adjust the gap between the two contact points to be exactly .015" when they are separated the greatest amount, so it's important to have the rubbing block placed on a high point of the lobe.

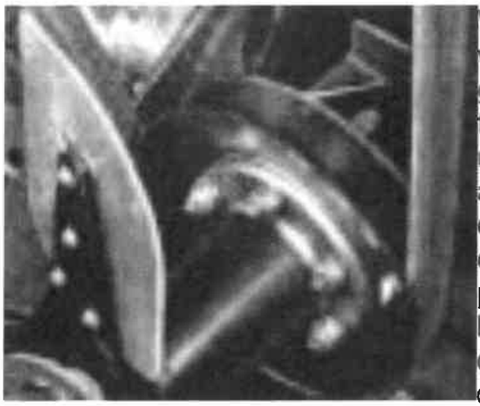
Begin by inspecting the mating surfaces of the two contact points. They should be flat and smooth for best results, and if they appear burned or pitted, replace with a new points set. Points adjustment starts by making certain that the ignition switch is "OFF", and then gently slide the feeler gauge between the two contact points to measure the gap between them. Watch to see that the feeler gauge does not force the points apart, which would indicate too narrow of a gap (less than .015"). Too wide of a gap is easy to see, and the feeler gauge will be loose and able to be move from side to side. If either of these conditions indicates that the gap is something other than .015", they will need to be adjusted.



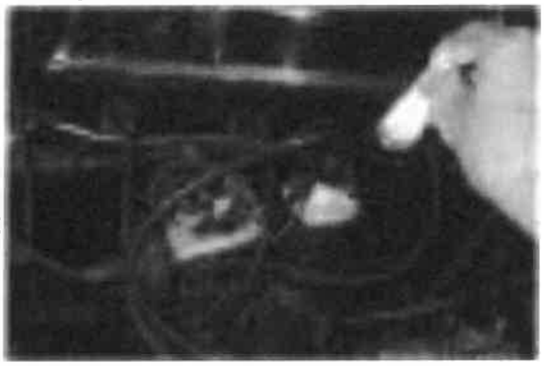
To adjust the point gap, you'll have to loosen the mounting screw slightly, and then move the points closer to or farther away from the cam lobe to lessen or increase the gap. There's a slot at one end of the points where a screwdriver can be placed and twisted with one hand to move the points in and out, while you drag the feeler gauge through the gap with your other hand and feel for a slight drag. (This is easier if you leave the mounting screw just tight enough that the points will stay where you put them!) Tighten the mounting screw and re-check the gap with your feeler gauge. I often think that Lucas designed these distributors to be best serviced by three handed mechanics, because it's not unusual for the points adjustment to change when you tighten the screw. If the points did move and your feeler gauge doesn't have the same slight drag as you slide it through the gap, loosen the screw and start all over again. Re-install the rotor when the points adjustment has been completed.

Once the points are correctly adjusted, you're ready to set the initial timing. There are two ways to manually change the initial timing on your distributor. One is by turning the external thumbscrew, and the other is by loosening the distributor clamp and rotating the distributor body itself. We'll use a combination of both to get the correct setting.

Because we'll be using the external thumbscrew later in the process, it's helpful to make sure it is resting in the middle of the adjustment range. Begin by turning the thumbscrew as far as it will go in either direction, then count the number of turns as you move it to the opposite stop. Divide that number in half, and return the screw to the middle of its range. Now you'll have adequate adjustment in either direction should you need it later.



We've finally reached the point where we can set the initial timing, and the next thing we must do is determine when the #1 piston is at Top Dead Centre (TDC). With the gearbox in neutral, you should be able to turn the engine (clockwise when viewed from the front of the car) by hand until the timing mark on the crankshaft pulley lines up with the pointer on the engine's timing cover. As long as someone has not assembled the hub and pulley incorrectly (see the factory workshop manual for more on this), the #1 and #4 pistons should both be at TDC. You can set the distributor cap loosely in place and if the rotor points to the #1 or #4 terminal locations, you can proceed with the timing adjustment. If you go past the place where the two marks line up, don't just back it up a small amount to align them. Back it up well past the correct location, and approach the spot again with a clockwise rotation of the crankshaft (to take up any possible "slop" due to a worn timing chain or gears inside the engine) or rotate the crankshaft another full revolution in the clockwise direction and try it again.

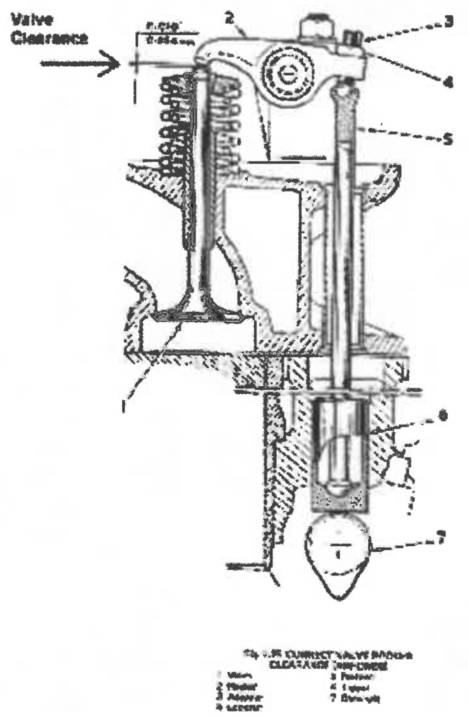


Now all that's needed is to position the distributor so that the points have opened just enough to stop the flow of electricity through the coil with the piston at TDC. To determine where this place is, you'll need a 12-volt test light (which can be purchased inexpensively from any automotive parts or tool store or homemade). Because electricity is somewhat 'lazy', it will always take the easiest path as it tries to return to the battery. The current will flow through the points when they are closed as opposed to flowing through a test light where it would have to do some 'work' on the way back to the battery. When the points open however, the only option left for the electricity to get back to the battery is through the light and it immediately takes this new return path, lighting the test bulb along the way! Therefore, with the ignition switch "ON", if you touch one side of your test light to the distributor side of the coil, and attach the other side to a ground, the light will come on at the very instant that the points "open" and the spark plug would fire. Simply loosen the clamp at the base of the distributor, and rotate the distributor until you find the spot where the light just blinks on with any movement of the distributor. Remember that the square lobe rotates counter-clockwise, so you're looking for the spot where the points will just open, not the closing point on the "back side" of the lobe's rotation. Turn off the ignition switch, and tighten the distributor clamp. Add a tiny amount of lubrication to the rubbing block to reduce wear, and you're almost done.

You've just set the ignition timing to fire the spark plugs when each piston has reached TDC, but Triumph has specified that this setting should actually be 4 degrees <u>before</u> TDC. How are we going to do this? This is the easy part. Just turn the external thumbscrew in the "A" direction (advance) as indicated by the arrow. There is a reference line through the middle the thumbscrew, and one complete turn is equal to 8 degrees of adjustment. Therefore, note the position of the reference line and turn the screw ½ turn in the "A" direction to set your ignition timing at the factory recommended 4 degrees BTDC.

Congratulations! Your timing is now set. Re-install the distributor cap, pick up all of your tools, and take that Triumph TR out for a drive!

Adjusting TR2-4A Valves



Adjusting the valves in your Triumph engine is one of those tasks which many of you try to avoid. It's a simple procedure that's vital to your engine's health and state of tune, but it's also easy to get wrong if you aren't paying attention. Follow along as I explain the hows and whys of adjusting valves, and let you in on a couple of methods to keep everything straight while setting it.

'Adjusting Valves' is really an abbreviated term for this maintenance procedure. What you'll actually be doing is adjusting the clearance between the rocker arm and the top of the valve. Without getting into a discussion of hydraulic lifters or overhead cams, let's just say that all engines which utilize solid lifters (tappets) like our 4 cylinder Triumph engines need to have this clearance checked and adjusted at regular intervals. Each engine manufacturer will have their own specification for the correct clearance and their own specific procedure for adjusting this clearance (ex: engine hot or cold). Should you install a high performance camshaft in your engine, the correct valve adjustment may change from what was specified by the engine manufacturer, and you'll need to follow the camshaft manufacturer's recommended setting. If your valve clearance is greater than it should be, the valve will not open as far as needed for full power and excessive noise and wear will be the result. If the clearance is less than specified, the valve may not close completely, causing the combustion in the cylinder to 'burn' and ruin the valve itself.

For our 4 cylinder Triumphs, the valves are adjusted 'cold'. Anyone who has ever adjusted valves which need to be adjusted 'hot' will know what a blessing this is! Clearance is .010" (ten one thousandths of an inch) for both the intake and exhaust valves on most of our Triumphs, but for all cars and various camshafts it's not uncommon to have a different clearance specified for intakes vs exhausts. For example, early TR2's equipped with iron rocker pedestals specified clearances of .010" for the intake valves and .012" for the exhausts. To determine which valve is which, see the description in method 2 below.

So why is it so 'tricky' to adjust your engine's valves? For that answer, take a look at the valve train illustration (fig.1). The valve opening and closing (valve timing) is controlled by the camshaft (part #7). As the camshaft (A.K.A. "bump stick") rotates on its axis, the egg shaped 'lobe' pushes the tappet up as the bump rotates under it. The tappet then forces the push rod (part #5) up, which in turn causes the rocker arm (part #2) to pivot (rock) on its shaft. Just like a couple of kids on a teeter-totter, when one side of the rocker arm goes up, the other side must go down, pushing the valve stem down and opening the valve (part #1) at the same time. To achieve the proper valve clearance, you have to be absolutely certain that the camshaft is not in a position to be exerting any upward pressure on the tappet (bump down).

But the camshaft is buried deep inside the engine, so how can you tell that it's not at a place where the lobe is starting to ramp up toward the tappet? There are a couple of ways to do this. The first is called the "Rule of 9", and while it works on our TR2-4A engines, it might not necessarily apply for all 4 cylinder engines. Here's how it works:

With the rocker cover removed, mentally number each valve and rocker from front to rear. There are 2 valves per cylinder, so your numbers will be 1-8. I like to pull all of the spark plugs so that the engine will be easier to rotate by hand, then I reach down and pull on the fan blade to slowly turn the engine over (clockwise when viewed from the front). When the #1 valve has opened fully and just starts to close, adjust the #8 valve (1+8=9). To adjust the valve clearance, refer to figures 1 and 2. Loosen the lock nut (part #4) with a ½" wrench, and check the clearance with a feeler gauge of the correct thickness while using a screwdriver to turn adjusting the adjuster screw (part #3). You will have achieved the correct adjustment when there is a slight drag felt on the feeler gauge. Hold the adjuster screw in position with the screwdriver while you tighten the lock nut firmly to hold the adjustment. The adjuster screw will want to turn as you tighten the lock nut, so you'll probably have to apply some opposite force to the screwdriver to prevent the screw from moving. When the nut is tight, recheck the clearance with your feeler gauge. If it has changed from the light drag you felt originally, loosen the nut and start over again. Continue until the nut is tight and you're certain that the clearance is as specified, and then move on to the next one.

Rotate the engine with the fan blade and watch valve #2. When it is fully open, and seen to just start to close, you'll know that it's time to adjust valve #7 (2+7=9). Continue working your way toward the rear of the engine, watching each successive valve open fully, and adjusting the valve whose number added to the open one adds up to 9. When you reach the rear of the engine, valve #8 is open and you've adjusted #1, all of your valves will have been adjusted, and the job is done.

As I mentioned before, this "Rule of 9" works on the Triumph TR2-4A engines, but it doesn't necessarily work for every engine. For that reason, I prefer to adjust valves on a cylinder by cylinder basis, so that I know what's going on with the camshaft of any engine I might be working on.

Take a look at figure #3. Here is a Triumph TR4 engine with the rocker cover removed. We know that there is an intake and exhaust valve for each cylinder, and you can see that they are positioned on either side of the spark plug hole. The first two belong to cylinder #1, the second two are for cylinder #2, and so on. Having a little bit of knowledge of the 4-cycle engine process, I know that the intake valve is open during the intake stroke, and the exhaust valve is open during the exhaust stroke, and both valves should be closed during the compression and power strokes. But which valve is which, and how do we know which stroke any particular cylinder might be on?

First, let's decide which valve is which. This is pretty simple to do with the rocker cover removed. Look at the opposite side of the head in figure #3, and you can follow the intake manifold runners from the carburetors to the intake valve for each cylinder. You can also see that the exhaust manifold lines up with an exhaust valve for each cylinder. Now if you rotate the engine slowly with the fan blade just as it was done with the "Rule of 9" method above, you can watch each valve open and know whether the cylinder you're watching is in the intake or exhaust stroke. By design, there is a small area between the exhaust and intake strokes where the exhaust valve is still closing and the intake valve is starting to open, so I adjust the valves of each individual cylinder as follows: When the intake valve starts to close, adjust the exhaust valve for that cylinder. There's no way that the exhaust valve is still open toward the end of the intake stroke, and the cylinder has to go through the compression and power strokes before it starts to open again. When the exhaust valve just starts to open, adjust the intake valve, confident that the full exhaust stroke stands between the piston's present position and the start of the intake stroke. Watching the valves in this manner, I can be certain that the camshaft bump is down for the valve I'm going to adjust. Works every time, for every engine, and I can adjust one cylinder at a time, without jumping around all over the place and having to work math problems at the same time!

With the valve adjustment complete, all that's left to do is install the spark plugs and rocker cover. Always use a new rocker cover gasket, and even then they're prone to leak oil so I always glue the new gasket into the rocker cover with 3M weather-strip adhesive and let it dry before placing the cover back on the engine.

EFI and the TR

by Brian Richards

I am at a stage now where I am looking for a new project and the one that I have settled on is to EFI my TR3A. Sacrilege I hear you all saying. Well maybe, but then my TR is not really 'original' as it is.

Like most old timers, I really did not know much about EFI except for the last 20 years or so, all my cars have been fitted with EFI and I have only experienced one failure, an EGO sensor. I have never changed their points, set the distributor or oiled the dash pots. The cars always start, regardless of temperature, and never miss a beat. I may have been lucky but they are reliable and hence I have not had the need to learn how they work. In fact all those wires and tubes tend to turn you off.

By searching the internet I have now learned a lot. I still do not understand the magic of computers but I do have some understanding of how the EFI system works. There is a great site that has a wealth of information. It is a DIY fuel injection site, www.megasquirt.info . It has a wealth of information on how it all works.

What I have learned is that there are a number of aftermarket ECUs (Electronic Control Unit) ranging in price from a DIY kit for about $180.00 to a some upmarket ones costing many thousands of dollars. There are a number of local (Australian) manufacturers among them. One interesting point I found, is that the great majority of aftermarket ECUs sold go on to cars that are fitted with EFI from new.

If you wish to modify the performance of a standard EFI engine then you cannot simply change the carbie settings and fiddle with the distributor. Some say that is a good thing. You need to alter the programme of the ECU and you cannot do that. Hence the sale of aftermarket ECUs into the performance market. All the standard sensors and fittings are retained. Basically only the ECU is changed then programmed with a lap top to achieve the results required. It is much easier in fact than on a non EFI engine.

With the TR we are going from Carbies to EFI, a much more complicated task as we have to modify the hardware. While sifting through all the advertising bumf and talking to two local performance shops, I was tending towards an Australian ECU for about $1000.00. It looked good and had all the features I wanted and more. On taking a step back, I realised I was getting away from my original intent, i.e. a 'project'. So I settled on a MegaSquirt 2 V3.0 kit from the USA for US$245.00.

This kit (MS2) is really starting from scratch as you get a PCB (printed circuit board), a packet of resistors, transistor, etc, and a case to put it all into. My soldering technique will get a try out. The finished ECU will give me full fuel and ignition control as well as control of the engine cooling fan.

The physical changes required are;

- New fuel pump
- New fuel filter
- Fuel return line and tank fitting
- Lock out the centrifugal and vacuum advance in the distributor.
- Fit the injectors to the existing or new manifold
- Fabricate a fuel rail that both holds in the injectors and supplies fuel to them
- Fit a fuel pressure relief valve that is controlled by manifold vacuum
- Fit a throttle position sensor (TPS)
- Fit one or more throttle bodies (butterfly)
- Fit manifold air pressure (MAP), intake air temperature (IAT), coolant temperature (CTS), and exhaust gas oxygen (EGO) sensors
- Fit a fast idle air solenoid (Fidle)
- Fabricate required air handling system and air cleaner.
- Fit a crank angle position sensor
- Wire it all up

Before these changes are carried out, a critical decision needs to be made. What kind of injection system am I going to use. By that I mean, how many injectors, how many throttle bodies (TB) and how will the injectors be fired. This will affect the air handling system (manifolds etc) and throttle bodies.

The throttle body is basically the butterfly, just like a carburetor. It is your connection to the engine. You can have one TB as is the case with most cars, two as is the case with the TR Carbies or, one per intake port as on EFI equipped motor bikes and outboard engines or the old Lucas system fitted to the TR6.

There are then two ways to set up the injectors, one per intake port like most cars today (multi-port) or fit them to the throttle body(s) and have one or two injectors for the whole engine like the early EFI Falcons and a lot of high performance V8s and drag cars.

Still another choice is the method of firing the injectors, batch, bank or sequential. With batch injection, all the injectors fire at once but not timed to any particular cylinder. With bank injection, half the injector's fire at once but again not timed to any particular cylinder. Sequential injection is where each injector fires at a specific point in its cylinders cycle.

With throttle body injection, they are usually batch or bank fired as they feed more than one, normally all, cylinders. Port injection is normally bank or sequential fired. Sequential injection is much more complex for the TR as you need a cam position sensor. Also the complexities would far outweigh the advantages.

I imagined that with sequential injection the fuel would be directed straight into the open intake port but in fact at higher RPM and load, there is not time. The intake valve is only open for about 30% of the cycle and above about 2500RPM and 30% max HP the fuel required cannot be injected fast enough. This means that fuel is injected onto closed valves, just like bank injection. OEMs use sequential injection to lower emissions at lower RPM. If you're good enough you can tune each cylinder individually and some high end cars do just that.

So, which one for the TR? As the TR head has four intake ports, port injection is the natural choice. On an MGB you would have trouble as they have Siamese ports. Next is the throttle body. The standard TR has two (SUs) and we could simply gut the carbies and use them on a standard manifold. The throttle set up and air cleaners can be retained. Also this would retain the 'period' look of twin SUs.

Another option is to fabricate a plenum chamber to connect the two flanges of a standard manifold and use one throttle body as do most cars today. You can find suitable ones at the wreckers. I got a 1987 Holden Camira one with all fittings for $45.00. This can then be fed by an air duct from the cool side of the radiator.

A third option is to use a set of motor cycle throttle bodies. These come complete with injectors, fuel rails, fuel pressure regulators, and throttle position switch. The big bikes can produce over the required HP and as such the injectors would be suitable. A simple manifold would need to be fabricated to match them to the TR head. Air would be fed to them by a fabricated plenum chamber and air cleaner much the same as a single throttle body option. At this point I am favouring the motor cycle TB option as it overcomes the problem of fitting injectors to a standard manifold together with the fuel rails. The ease of directing cool air to them is also an advantage. Utilising the SUs as throttle bodies also has a lot of appeal. Decisions, decisions.

I have ordered my MS2 kit as well as a simulator kit to test the ECU as I build it. I will update the progress of this project in the next Sidescreen.

EFI Conversion – Part 2

As you may recall, I was deciding on the manifold/throttle body set up for my conversion. I was favouring motor cycle units over the original TR4A manifold and gutted SU carburetors or new fabricated manifold. I inspected a number of motor cycle units and decided that there would be some real problems with spacing and a new air manifold would still need to be fabricated to connect the four throttle bodies to an air cleaner.

In the end I decided on a new manifold. Once that decision was made I was able to get down to some serious work.

The Megasquirt and Stimulator kits arrived just four days after ordering out of the USA. It took me about five days of soldering at night, on the kitchen table much to the consternation of my wife, to complete the kits. My first problem occurred when I tried to down load the firm ware to the MS (Megasquirt) unit. This is the base software the unit uses, like the operating system on your computer. I am a bit of a novice when it comes to software so I called on our Editor, Bob Slender, for some help. After a bit of fiddling at his place we were up and running and I was able to test the MS assembly. This checked out OK so I put it aside and went to the garage for the serious stuff.

After many hours at the local Pick and Pay wrecker, I settled on the 1986 Camira 1.8ltr engine as the donor car for most of the EFI parts I needed. This was chosen as it has all the components I needed with a comparable engine output. The parts I am using are the injectors, throttle body complete with throttle position sensor and idle control, air intake temperature sensor, coolant temp sensor, fuel pressure regulator,

Throttle operating mechanism and cable, air intake hose, and the engine wiring loom and relay/fuse block. The wiring loom gave me all the colour coded wire as well as all the weather proof connectors I needed to connect the various sensors and injectors to the ECU. This all cost me $135.00.

The new inlet manifold was the next on the list and to complete this I purchased some 12mm and 6mm plate, some 40mm x 3mm tube and 20mm rod from my local aluminum supplier. I made up the two manifold mounting plates from an old damaged TR3A manifold. I had intended to make them from the 12mm plate but it was easier to cut up the old manifold and bore them out to take the 40mm tube. Next were the four 40mm runners with the holes cut in to fit the injector mounting bosses. I then removed the whole carbie set up from my car so I could make a mockup of the manifold/plenum chamber.

I made the plenum chamber from cardboard and fitted the assembly to the engine to ensure that all would fit OK. The throttle body mounting plate was machined from 12mm plate. This would form the front face of the plenum chamber. Next I had to work out how to operate the throttle. I settled on the original Camira mechanism which could easily be adapted to my car as I already had converted to a cable assembly for my HS6 SUs. This then involved incorporating a mount on the plenum chamber so a mount was made from 6mm plate to be welded to the top of chamber. Bosses were also made to mount the air intake temperature sensor and the vacuum take-off for the brake booster.

This mock up and the bits I made were the taken to my friendly welder (I am next to useless with a welder unless it is at least ¼ inch steel plate). The extractors were also removed and a mounting boss fitted for the exhaust oxygen sensor.

I turned up the injector mounting bosses and the fuel rail connecting bosses from the 20mm rod. These bosses were to be glued to the manifold runners and fuel rail. The fuel rail is mounted to the manifold and performs two functions. It transfers fuel to the injectors and holds them in place. This retaining function means that it must be firmly attached to the manifold and cannot simply sit on the injectors. It is always in the back of your mind that you are dealing with 3 bar (approx. 45psi) fuel pressure up in the engine bay.

My welder completed his job and the assembly looked great. The only problem with it is that he made it all out of 6mm aluminum plate and it is a bit heavier than I planned on. Still, one side, the bottom, and the back of the chamber can be cut off and replaced with 2mm if it proves to be a problem down the line. I glued the injector bosses into the runners and fuel rail with good quality epoxy glue; they stick aircraft together with this stuff. I then mounted the throttle linkage and fabricated the fuel rail mounts. Next was ensuring that the whole assembly was clean, no metal filings etc. The various bits and pieces were assembled to the manifold and on to the engine to check fit and clearances.

Now the throttle cable had to be adapted to the TR mechanism. A relatively simple bracket was fabricated and mounted to the bulkhead utilising the two mounting bolts that hold the upper steering column to the bulkhead. This worked out well and I was able to use a standard Camira cable. All looked good and I started on the wiring loom. See photo

The relay/fuse box was mounted were the regulator would normally fit. My car is fitted with an alternator so the regulator is not there. This brings me to an important point. If you consider EFI then you must also fit an alternator. The Lucas generator is just not good enough. I mounted the ECU under the battery box. It is out of the way, accessible and not likely to get wet or too hot. All the leads were run to and from their various locations including the ECU and then tied together with small loom ties. I used the Camira plugs and wires to connect the various sensors, the coil, and the injectors. The main fuel pump wires were also run from the rear to the relay box. All sensors hade their own earth return and these were all joined and connected to the negative terminal of the battery by a heavy cable. Poor earth returns can be a very real problem.

The skeleton of the loom was removed and wrapped with black tape to form a separate loom. My intention is always to enable the car to be returned to its original form easily, if desired. The new loom was then fitted to the engine.

A VL Commodore fuel pump (Bosch) was purchased ($50.00) as was a small surge tank, and EFI fuel filter. I figured that I would need the surge tank as when I run on the track, I normally run with low fuel levels and surge may be a problem. It is not a problem with carbies as they incorporate one in each, called float bowls. For normal road use the surge tank, low pressure fuel pump, and filter is not required. A mounting bracket was then fabricated with the original Commodore fuel pump mount as the main component. This was then all fitted under the floor of the occasional seat on the driver's side. A return fuel line was fitted from the surge tank to a fitting screwed into the fuel tank drain plug. A return fuel line was run from the engine (pressure regulator) to the surge tank utilising the plastic fuel line from a Triumph sedan. *There was a problem with this line and the proximity to the exhaust so I changed to a flexible rubber fuel hose.*

Now the fuel flow is from the normal tank pick up through a low pressure filter, low pressure fuel pump (my original set up) to the surge tank. Excess is returned to the tank via the drain plug. The main high pressure fuel pump draws from the bottom of the surge tank and pumps it through the EFI filter and up the main steel fuel line to the fuel rail. Excess fuel from the regulator is returned back to the surge tank. With all the fuel plumbing hooked up I pressure tested it to ensure no leaks.

I modified my spare distributor (82 Honda Civic) so that the advance mechanism was locked and fitted it to the engine.

Now with all assembled it was time to try and start it. I had already set up the basic configuration as per the directions from Megasquirt. Try as I might, it would not start. There were a few bangs, pops, and farts but no start. After a few days of trying to find the problems in the software I decided to isolate the fuel from the ignition. If I reverted to standard ignition, then I only had to worry about the fuel. After I got that sorted I could then concentrate on the ignition. All the original wiring was still fitted so it was an easy job to switch back.

Now with normal ignition, I tried again and it fired up immediately, run very rich but run. I am slowly sorting out the mixture. Learning how to use the software is proving a real challenge. At this point I must stop my project for a spell. My wife and I are off OS for a holiday till mid-September. When we return it will be back into it again as it must be ready for the National Meet and Concourse at Port Macquarie.

EFI Conversion Pt 3

After my quick trip around the world (seven weeks) I was looking forward to getting back to my project. I had managed to get it fired up before I left, but was unable to devote much time to tune it. Just how to set up and use the many and various parameters was proving a little more difficult than I had anticipated. The mechanical part of the project I found relatively easy but playing with software is not my main game.

To start with, you need to configure the ECU by inputting parameters such as, number of cylinders (that one was easy), alternating or simultaneous injection, required fuel, VE chart, calibrate sensors, etc. Then the basic settings to get the engine started need to be inputted such as cranking pulse width, after start enrichment, idle stepper motor steps, etc. Once the engine starts it needs to be set to idle OK. This is done by playing with the idle settings, the VE (volumetric efficiency) chart etc. to give a good reliable start at any temperature and satisfactory idle.

Then tuning starts and this can take some time with a lot of road tests or a few hours on a dyno. After the tuning is completed, you need to go back and re tune the start and idle, because you will have changed some of the base settings that the idle relied on. All this should be achievable with a little effort and patience providing your ECU and installation is up to scratch.

When I first powered up the installation I found my first problem. The fuel pump should run for 2 seconds then stop until the ECU sees a tach signal i.e. the engine is turning. Well mine stays on all the time. Also I have set up one output to control my engine fan. That too stays on regardless of engine temperature. Both of these drivers utilise identical components and circuitry in the ECU. To date I have been unable to find the problem. Fortunately it has not stopped me from proceeding with the tune.

The second issue I found was that the ignition control was providing the correct advance curve but that the coil driver was malfunctioning and the spark was erratic. I am currently working on this via email with MS in the USA. I disconnected the ignition driver and reverted back the standard ignition so that I could concentrate on the fuelling side of it until I can sort out the ignition problem.

Well my attempts to date have been far from fruitful and I must admit I was a little disheartened by the issues I found with my ECU and have been unable to correct. As it is my strong desire to take the car to Port Macquarie with the fuel injection fitted, I have ordered a fully built up ECU out of the USA and will work on getting the one I built fixed as time permits.

There has been some success. The installation worked out well and I have actually managed to drive it around the block a couple of times. It felt good under power but idle is still an issue, although it starts OK. There is a facility to data log all the things that are going on in the system and that is a great help when fault finding and tuning. What I have found is that some of the results that I have achieved have not always been repeatable and that is a little frustrating.

To test my installation I removed the system from the car and built a bench test rig. I left the manifold on the car, just removed the ECU, fuel rail with injectors, all the sensors, fuel pump distributor, and the wiring loom. The distributor is driven by a battery powered drill and four Vegemite jars collect the fuel as it is injected. Except for the issues of the three faulty drivers (pump, fan and coil) the system works faultlessly. This I found a bit disconcerting and as such went looking for sources of stray signals in the car that may be affecting the various sensor inputs. As of today I have found none but stripped the wiring loom and rebuilt it to ensure there were no issues there. It has been refitted and it tested out well.

While awaiting the arrival of the new unit from the USA I will refit the system to the car and see if I can get the fuelling to work. This should save a lot of time when the new ECU is fitted as I can simply down load the set up file and load it in to the new ECU.

All in all, not as straight forward an exercise as I anticipated but I have been encouraged enough to say at this stage that it will work well when I get the issues sorted out. I did say at the beginning that I wanted a project....

EFI Conversion Pt4

As you may recall in Pt3, I was attempting to get the set up working on just fuel until the new ECU arrived from the USA, well my attempts were not that good. With the Narrow Band (NB) O2 sensor I had fitted, it was very difficult to know just what the fuel/air mixture was. In all the data on setting up EFI systems they always recommend a Wide Band (WB) sensor. A NB sensor will only give a 0 – 1.0 volt signal to indicate the mixture just either side of the ideal (14.7 : 1.0). This is fine for the set up once it is tuned as the O2 reading is normally only used to fine tune the engine at cruise and give best economy and lowest emissions. They are less expensive and much more robust and as such are what is normally fitted to your car. For setting up a new installation you need better information and the WB gives a mixture reading of about 7:1 through to 20:1.

After experiencing the difficulties with a NB I bit the bullet and ordered a WB sensor and controller from Innovate in the USA. You need a controller to be able to read the output of the WB sensor. This cost about $200.00 but can be removed and replaced with a NB once the installation is tuned. It can then be used on other installations for tuning, either EFI or carbs. It also has data logging capabilities.

The new ECU arrived and was duly fitted. Well everything worked, fuel pump, ignition and fan control. Some tuning was done until the WB arrived. When it was delivered and fitted, tuning really started. What a difference it made. I now knew just what the mixture was for the various RPM and power settings. This naturally made tuning much simpler and accurate.

Utilising the software available I was able to carry out an on road dyno test and it showed a good curve up to 5400rpm with a max HP of 80 @5000rpm at the wheels.

On the weekend prior to the Concourse I took the car on a run up to Murray's Run and back, about 250km. The car run like a champ but on the return trip the WB sensor had failed. I had fitted it to the NB bung in the exhaust and that proved to be too close to the head and the temp caused it to fail. They do not like too much heat.

That was OK; I would just fit the NB one and take the car to the concourse. It was after all in a reasonable state of tune. I changed the sensor and made the required changes to the software to tell the ECU of the change. Well, it all went to hell. The car would not now run well. As I only had a couple of days before setting off to the concourse and I had not even started to prepare it, it was still set up for Wakefield Park race track; I regrettably made the decision to revert to carbs. This took about 3 hours. I left the ECU and new loom in place and used it to control the fan.

As the distributor was still talking to the ECU, I was able to carry out an on road dyno test with the carbs fitted. The result was very interesting. At the lower end of the RPM range, up until about 3500RPM, the carbs were better but after that the EFI was better. At Wakefield I always felt the car run out of puff at about 4600RPM and the test showed why. At 4600 the HP just levelled off and the mixture went lean. The engine was starving.

What the two tests showed me was that the EFI was going to be much better overall once it was tuned correctly and I now have much more confidence in my ability to get it right with the WB sensor.

A very real problem with my new manifold has proved to be one of vibration. At about 2600rpm, it gets a violent vibration around the manifold/throttle body area. It was vibrating like a guitar string. Its mass and length was tuned to the engine at that speed. If continually run around that speed it would eventually suffer a mechanical failure, most likely at the weld where the runners met the cylinder head attaching flange. I had elected to run it to the concourse and modify it latter but due to the software issues it was not to be.

A new WB sensor has been ordered and it should arrive this week along with my original ECU. I had returned it to be repaired. The problem turned out to simply be two transistors that I had fitted incorrectly.

As the manifold requires modifying, I decided to try a different approach and use a pair of SUs as the throttle body. I had a spare pair of carbs and fitted an injector to each. Fitting was relatively simple as they fitted where the main jet would normally be. As the jet pointed up at the dash pot (this was lock fully up) I needed to re-direct the fuel spray at the throttle plate. To achieve this I fabricated a stainless steel deflector plate that sits above the jet. This works well and the engine started and run well. A throttle position sensor was fitted to the front carb. All this took about one day and required no permanent mods to the carbs. Also the engine looks standard and you even use the original air cleaners.

The problem with this set up is that the injector I am using does not have sufficient flow as we now only have two injectors, not four. A new pair should be delivered today and with the new WB sensor I should be able to get the engine running well. My plan is to take it to Wakefield Park on the 5th Dec for my GEAR day. It will be interesting.

EFI Conversion Pt 5

I read through my previous articles on the EFI conversion and realised that it has been a real journey. A lot of the problems have been mine in that I did not come to grips with the soft wear issues. I still struggle with them.

In the last issue I had been fiddling with an SU version of a throttle body system. Well the new higher flow injectors were not man enough for the job and although the engine ran OK, it run out of fuel as the power demand went up. Whilst thinking about a solution, it suddenly dawned on me that I had lost the plot. Some say that happened at birth...but...

Why was I heading off in a different direction with its own set of problems? I had sorted the port injection set up and knew how to fix the problem with the vibration in the manifold. Why was I off trying to reinvent the wheel?

The Christmas, New Year silly period came and nothing happened for some time.

A couple of weeks ago I took a cutter to the EFI manifold I had made and cut off the top, side, bottom, and end, only retaining the runners, throttle body mount, and the side that they were welded to. My aim was to reduce its weight; it was made from 6mm aluminium. I purchased some 2mm sheet and had the modified manifold welded together. The result was a manifold that was about half the weight of my first attempt.

All my data logs had also showed that I was dropping a tach signal every now and then and was unable to correct it so I modified the ECU and test proved that it was now consistent. I rebuilt the wiring loom to improve its routing in the car and fitted the whole modified assembly to the car.

Well it started first go, could not believe it.

I spent a few days with the tune but unfortunately still had a problem with my WB oxygen controller and had to use the NB one. This made it hard without a dyno but I managed to get it to run OK and took it on its first club outing, the Presidents Australian Day bash.

All went well with the only real problem being a slight lumpiness at low power but it would clear as power was applied. Some fine tuning is still required. The vibration issue appears to have been resolved so I now confident we are back on track with a viable system.

EFI Conversion Pt 6

As you will recall, in the last issue I had the engine running. Well things moved on rapidly from there and the installation is all but complete. After the President's Australia Day Bash I carried out some more on road tuning and had the car running fairly well in the lower power range. My problem was ensuring that the upper power range was fueled correctly as I did not want to do any damage to the engine such as melt a few pistons. The next GEAR meeting at Wakefield Park was coming up on the 13 Feb and I had entered the TR.

To ensure the engine was fueled correctly, I booked it in to a local Dyno specialist to get the top end of the fuel map sorted. I chose to do this with 95 RON fuel as this is what I normally run. I only use 98 for Wakefield. On the Monday before Wakefield (Wednesday) I took the car in and it was put on the dyno. The operator allowed me to stay with the car during the dyno run so I was able to watch the process. It was also handy as the operator had never worked on Megasquirt before and was unfamiliar with the tuning software.

First run was on the engine as presented. The top HP was 75 at about 5200RPM which is about what you would expect on an average TR. He then proceeded to set the fuel map. To do this you set the engine under load at a particular RPM and manifold pressure. The amount of fuel injected is then adjusted up or down to achieve the desired mixture which is measured by an oxygen sensor in the exhaust pipe. This process is repeated through the engines operating range.

After these adjustments another power check was run and it showed 90.2HP, a real improvement. This was achieved by greatly increasing the fuel at the high RPM and manifold pressure settings.

After this power run we checked the spark plugs and there were some slight signs that there may have been some detonation (pinging) even though we did not hear any during the run, it is noisy in the dyno room. As the ignition is also controlled by the ECU, it was easy to retard the advance curve by 2 degrees back to a maximum of 34 degrees. Another power run showed 89.1 HP at 5000RPM (I try not to run the engine faster than 5000RPM). A loss of only 1 HP and I could live with that given the safer ignition setting. The plugs were one heat range hotter than standard so I will also go to a plug one heat range colder than standard to further ensure no detonation.

A road test showed some hunting at constant low power setting such as driving at around 60 KPH with a light throttle setting on flat road. You cannot simulate this on a dyno as it does not have the inertia of a car to drive it. This was only fine tuning that I could do on the road. We put the car back on the dyno and the operator done a bit more fiddling; I paid the bill and drove home very happy.

On the Wednesday morning I picked up Register member John Muddle and we headed off to Wakefield Park for the big test. As normal, we stopped at the Mobile service station at Pheasants Nest and filled the car with 98 RON and we had breakfast. For those who do not know, Pheasants Nest is about one hour south of Sydney and Wakefield Park is about another one hour ten minutes south, just outside Goulburn. The car ran like a charm on the trip down and I was feeling very pleased with myself.

After scrutineering and the normal preparations, it was time for the first practice run, and the TRs first real test. The car was running well but then started to misfire. Back in the pits I hooked up the lap top and saw that the engine was intermittently losing its run signal. I cleaned up some wiring in the engine bay that I should have done before and all seemed well. Another run proved that the problem was still there and I started to work out how I was going to get the car, John and myself home. Further investigation showed that the connection for the power supply to the ECU was loose. Fixed that and all was well.

On the track the car went like a train and I was consistently about two and a half seconds faster than before (around 1.22.3 per lap). This was not all down to EFI. The track had been resurfaced and was about one to one and a half seconds faster. Still a good result. On the trip home we normally get fuel about twenty minutes north of Goulburn. This time I was able to drive home without fuelling so there has been an improvement there though I had missed some laps due to my electrical problems and that would have helped.

So now the EFI project is basically finished. Would I do it again? YES. I learned a whole lot about EFI and the end result was worth it. Would I use Megasquirt again? Maybe. It is, as Megasquirt says them self's, a proto type system, not a commercial one and is designed to teach you all about EFI and to allow you to add or modify to your own requirements.

Software and electronics is not my thing so I struggled with it, especially the software and there is no local support. I did enjoy and felt comfortable with the mechanical part of the project.

Post Script.

I took the car to the Princess' *(the Xerri owned TR3A)* birthday bash in Cobram. We completed around 2000km including a run through Cooma and Kiandra. Starting the engine in the morning after overnight stops in Cooma and Bright was interesting as I had never had to start the engine in 3ºC temperatures before and as such had never been able to tune it for cold starts. The engine was reluctant to start but once it did it was fine. This issue will be gradually sorted as winter comes to Sydney.

Apart from the cold start issues the engine run faultlessly for the entire distance.

I started this project in August 2007 and effectively completed it in March 2008 - Brian Richards 2008

Update (1/1/2009)

It has been some nine months since my EFI project was determined to be finished. Since then I have completed another four Wakefield Park track days, participated in a mini TR Tour around NSW, gone to Canberra for our Christmas in July, and attended the 2008 National meet at Thredbo. In total, some 6500km.
In all that time I have not experienced one failure and the car has run perfectly except for some difficulty in starting a cold engine.
My problem with the cold start turned out to be a programming issue. In the MS, you have two choices for cold start set up. Cold start settings can be likened to the amount of choke you apply to carbies. It sets the additional fuel you require when starting a cold engine.
One option is where you set a cold point and a hot point. The programme then simply draws a straight line between the two and uses that to set the cold start fuelling. The other utilises a twelve point chart where you can set the amount of fuel required for twelve different temperature settings. This allows you to draw a fuel graph that better suits your engine.
I had told the ECU that I was utilising the twelve point chart and as such it ignored the two point graph but all the adjustments I tried had been to the two points. In reality I had no choke as the settings on the twelve points were all zero.
Once I set up the twelve point chart, starting was no longer an issue. Software again!!!!!!!!
As a result of my little project, one of our members asked me to fit EFI to his carbureted TR6. To do this I chose a local ECU (Adaptronic) as local support is available if I happen to fall under a bus.
I modified a set of original Lucas manifolds to take the Bosch injectors. The Lucas distributor was completely gutted and two Hall Effect sensors were fitted to give a timing signal and cam position signal.
Basically the set up was the same as for the TR3A and did not present any real surprises. The engine runs well and except for some cruise economy tuning yet to be done, goes well.

My DIY EFI had been working well now for a number of years with some mods along the way. Was this the end....no? Now there is a MS3 with an optional extension (X). With this, I can go fully sequential injection and coil on plug (one coil for each plug). There are also a number of other features that are available. Another upgrade. The MS2Extra utilises the same ECU as the MS2 and the MS3 uses the same motherboard with a different plug in chip. The X is another add on board. This meant I can still use the ECU I built six years ago. I purchased the new parts and fitted them. I decided not to go coil on plug, no need for it with an engine as slow revving as the TR.

With the new MS3X, I needed to modify the loom so decided to purchase a whole new DIY loom. A number of changes had been made over the years and it was getting a little messy. After rewiring the engine it all run well but did require a bit of retuning. No real change was noted in the engines performance which was a little disappointing. It still idled poorly. After that I decided I needed a cruise control. The fitting of this was not difficult and is great on the freeway. All went well for about 18 months. While the engine was running well I felt it could go better and that the throttle bode was strangling the engine at high power and RPMs. That set me off on the design of a new manifold.

After a lot of research I decided it was not going to be easy due to the limited space in the TR engine bay. I tested my old manifold for air flow with the trusty garden blower and an anometer. The results confirmed my worst fears; there was a significant variation in air flow from the four ports. Research showed that manifold design is a bit of a black art and with a naturally aspirated engine the only real answer is individual throttle bodies. That all looked too expensive. Then Dr Google came up with the answer. I found Jenvey in the UK. They make pairs of individual throttle bodies that fit the standard Webber manifold. They are the same length and have the same mounting pattern

I purchased a pair of 45mm units from the local agent together with a suitable Throttle Position Sensor. These turned out to be a very professional product and had individual idle balance screws to fine tune each cylinder at idle if required. I also purchased a new set of 45mm Webber manifolds from one of our members. All the other bits and wiring loom from the old set up were still able to be used.

After a bit of fiddling, I fitted up the manifold and throttle bodies. I had a spare head so was able to do this on the bench. Much easier than on the car. A throttle cable end and linkages were then fabricated and mounted on an aluminium plate that attached to the lower two mounting studs for the front throttle body. I needed to get a Manifold Pressure Sensor plumbed in so fitted four small hoses, one from each manifold runner, to a single collection chamber also mounted on this plate. This was then connect to the sensor and the PRV. A brake booster line was also fitted.

The whole assembly was then fitted to the engine and much to my relief, fitted in well. After a visit to the Pick & Pay wreckers, I had a suitable throttle cable to modify and fit. This worked out well and I was able to get a progressive throttle movement. With four 45mm TBs it does not take much throttle peddle movement to get a big change in engine response, so to reduce the sensitivity you need to work out a progressive linkage.

Now, will it work?? First go and it started and run OK. After balancing the two throttle bodies (just like a pair of SUs) for air flow I did a bit of idle mixture tuning. It did not need any fine balancing with the air balance screws. To my surprise I could get the engine to idle comfortably at 600RPM. With the old set up I had to idle at around 1000RPM and it was lumpy at that. What a difference a good manifold set up makes.

Now the difficult part and the one that took the most time. The air cleaner. My first EFI set up used a foam pod filter just inside the grill and connected to the throttle body with some of the Camira air intake hose. This would not work with the new set up. With the TR there is limited space due to the inner guard flowing in towards the engine at the front. With number one runner there is only 42mm clearance. Ideally you want a minimum of 19mm from the intake to the filter medium and filters are normally at least 25mm thick. Most people with Webbers modify the inner guard to accommodate a suitable air cleaner. I did not want to do this as I always try not to modify the body or chassis with my mods. With all except the rear brakes and shock absorbers I was able to do this and those mods are only minor.

Research found that Piper Cross make a filter that would fit that is only 40mm deep. I purchased one and fitted it. The foam did touch the inner guard a bit at the front but did work. Ideally you need to fit intake trumpets to get the best air flow through the intake but 25mm were the shortest I could find. These could not be used so I turned up four 10mm deep units. Not the ideal but a good compromise

After doing some more tuning the engine was running well and much better at lower RPMs. The effective length of the intake runners was increased from about 100mm to 220mm and this greatly helps with lower end torque. I can now drive around at 1500 where as before I would have to go up a gear. My cam comes in at around 2400RPM.

I took the car to Wakefield Park and knocked some more time of my PB. Still, I was not finished. I wanted cold air intake and this was not possible with the filter I had. A new cold air box was needed. Again after some research I purchased some polyurethane extruded foam and sculptured a air intake manifold. I then covered it with fibreglass and sanded it relatively smooth. The foam was then picked out leaving me with the required manifold. After a bit of clean up I painted it crackle black (hides a multitude of sins) and it looks great. I then adapted this to the aluminium backing plate that came with the Piper Cross filter, fitted a new pod filter behind the grill and connected them with a flexible hose.

In the end it cost me under $900.00 (including the filter I ended up not using) to get what I should have got at the start but I have learnt a lot on the way and it certainly keeps me out of the pub.

It is now finished.......I know I have said this before but this time??????

UPDATE ON EFI PROJECT
You all thought this was over.........no, it is still ongoing.

The system has been in operation now for a few years and overall has performed well. About 6 months ago I decided to tidy up my wiring loom a little. Ever since then, I had some irritating tach signal problems that caused my ignition advance to wander. The engine still ran OK but was not as sharp as it should have been.

About 8 weeks ago I decided that I would find the problem and fix it. Well, to cut a long story short, I elected to update the set up to go wasted spark and semi sequential injection. This entailed fitting a toothed wheel and sensor to the crank, some internal mods to the ECU, fitting new coils, removing the distributor, and some wiring changes.

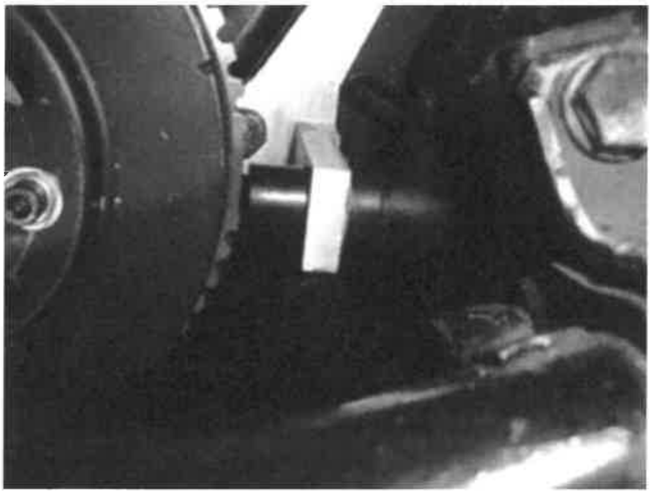
I had some issues with the fan control on the ECU so I sent it off to a contact in the USA to fix and modify. The mods were not major but as it was there, I got him to do it and this also gave me ready access to good advice on the project. I had a spare ECU so I could still use the car.

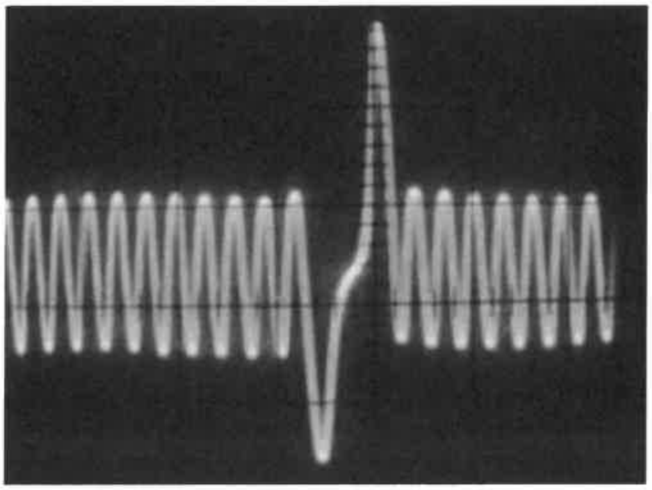
Next I had to find a suitable timing wheel. With EFI, you have to tell the ECU what is going on with the engine. To calculate the engine speed, it reads the timing pulses, measures the time splits and calculates the RPM. From this it calculates the next ignition event based on the last event. When you use a distributor to provide the pules, the ECU only gets this information every 180 deg of crankshaft rotation. So when you are accelerating, the timing information is 180 deg old by the time the ignition occurs. As the engine speed has increased, the ignition will be a little later than the optimal. With a distributor based ignition system as is normal on a TR, this is not a problem as it is connected to the crank and always knows what speed it is doing but with EFI it is an issue.

Now with the mighty TR fitted with EFI, this problem is not great as it does not change its RPM that quick but it still exist. After much searching through Pick'n Pay wreckers, I decided on the wheel from a mid 90s Daewoo Lagansa. It is a 60-2 wheel. This means that it has nominally 60 teeth but with 2 missing. With 60 teeth, the ECU will get the speed and position information ever 6 deg of crank rotation, much better than every 180 deg. The two missing teeth provide the ECU with a marker on crankshaft position. This meant that I no longer required a distributor....more on that later.

The wheel on the Daewoo is part of the harmonic balancer/pulley. I was able to cut the wheel off the balancer and machine it to fit the Holden balancer I use on my engine. As you can see by the picture, it fits very well and looks like it was meant for the job. (1)Three screws through the puller holes on the balancer are used to retain the new wheel to the inner element of the balancer. Due to the mass of the wheel, I was concerned that these three screws would not hold against the torsional vibrations of the crank. To handle these torsionals, I fitted six pins to prevent any relative movement between the balancer and the wheel. Once this was done I mounted the assembly in the lath and gave the outer rim a light skim to ensure it run true.

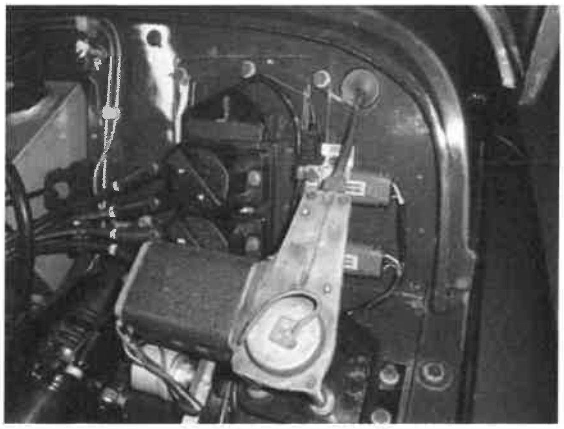
Much to my relief, this modified balancer fitted perfectly and required no modifications to the timing cover area of the engine. Next I fabricated an aluminium bracket to mount the VR sensor, also from the Daewoo. (2) All this of course required the front apron and radiator to be removed. Once the new wheel and sensor was fitted, I refitted the radiator so I could run the engine. It was still set up as before and nothing I had done prevented it from running. All I had done was to fit the timing wheel and sensor.

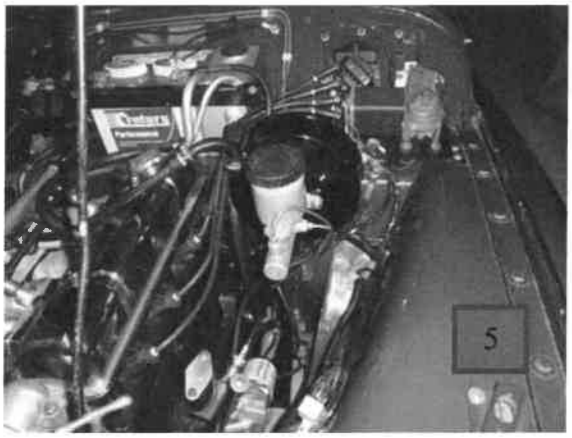




With the engine running I was able to check the output of the sensor with an oscilloscope. (3)As you can see by the picture, it was very good. You can see the regular pulses of the teeth and the major pulse as the two missing teeth passes. By this time my ECU had returned from the USA and I had hoped to have it ready for the National meet in Toowoomba. I refitted the front apron as all the remaining work was now under the bonnet.

The next step was to set up the wasted spark ignition. Most cars these days run either wasted spark or coil on plug ignition systems. With coil on plug, there is one coil for each plug and the ECU can control the ignition for each cylinder independently of each other. With wasted spark, there is one coil for each pair of cylinders, both controlled by the ECU. (4) That means on a TR there is one coil for number 1 and 4 and one coil for number 2 and 3. So when number 1 fires, number 4 also fires. This is not a problem with number 4 as it is at the end of exhaust stroke and the spark is only 'wasted', hence the name 'wasted spark'. The same applies to the other cylinders.





It can be seen therefore that as the ECU controls which and when each coil fires there, there is no longer any need for a distributor. Unfortunately, sourcing suitable coils took more time than I had so I reprogrammed my original ECU (I have two) to run my old set up but use the new timing wheel to provide the timing pulses With this set up the distributor is still required. It improved the cars running and that is how I ran it to Toowoomba.

On returning I started back into the coil problem. I elected to run two Holden Commodore V6 coils (they run wasted spark). Next, I required two trigger modules. The ECU cannot fire the coils directly and require a trigger to do this. These are available new for around $80.00 each and as the full Holden coil pack only cost $40.00, I returned to Pick 'n Pay and found suitable triggers on a Nisan Pulsar. These were only $10.00 for the pair.

With the Holden coil pack, it contains electronics required in the GM system and has three coils. I was able to modify it by removing the third coil, the electronics, and one third of the mounting plate. The new coil pack and triggers were then fitted to the LHD steering cover plate on the fire wall behind the wiper motor. See the pictures of the fitted system.

Next I removed the loom and modified it to add two ignition outputs, wire each injector separately and include the new VR sensor for the timing wheel. With all this in place I downloaded the new software required to run the system and programmed the modified ECU to run wasted spark and to go semi sequential injection. Semi injection means that the injectors are fired in pairs just as the coils are and they can also be timed.

Update....Wakefield Park. The trip down went well and the car sounded and felt good. For the practice session, I set up my lap top to log the engine parameters so that I could check the engines performance. The air fuel ratio was my main concern. During the session, the engine would not rev out past about 4000RPM. Back in the pits I checked out the data log and it showed that the engine was running so rich at high power settings, that it was putting the fire out. I changed the fuel map by pulling a lot of fuel out of the high end of the fuel map.

For the first event, I set up the programme in the lap top to automatically change the fuel map to achieve the air fuel ratios I had nominated. On the first lap the engine still was not happy at the high end but was much better than the practice session. As the event progressed, the engine went better and better until at the end, it was great. Over the course of the event. the automatic programme pulled more fuel out until it gave the mixture I had nominated. During that session, I put in my personal best for that circuit.

For the remaining two events I just let the engine do its thing without any input from me or the lap top. All in all the car ran well and after some more tuning at home, I now consider that the system is completed. (5)

Brian Richards

Lucas vacuum advance units

Distributor vacuum advance unit - general

Over the last forty years or so perhaps the most significant single contribution to the efficiency of the automobile engine has been the introduction of the humble vacuum advance to distributors.

It achieves this efficiency by monitoring inlet manifold pressure and providing further spark advance at partial throttle openings; the smaller volume of air/fuel mixture being delivered at these settings is burnt more completely and significant extra power is delivered to the transmission to allow the driver to ease back on the accelerator pedal that extra inch or so.

At highway cruising speeds this feature can be responsible for a great reduction in fuel consumption and wastage and if the unit has been well matched to the engine, unburnt mixture is virtually eliminated reducing engine wear and deposit build up in the combustion chamber and ports. Over the years the vacuum control unit has been quietly responsible for the saving of billions of litres of petrol and untold thousands of dollars by extending overhaul periods.

Some symptoms of a failed vacuum advance unit

Poor fuel consumption and acceleration, higher idle speed, a louder exhaust note but not much power under moderate acceleration, dark deposits on spark plugs and in the exhaust pipe. A failed vacuum unit may cause and will certainly contribute to these symptoms.

Availability of replacement units

The diaphragm chamber of all Lucas vacuum units was considered 'unserviceable' and so failed units were thrown away and replaced.

When stocks of new units with the knurled adjusting nut dried up some years ago, the second hand field only was left; suitability of units drawn from this area was often questionable due to age and the wide range of specifications made for different engines.

Serviceable and suitable replacement vacuum units with the knurled adjusting nut have become generally unobtainable and the sole purpose of a great many of those still in service is to hold the points plate steady. Owners have had to accept diminished engine performance; most do not know the condition of their vacuum unit, and would be unable to do much about it if they did - UNTIL NOW !

Repair of early Lucas vacuum advance units

To help overcome the serious shortage of replacements for the earlier type of vacuum advance units (the one with the knurled adjusting nut); I have developed a procedure where the original dia phragm material is replaced with new material, enabling previously unrepairable Lucas vacuum units to be restored to 'as new' service condition.

I am offering a service through car clubs for the rebuilding, repair, and service of older Lucas distributors and vacuum advance units; the service at this stage is limited to Lucas equipment and is intended to operate by mail.

To this end I am compiling a library of Lucas distributor specific at' ns for all vintage vehicles using the system and am approaching ca. lubs and other sources to achieve this.

A vacuum advance unit alone or complete distributor may be mailed by parcel post to -

Reynolds and Associates, 5 Duke Street, Forestville N.S.W. 2087

The charge for rebuilding a vacuum advance unit is $80.00 and this fee should accompany the package; turnaround is within 7 days. If distributor repair/service is required see sheets 2 and 3; for distributor and vacuum advance removal information see sheet 4.

Philosophy

In recognising the difficulties most owners of vintage and veteran vehicles experience when confronted with the prospect of rebuilding small components (and large ones too); I see the need to develop small, specialised workshops that, instead of servicing vehicles with their attendant access problems; service single components only; such components as may be conveniently mailed by parcel post. A workshop would have to be run by someone (retired?); with the ne cessary integrity, expertise, experience, and love of old vehicles.

The club system would allow inexpensive Australia-wide access to the necessary specialised 'know how' often not available to members and the club newsletter could be used to inform members of services ` to provide owners with any necessary component removal i rmation.

Lucas distributors/vacuum advance units - removal

Removal of distributor

Remove the spark plug terminals and the high tension lead from the coil tower - label the leads with respect to each cylinder; No 1 being the cylinder nearest the front of the vehicle. Remove the low tension lead from the terminal on the side of the distributor body. If a vacuum unit is fitted, unscrew the vacuum pipe union or, if a vacuum hose is used, pull off the hose.

If the vehicle is not fitted with a manual advance lever, remove the distributor body clamp nut(s) which hold the clamp plate to the engine. If it is not intended to turn the engine while the distrib utor is removed, remove the distributor cap and take note of the position of the or relative to the casing; also note the positi on of the casing lative to the engine; a simple sketch is useful.

The distributor may now be withdrawn - N.B. If the rotor turns as the distributor is being withdrawn it may mean that a skew gear is fitted instead of a drive dog; if possible note the new position of the rotor relative to the casing when the rotor stops moving. If a drive dog (keyed connector) is fitted this last may be ignored

If a manual advance lever is fitted it is usually necessary to loosen the clamp pinch bolt and leave the clamp attached to the engine

Removal of Lucas vacuum unit (with knurled nut) from distributor

Remove distributor cap and rotor; remove small wire clip from end of threaded adjusting rod protruding from the knurled nut; remove vacuum connection (if not previously removed); (A) lift the spring/eye connection off the points plate peg or (B) remove the retaining spring pin from the vacuum unit lever peg; remove the two points assembly to casing screws and lift the points plate assembly away.

Note that one of these screws holds the points plate earthing wire.

Unscrew the knurled adjusting nut completely (CARE: it is spring loaded) and remove together with the load spring.

The vacuum unit may now be withdrawn; note the small flat indexing spring in the knurled nut recess.

Refitting is a reversal of the above procedure; it is not necessary to refit the small wire clip and it may be omitted if desired.

Distributor installation for TR2-3A

The advance plate on the distributor has been set to maximum retard with reference to the type of vacuum advance unit fitted; this setting should not be altered until the distributor has been installed.

The engine should be set up with No 1 piston at top dead centre on its firing stroke by turning the crankshaft MANUALLY in a clockwise direction (viewed from the front); DO NOT allow the crankshaft to rotate anticlockwise even a small amount to achieve this setting as the backlash in the distributor drive train may cause the initial distributor setting to be incorrect.

The No 1 piston is at top dead centre when the hole in the back flange of the crankshaft pulley is aligned with the pointer on the front of the timing chain cover or when No 7 and No 8 valves are at the point of balance.

If a crankhandle is not available the engine may be turned over by selecting top gear and slowly pushing the car forward - remember to take the car out of gear and apply the handbrake after achieving top dead centre.

With the clamping yoke loosened and its bolt as well as the vacuum unit facing away from the engine, slide the distributor assembly into the pedestal mount, rotating the distributor cam until the drive dog locates positively and the assembly is correctly seated. The rotor should point approximately towards No 1 spark plug hole and the vacuum unit approximately towards the left hand (passengers) edge of the water pump housing.

Centre the clamping plate on its studs by rotating and fit the washers, split washers, and nuts.
Rotate the distributor body until the points are JUST starting to open and tighten the clamp pinch bolt; turn the knurled nut to advance (A) the unit one division on the scale stamped on the body of the vacuum advance unit; final timing should be set on the road.

With the engine at operating temperature and travelling at 30 MPH select top gear and accelerate to 50 MPH; the setting is correct if just the faintest trace of pinking is heard - heavy pinking means too much advance - use the knurled nut to achieve the final setting

Darcie Reynolds

Uncle Jack's Engine Building Tips

These apply to the Triumph TR-2, 3, and 4 engines.

Block

1. Have it tanked. This cleans all the passages.
2. When it's tanked, the aluminum plugs in the ends of the oil gallery will melt. Replace them either by tapping the holes NPT or using straight socket head setscrews. Be sure to not screw the front one in so far that it blocks the passage to the front cam bearing. Be sure the front plug is at least flush with the front of the block as the engine mount plate covers it.
3. Have cam bearings installed, plus plug at rear of gallery. Check to see if the shop installed the rear bearing correctly by blowing air down the rocker feed hole and feeling to see if air comes out the hole in the rear cam bearing. Put a bead of JB Weld around the edges of the rear cam expansion plug.
4. If you are going to plumb an Accusump into the main gallery, now is a good time to drill and tap the centre hole in the gallery to accept an NPT fitting for the Accu hose. While doing this, you can also drill out the passages to the centre main, because it supplies oil to two crank throws, while the end mains supply only one throw each. Be careful not to drill too deep, and remember that when the holes intersect, the drill will catch and try to break your wrist.
5. When you are ready to install the plugs in the sides of the block, make sure the holes in the cam bearings are exactly lined up. Install the sealing bolts very slowly to make sure the little nubbin on the end goes into the bearing hole. If misaligned, it ruins the bearing. In a worst case, you can grind the nubbin off of the bolt. The cam bearings aren't going to turn in the block – this practice of locking the bearings in place was used very rarely in the era and never today. Some builders feel that the plugs in the side of the block should be drilled and safety wired. I've never done that and have never had one come loose, but I can't criticize the practice. The rear cam bearing supplies the oil to the rocker assembly via a long hole from the bearing to the top of the block. If the machine shop does not align this hole properly, no oil will get to the top. Check it with compressed air.
6. Use emery cloth on the liner registers (where the figure 8 gaskets at the base of the liners seal against) for good sealing of the liner bottoms. *(I cleaned the liner registers in the block with a small wire brush on a long drill extension and a ¼ inch electric drill. TFM)*
7. At about this point, check the water outlet hole in the side of the block just above the starter. In old blocks, this hole will be rusted shut. Drill it out so that the block will drain. I don't trust the old spigot type plugs – I use a cap screw and a nylon washer as a plug.
8. You can paint the inside of the block if you want to but I've never seen a benefit from it.
9. Some folks think that the block should be resurfaced on the top because these blocks are now pretty old. I don't do that, because I've never seen an engine on which this was done still have the top surface at exactly the right relationship with the liner registers. In addition, the liner protrusion will be even more difficult to set.
10. The head bolt holes should all be re-tapped (chase the existing threads with a tap). Getting the old studs out is sometimes a problem. As a next-to-last resort, weld a nut to the top of the stud and use a big wrench. Breaking one off is not a good thing to do. As a truly last resort, leave the old stud. *(In a conversation with Jack he was of the opinion that if the studs threads*

and studs looked good, just leave them in. Can do more harm than good trying to take the old 40 year old studs out of the 40 year old block, like breaking the stud off down in the threaded hole!)

11. *(Use ARP nuts and ARP hardened and ground washers for the head nuts. The stock washers or even Grade 8 washers will get "indented" from the torque of the head nuts. TFM) RP assembly lube.*
12. You must decide at this point which kind of lifters you are going to use. If you are going to use "GT40" lifters, they have a smaller diameter and the holes in the block must be sleeved. They are very high quality and long lasting, but then you always have to use them in this block because the sleeves will never come out. The sleeves need to be honed at the very top after installation. Some cams require a larger diameter lifter, so you use stock lifters. This requires no extensive block preparation, but it's a good idea to use a brake hone on the bores to make sure they are okay.
13. There is a big hole on the left side of the block in which the draft tube was originally installed. This is the best place to install a nice big sump vent. If you install a little one in the fuel pump plate, you run into many more problems of leakage and inadequate venting. I make an elbow out of an old draft tube and attach a flexible hose to it. You must install the catch tank pretty high in the engine compartment or else the tank will fill up with oil that has slopped over to the opening under hard cornering.

<u>Crank</u>

1. If you are going to install the aftermarket rear seal, have the seal surface of the crank turned to 2.525 – whatever the current instructions may say. These seals are leaky and they need all the help they can get. The lip tension is too low. Therefore, measure the length of the spring and alter it to be exactly 8" long.
2. If using an old crank, remove the plugs and clean it out. Heat up the area around the plugs with a propane torch to make the plugs easier to take out. Tony note: I was never successful getting these out and have the local GOOD crank shop do the plug removal, cleaning and installation of new plugs.
3. If you have a Moldex crank, and have it reground, the grinder must very carefully match the wheel shape with the journal corner radii. After grinding, the crank must be nitrided again. No
4. Put a very small amount of RTV along one edge of the seal groove in the aluminum housing. Also put a very light coat of liquid gasket sealer on the surfaces against which the seal housing will go. *(This is for the aftermarket rear seal. TFM)*
5. Install the seal on the crank. Arrange the seal so the split will be on the upside / top after the engine is right side up. *(This is for the aftermarket rear seal. TFM)*
6. Main bearings – install in block, lather up with a good assembly lube. Redline works really well but others do too.
7. Install the top halves of the thrust washers, grooved babbit side <u>toward</u> the crank cheeks. (Tony Note: the grooved side toward the crank is CRITICAL. Destroyed a block and crank by doing this wrong - was going to have the Moldex welded up and reground when the found the cracks mentioned in item #3 above)
8. Install main caps. Torque evenly. Some builders swear by studs, some by caps crews. Studs eliminate the problem of repeated disassembly and assembly damaging the threads in the block.
9. I also like to strap the centre main to add rigidity to the bottom end. To do this, mill off the cast face of the main flush with the surfaces for the head bolts. Get a front strap for a Chevy 400 block. You must enlarge the holes in the strap and you must use longer bolts. Some builders feel that this is totally unnecessary, but since starting to do this, I have never had a main bearing deteriorate faster than a rod bearing, which is something that happens more frequently than you would expect.
10. Be sure to rotate the crank frequently during the assembly sequence. It should turn VERY freely with the caps fully torqued.

<u>Front plate</u>

1. Trial fit the new gasket and check to see if the holes actually will line up with the holes in the block. They often do not. Enlarge the holes in the gasket.
2. You can use lots of different sealants on this gasket. I use dumb old Permatex "Indian Head Gasket Shellac" (brown / black liquid in a container with a cotton ball looking thing attached to the lid)
3. Put in three or four bolts to hold it in place.

<u>Aluminum front sealing block</u>

1. Orient this properly with the centre pan hole showing. The little T shaped gaskets are a PITA. I trim them off to fit the grooves in the sealing block, smear them up good with RTV, and help the whole thing into the front block opening with the help of a thin, stiff knife blade.

<u>Camshaft</u>

1. Lather up the journals with assembly lube. Lather up the lobes with cam lube from a cam company. It should be moly or stiff grease. They (assembly lube and cam lube) are two different things. (Tony Note: we also pour GM's EOS over the lobes before installing the lifters)
2. Assemble the shaft to the block. Don't damage the bearings in the process. You can make it easier by screwing a couple of 5 or 6" long bolts into the front of the camshaft and using them as a handle.

Degree the camshaft

There are lots of write-ups on how to do this so I'll just touch on small tips and potential shortcuts.

1. Install #1 sleeve, piston, and rod. Lube the rod bearing but you don't have to install the rings yet.
2. Set piston #1 at Top Dead Centre, using a dial indicator. The keyways for the front pulley should be on the bottom. Set the reading for zero degrees on the degree wheel you stick on the crank.
3. Set the crank so that it is at the position you are going to set the cam – that is, if the intake is to be at .050 at 28 BTDC, set the crank at 28 BTDC. With a dial indicator in the top of the pushrod for #1 intake, rotate the camshaft until the valve is .050 open. The crank and cam are now in the approximately correct relationship. (Tony Note: the #1 Intake is the 2nd lifter from the front, NOT the front lifter. Also, this is assuming that the cam spec is 0.050 at the lifter, not the valve. If at the valve it would be 0.033 at the lifter)
4. Install the sprockets and chains without moving the crank and cam. Rotate the engine and see where the cam really is at .050 opening. You probably won't be able to get it exactly right the first time. You have to loosen and reinstall the cam and crank sprocket repeatedly to get it to come out right.
5. Usually the most power is obtained with several degrees of camshaft advance – most of them like three to five degrees advance – that is, opening three to five degrees before the theoretical point specified by the cam grinder, unless he has already built that into his spec.
6. When everything is as you want it, throw away the sheet metal locking tabs, put some red Loctite on the threads of the cam gear attaching bolts, and torque them down.

Timing sprocket cover

1. The cover will seal a lot better if the area with the bolt holes is flat. Use a hammer with something steel to back it up, and make it flat around the bolt holes.
2. Install the seal in the cover, and then before assembly on the engine, push the front pulley through the seal to make sure the supplier sent you the right seal. Don't ask why I recommend this. (Tony Note: some of the narrow front pulleys use a non-stock diameter seal (ran for 2 years before I found the cause of my leak). If you measure the diameter of the housing and the diameter of the pulley a local bearing / seal house should be able to supply you with a proper seal.)

Front pulley

1. If you have purchased a new front pulley with a harmonic dampener in it, you have to place timing marks on it. Do this now, before the head goes on. Set the crank at TDC using the dial indicator, attach the front cover, and mark the pulley for TDC, 10, 20, and 30 degrees. To make it easy to read with a timing light, paint the pulley black and the marks white. *(If you have the harmonic balancer with the "rubber ring" sandwich, you may want to drill the 1/8 inch hole in from the periphery per one of the Kastner books to make it possible to see if the outside piece has "slipped" thus changing the timing mark!)*

Sleeves

This is one of the two most vexing parts of the assembly.

1. First of all, the liners should be honed to give .004 - .005 clearance for the pistons. Anything less and you are in danger of "scuffing" the pistons – piston material sticks to the walls. (Tony Note: 0.006 is the minimum clearance. Also top ring gap of 0.014 min and 2nd ring gap of 0.011 min). *(This is especially true for forged pistons! May want to check with piston supplier to make sure you are using the right clearance with the sleeves you are using. TFM)*
2. Install the sleeves with a set of figure 8 gaskets in place, without any sealant. Clamp them down in place with washers, tubes or long sockets, and head nuts.
3. Measure the liner protrusion with a straight edge and feeler gauge per the shop manual. If you are going to use a stock (sandwich) gasket, using the .004 - .006 protrusion will work well. If you want to use a steel shim gasket or a solid copper gasket, you must work with less protrusion. The figure 8 gaskets are almost always too thick. Generally, .004 - .006 is

okay with stock gaskets, steel shim gaskets are happier with .002 - .004, and solid gaskets need .002. There are some other specific things you can do to help with the solid copper gaskets. If you need thinner fig 8's, you can make them out of the proper thickness brass shim stock, cutting them out with tin snips. It takes about a half hour to make a set, so it's not an overwhelming task. Remember that the goo you put on these fig 8's has a thickness – using the thinnest sealant available smeared on very thinly with your fingers, you must allow for .001-.002 on each side of the sealing ring. Don't use anything thick. *(I found that the stock figure 8 gaskets gave me the proper protrusion using the 87mm "racing" sleeves. I did not have any difference in protrusion <u>after</u> installing with the Permatex "Indian Head Gasket Shellac". I did <u>not</u> "allow for .001-.002 on each side of the sealing ring" as Jack said above. I <u>did</u> clean the liner registers in the block with a small wire brush on a long drill extension and a ¼ inch electric drill. TFM).*

4. This leads us to a brief exposition on type of head gaskets to use. There are three that I know of, each with pros and cons. Since this is a controversial subject, I'll just present the pros and cons as I know them.
   <u>Stock gasket</u> – Pro – most forgiving of irregularities. Requires the least attention to protrusion. – Con – the gasket will protrude into the combustion chamber below the intake valve, because when the head is milled, the combustion chamber lip is removed. This means better initial sealing but earlier failure. The gasket will last longer if you O-ring the tops of the liners by machining a groove for .040 stainless steel wire.
   <u>Steel shim gasket</u> – Pro – thinner and gives slight increase in compression ratio. With the embossing it seals reasonably well. The combustion chamber opening is large enough on British Frame and Engine's version of this gasket that it will not stick out into the chamber. Con – It is somewhat more finicky on protrusion than the stock gasket.
   <u>Solid copper gasket</u> – Pro – the combustion chamber hole is right and you can get them in a number of thicknesses from The Gasket Works. They also make some sealing rings that I will let them describe. Con – the most demanding in terms of having everything flat and having proper liner protrusion. Some builders have excellent results but some cannot make them work. Ya pays yer money and ya takes yer choice.
5. You must chamfer or relieve in some way the tops of the liners below the intake valves. There are a number of ways to do this and the marking procedure is spelled out very well in the Kastner books. If you are milling the head and using one of the modern very high lift cams, the valves will protrude into the liner at full lift. Therefore make the chamfers deep enough to allow for this. You can even make the chamfers radiused instead of just angled. You want to avoid interference at all costs. The objective here is to give adequate vertical clearance for the valves at full lift, but if you make the chamfer too wide, there will be less sealing area on the liner tops, resulting in leaking between the water jacket and combustion chambers.
6. *(After chamfering the liners per the above, I installed the crank (but not the pistons) with the head on, the cam installed and the timing chain on. I turned the engine upside down on the engine stand and rotated the crank while I watched for interference between the valves and the sleeves. It was <u>very</u> close on a couple of intake valves so I removed the head and used Dykem or bluing to mark the sleeves where there was possible interference. I then put the head back on and again rotated the crank to "mark" any interference on the Dykem. After removing the head again there were small marks in the Dykem on two sleeves so I reground all the sleeves to give more clearance. Maybe saved the engine by doing this. TFM)*

<u>Lifters – (cam followers)</u>

1. At the time of this writing, there are no reliable sources of lifters. BFE. Moss, TRF, and BPNW all sell lifters that vary greatly in hardness. There are various philosophies on how hard they need to be, with middle 50's on the Rockwell C scale being the agreed-to standard. Have them all checked, and use only lifters that are over 50 as an absolute minimum.
2. Lather the bottoms of the lifters with assembly lube, even though you have previously lubed the camshaft.

<u>Rods</u>

1. If you are using stock rods, limit your rpm's to 6000. Throw away the locking plates. Clean all the holes and bolts with lacquer thinner. Apply red Loctite to the bolts and tighten to factory torque. Research by leading companies has shown that the sheet metal locking plates are the least effective means of retaining thread fasteners, while Loctite is the most effective.
2. Of course you know that caps and rods must be assembled together and not mixed. But if you lay down a cap and can't remember which way it goes on, remember that they are made so that the bearing tab in the cap and in the rod always go on the same side. Same with main bearings. *(The stock rods and caps on my engine were stamped with the cylinder numbers, 1 to 4. Don't know if they come from the factory this way or the previous engine builder stamped them. TFM)*
3. If you are using aftermarket rods, treat the bolts per the manufacturers spec. If the bolts have a reduced diameter between the threads and the head, they are designed to stretch but if you stretch them too far they will yield and fail. If you don't

have a stretch gauge, cover the threads and the bottom face of the bolt heads with moly lube and torque them to 60 ft lb. You must look at the little printing on the bolt head to determine which brand bolt it is. Then the torques are: 3/8" CARR -- 65 ft lb; 3/8" WMCS - 45 ft lb

Pistons

But before you use the pistons, install rings dry on a couple of the pistons and measure the clearance with between the top of the ring and its mating face on the ring groove with a feeler gauge. If you have more than .004 - .005, the pistons are not usable because the rings will pound up and down in the grooves and will break.

1. It is assumed that you know how to put rings on pistons, and how to assemble rods to pistons.
2. If you have occasion to measure pistons, remember that they are barrel shaped and must be measured in the middle.
3. Have the pistons honed to give full floating pins.
4. You don't have to put much oil on the walls or pistons. If you put a light smear of oil on the skirt of each piston, that is enough. Then when you start the engine, you absolutely must run it at 2500 rpm for five minutes or so initially. The rings will break in rapidly. This seats the rings quickly and breaks in the cam and lifter face properly. I can hear the screams of alarm even as I write this – but this is the practice recommended by the motorcycle division of BMW and it works. (Tony Note: we normally run 2000 RPM for 20 minutes if the lifters are new. You have to do this for proper break-in of the new lifters. A lot of times, I have to do this in two runs of 10 minutes or the car overheats. DO NOT BLIP THE THROTTLE, your lifters can go away if you do. It's not uncommon for the header to glow red during this initial run-in. Bring the car quickly up to 2,000 RPM, don't let it idle at 1000.)

Oil pump

1. These pumps are really good and long lasting. Do check the clearances per the factory manual. If you buy a rebuild kit, the innards may be too long for the cavity so beware of this.
2. Check the pin that holds the rotor to the shaft. These sometimes fail with serious consequences. New pumps seem to be worse than old ones.
3. When I find a loose one, I drive out the pin and tap both sides for a 3/16" set screw. If you have a hardened shaft, you can tap that only so far and then the tap won't cut it. Use Loctite on the setscrews.
4. The most common failure on these pumps is the two ears on the end of the shaft, which drive the whole thing, tend to break off. To minimize this possibility, the sharp corner at the bottom of the slot must be eliminated. I've tried several approaches on this and so far they have all worked. The one I now like the best is using a cutoff wheel in a die grinder to make the flat bottom of the groove into one big radius, and then finishing the surface with a tiny stone in a Dremel tool so the scratches go around the curve instead of long ways on the curved portion.
5. For quicker priming for startup, put a small amount of grease on the rotating parts of the pump to give it more initial sealing and it will prime faster.
6. Make sure you get the oil pump gasket on right, so the hole for the oil to go through the passage is not covered up.

Sump

1. As with the front cover, do a little bodywork on the gasket flange to help it seal better.
2. It is best to install a baffling system in the pan. This can become a separate hobby in itself and can challenge your imagination. If you want a simple but effective approach, put a vertical baffle front to back, along the slanted edge of the oil pump cutout hole in the windage tray. The bottom of the baffle should be about 3/8" above the bottom of the pan. You can attach the top of it to the windage tray by bending a flange on the top of the baffle, drilling a row of holes in the windage tray, and plug welding the baffle and tray in the holes.
3. You must also run the oil level right at the full mark on the dipstick. *(This holds true regardless if you using the stock pan of a deeper aluminum pan. TFM)*
   (Note: the sign of having the oil level too low is a drop in oil pressure on left hand corners)

Head

1. Porting the head. I will tell you what to do to get about 80% of the flow improvement that a professional head flower (crazy term) will get.
2. Intake – Size the ports per Kester's book, 1-1/2" all the way from the manifold face to the valve guide. Take most of the metal off of the short side. Remove the bump that is just inside the manifold face in the port, adjacent to the head bolt

hole. Make the short side radius just under the valve seat as smooth and consistent a radius as possible. Feel it with your finger. Leave the port just under the valve seat a little smaller than the valve seat, so that when the machine shop puts in the three angle competition valve seat, you get the full effect of the velocity-inducing three angle seat.

3. Exhaust - with a long shank carbide cutter, remove the big bump in the floor of the bowl where the guide comes through. When viewed from above, if you had x-ray vision, you would see that the path of the port is S-shaped, Remove metal from the inside of the "S" closest to the valve. Removing more does not do much for flow. If you remove too much, you will cut into the water jacket, scrapping the head.

   Note: be very careful with the whole "port matching" deal - it's very easy to do more harm than good. Jack and the flow bench found a zillion things that "obviously" would improve flow that actually <u>hurt</u> flow instead. Unfortunately, I don't know all of the tricks. Having a little step in between the manifold the head is better than having the intake manifold suddenly go to a larger diameter. You cannot go more than 7 degrees from a "straight tube" or the flow separates from the sides and you generate turbulence that actually reduces the effective diameter of the tube. My head flows almost as good as the best one Jack did, and the intake ports are 1-9/16" at the outer face and I run stock diameter valves.

4. Here are the instructions to the machine shop:

   A. Clean the head thoroughly. Replace the rear freeze plug.
   B. If they accidentally put a head with aluminum pushrod tubes in a caustic tank, the tubes will disappear. Do not despair. It is really easy to replace them with ¾" aluminum tubing
   C. The aluminum plug on the top of the head may leak. It is in a threaded hole, and after removing, you can tap it to NPT and put a pipe plug in it.
   D. Tell them how much to mill. If they are a good shop, you can just tell them the cc's you want in a combustion chamber and they can mill to that. It is risky to take off more than .165 from the stock head thickness of 3.325".
   E. Install guides –if you are using the bronze guides, they MUST have .004 stem clearance. The shops take some convincing, but if clearance is less in these old engines, the heat will cause the guide to shrink and the valve to stick, perhaps destroying the entire engine.
   F. When you get the head back, put a small bead of JB Weld around the edge of the rear freeze plug. Also chamfer the edge of the combustion chamber to remove the hot spot corner created by the milling operation.
   G. Tell the machine shop the amount of lift of the valves, and have them machine the valve guide accordingly.

<u>Rocker assembly</u>

1. Whether you use the stock rocker stands or aftermarket stands, put spacers between the rockers, leaving about .010 side clearance.
2. Competition stands prevent the shaft from breaking on the very outer ends where the stock stands support the shaft on only one side.
3. If you use competition stands, check for interference between the head nuts and the stands. You may have to remove some metal from the stands, and maybe use short head nuts.
4. Check the contact pattern of the rocker tip on the valve stem. Theoretically you want it in the centre of the stem at half valve lift. If the contact is outside the centre, you correct it by milling the stands. If it's inside the centreline, you shim up the stands. However, it's really difficult to get it theoretically correct, so if you get it to 60/40% that's pretty good. It's easiest to check all this with the head on the bench and a very light spring on one valve. The centreing-up is entirely due to ratio of rocker stand height to valve stem height. Pushrod length has nothing to do with it.
5. Note: some of the rocker stands have a certain amount of "slop" in the stud holes. Just sliding the whole rocker assembly toward or away from the valve can affect the centering.
6. *(Use ARP hardened and ground washers on the head studs. Anything else, even double Grade 8 washers, will get concave due to the large holes in the top of the pedestals. This will cause the nuts to loosen and possibly allow the stud to bend sideways causing failure. TFM)*

<u>Pushrod length</u>

1. After installing the head, install a couple of stock length pushrods and the rocker assembly. Adjust those valves to the proper lash. Look at where the adjusting screw is. Determine how much shorter the pushrod must be to centre up the adjusting screw.
2. It used to be that you could shorten the pushrods in a lathe and press the end in further. Nowadays the competition pushrods have such a tight interference fit that this is nearly impossible to do.

3. Final rocker assembly to head - back off the adjusting screws a LONG way so you don't accidentally push a valve too far into the bore, causing interference with the sleeve top, bending the valve. Again, don't ask me how I know. Install the assembly. You must have all the adjustment screw balls in the pushrod cups or you may bend valves from forcing the valves to interfere with the chamfers on the sleeves.
4. Finally, adjust all the valves (but you knew this already, right?)

Water pump housing / bypass hose

1. You may or may not want to use a bypass hose. Its function is misunderstood. If your car has a thermostat, then the bypass allows coolant to circulate through the head anyway while the thermostat is closed. If you're not running a thermostat, some coolant flows through it all the time, which theoretically decreases cooling system capacity. I've run with and without the bypass hose, using a thermostat and not using a thermostat. I can't tell the difference in cooling.
2. Anyway, if you want to run without it, tap the bypass hose outlet and put in a pipe plug. The rear hole where the heater pipe screws can be plugged or you can install a fitting and run a hose to the hole in the top of the rear of the head where the heater valve is normally screwed in, to help coolant fill and circulation.

Water pump

1. The high capacity pumps that are available on the market are pretty nice, but not necessary if you install a really big and efficient radiator, which at $180 is cheaper than the expensive water pump anyway. *(Be aware that the water pumps with a 5/16 threaded end for the retaining nut for the pulley have a known failure problem. The threaded end breaks off, the pulley beats the keyway out on the water pump shaft, the belt comes off, the engine overheats from no water flow and expensive things happen. As Jack has said, don't ask how I know this. The latest stock water pumps from Moss (May, 2008) have a ½ inch threaded shaft but with a 12mm x 1.25mm pitch on it. As of this writing, I haven't been able to find another ½ inch nut with 1.25mm pitch threads! I have to contact Moss. TFM)*

Distributor, shaft, key, gear, shimming

1. This is the second most difficult thing to do on these engines.
2. The bottom of the shaft has a tang which engages the oil pump. It also has sharp corners. Eliminate the sharp corners. These shafts tend to break there.
3. Getting the gear, shafts, and pedestal parts aligned for first assembly is a real pain. It can take a couple of minutes or an hour. The problem is getting the oil pump slot in the right position so that the distributor pedestal drops all the way in the hole. I bought a really long screwdriver and filed a line across the end of the handle parallel with the blade of the screwdriver. I stick this down the hole and turn the pump so the slot is almost straight across, front to back. Maybe someone else has a neat trick for doing this more quickly. I do all of this after initial priming of the engine. See startup tips.
4. Another completely different approach to this bit of the assembly is to leave the sump and oil pump off. With the cam where you want it, install the distributor drive gear and shaft in the position where you want it, and bolt down the distributor stand. Then turn the engine over and install the oil pump. This way you have only to line up the slot and the three studs, since the gear mesh is already taken care of.
5. *(See TFM* "TR4 Engine Service Note - Installing Distributor and Pedestal to Get Correct Timing" *of October, 2008.)*

Startup

You don't have to put much oil on the walls or pistons. If you put a light smear of oil on the skirt of each piston, that is enough. Then when you start the engine, you absolutely must run it at 2500 rpm for five minutes or so initially. The rings will break in rapidly. This seats the rings quickly and breaks in the cam and lifter face properly. I can hear the screams of alarm even as I write this – but this is the practice recommended by the motorcycle division of BMW and it works.

(Tony Note: we normally run 2000 RPM for 20 minutes if the lifters are new. This is necessary for proper break-in of new lifters. A lot of times, I have to do this in two runs of 10 minutes or the car overheats. DO NOT BLIP THE THROTTLE, your lifters can go away if you do. It's not uncommon for the header to glow red during this initial run-in.)

A couple weeks ago I found a web page that actually explains why you break a cam using 2000 RPM. The reason is that the highest stresses are on the nose of the cam at zero RPM, because the nose has the smallest radius of curvature and when you spin the engine the forces due to the rotation (inertia forces) act to reduce the force between the lifter and the nose of the cam.

I'd suggest you bring it up to 2,000 as quick as you can [rather than slowly bringing it up to 2,000 - Tony]. Of course, using only outer springs also reduces the stress on the cam.

1. If you start the engine up without first pressurizing the oil system, you can count on damaging the bearings. Although it only takes a few minutes of running for the oil pressure to come up, that few minutes is critical to the life of the bearings. You can pressurize the system by putting the distributor drive shaft in the chuck of a ½" drill and rotating the pump COUNTER clockwise. Watch the oil pressure gauge – after a little bit you will see maybe 50-60 psi when being driven by the electric drill.
2. When you start a TR engine, expect the coolant to boil very quickly – maybe four or five minutes. Shut it off before that happens, let it cool, and restart. You may need to do this several times. Putting a big fan in front of the radiator helps too.
3. Check and adjust everything, of course.
4. After starting it up several times and getting it hot, remove the rocker assembly and re-torque the head.

THROTTLE LINKAGE CARE

It never ceases to amaze me how our beloved TR's survive our sometimes careless maintenance and sometimes non-existant maintenance. The worst example of this usually is the throttle linkage. How many of us have seen pivot balls in the linkage worn so far out of shape that the linkage jumps apart with the slightest nudge? How many of us have a bellcrank or bellcrank pivot that is not worn almost beyond recognition?

Most of this is unnecessary if at each service (about 2,000 miles) we will take an oil can and put a few drops of oil at each moving joint. While you are at it, check to see if the throttle return spring from the fire wall to the throttle arm is in place (you would be amazed at how many are missing!) It also won't hurt to have someone push on the throttle and then lift one piston and see if the carburetor throttle plate is fully open. All very elementary, but a little care can prevent a lot of grief later.

I CAN'T TAKE THIS PRESSURE – **Marty Lodawer, TR Southern California**

So there I was, motoring along at a sprightly gait whilst enjoying all that wind in the face and exhaust roar, when a routine glance at the instruments brought forth some alarming news. The oil pressure gauge was reading barely over 20psi - pulling up to a halt , the reading was practically zero. What's the deal?? There There were no ominous noises or other signs of trouble - everything still sounded fine. Hmmmm. Looks like we had better open it up and find out what's wrong.

I started out with the obvious stuff first. All the oil line connections looked good and there were no apparent leaks. Well, perhaps the oil pump had gone bad. I pulled the pan and replaced the pump with a good spare. Fire it up and voila! No change! Hmmmm.

Telephone call to Technical Secretary Ken Gillanders: "What's the deal?" Ken's first question: "Are you using Castrol oil in your car?" "Why,yes." "Probably your pressure relief valve is not seating properly and causing the pressure loss." How right he was!

What had happened was the oil pressure relief valve inside the oil filter head had stuck partially open and caused the pressure to fall. Ken told me he had seen this happen countless times over the years, and the one common factor was the use of Castol GTX oil. Now I've used the stuff for the last eight years with no prior trouble, but this time it sure seemed to fit the pattern. Apparently due to the chemical makeup of this oil, it can leave a sticky residue which can cause the valve to stick. It's easy to remedy once you know what to look for.

The solution is to simply remove the relief valve assembly from the filter head, clean it thoroughly with a degreaser or carb cleaner, and replace it. It took only a few minutes to do this, and the oil pressure immediately came up to normal.

The valve assembly is located on top of the filter head and will be seen as a large screw with two locknuts at its base. Loosening the lower (larger) nut will pull the entire assembly out for disassembly and cleaning. The one thing to be careful of here is to carefully note how far in the large screw is positioned - you'll want to be certain to replace it exactly the same way so as not to tamper with the oil pressure adjustment.

Once you have marked this position, remove the screw completely which gives you access to the steel ball and spring. Clean these parts thoroughly and note their condition - new springs are available from suppliers like Roadster Factory and Moss Motors. After these parts have been cleaned they can be dipped in clean oil and replaced, again making sure you replace the adjusting screw exactly as it had been.

My TR2 has been running happily ever after since doing this, and I'm still using Castrol oil!

PLEASE NOTE THAT THE ABOVE OF COURSE REFERS TO 4-CYLINDER TRs.

Camshaft and Lifter Life

by Ken Gillanders

Even with a dead stock engine, tappet and cam life can be very poor indeed. Hardly an engine is torn down for a rebuild that doesn't contain tappets having dents in their faces which look like the nose of the cam. Most original cams last for about 60.000 miles at which point they begin to suffer damage.

The largest source of problems is that the tappets stop turning while the engine is running, causing very rapid deterioration of both the tappets and camshaft lobes. This problem gets worse with age as varnish and gum builds up in the tappet bores.

A close second as a cause of this wear is lubrication. Fortunately, most modern motor oils (such as Valvoline 20/50 All-Climate and Castrol 20/50) will, if changed regularly, prevent the formation of varnish and gum deposits while still providing the anti-scuff quality needed.

The least likely cause is called bumping, and occurs when valve springs are changed for the wrong part, and compress to stack before or right at maximum lift. As there is nowhere for the parts to go, they stack solid and tear off the nose of the camshaft. The same thing can happen when the valve guides are not set deep enough, and the bottom of the valve spring retainer strikes the top of the guide.

All of the above can be avoided with a little work. Be sure to clean the tappet bores, and you can also do a light honing job with a wheel cylinder hone. Polish the sides of the tappets with ultrafine (1000) wet or dry sandpaper and a little light oil. Be certain the tappets turn freely in their bores by inserting your finger into each one and seeing how much effort is needed to rotate it.

Check the fitted length of the valve spring and use a punch in a drill press to see if you have the required lift available, plus about .060" extra.

Finally, always change your oil frequently, and use the best.

Dropping Oil Pressure Fix

Loss of oil pressure in our TR's at any time is a sphincter tightening moment as it can so easily be terminal, but when embarking on a long trip with deadlines like catching a ferry a couple of thousand K's away can quickly become quite distressing.

We were heading down to Melbourne for a Friday afternoon Ferry across to Tasmania so after driving for 4 hours we took a short break for the usual fuel and other stuff before heading from Grafton up through the Nymboida ranges on our way to Armidale, only to observe the oil pressure a tiny little bit lower than normal.

The tiny bit lower became just a bit more than a tiny bit as we progressed, with a loss of about 3 psi every 20 K's or so. One can easily get fanciful when faced with this odd situation with all the possible causes racing around between the ears at a great rate. Perhaps due to having just finished a crank out installation of a new rear oil seal, was a bearing disintegrating? Or perhaps I had missed something out of the re-assembly process? Or, or, maybe deterioration of the oil pressure relief valve seat allowing the spring to gradually force the steel ball further into the seat until it finally bursts through.

Anyway by the time we got through the steep climb and hairpin bends there was a place to stop before all pressure was lost below 2000 rpm and time to take stock of our options.

I decided to take a look at the oil bypass pressure relief valve, so backed off the lock nut and gave the tensioner a 360 degree twist, which to my delight immediately provided 25 psi at idle and 65 psi at 2500rpm. Time for a cup of strong coffee and an ice cream to suppress the jubilation and disguise the concern about said seat regression in the valve housing.

We then made a stop in Armidale for a visit and conference with Rob Nunan who offered a spare housing assembly off his TR4, however the pressure was again perfect and operating quite normally so we concluded that perhaps the spring had been caught on the housing and stuck open or perhaps some dirt from the crank work had caused the problem and it was now cleared. I decided that we did not need the offered housing and we set off with confidence to Willow Tree.

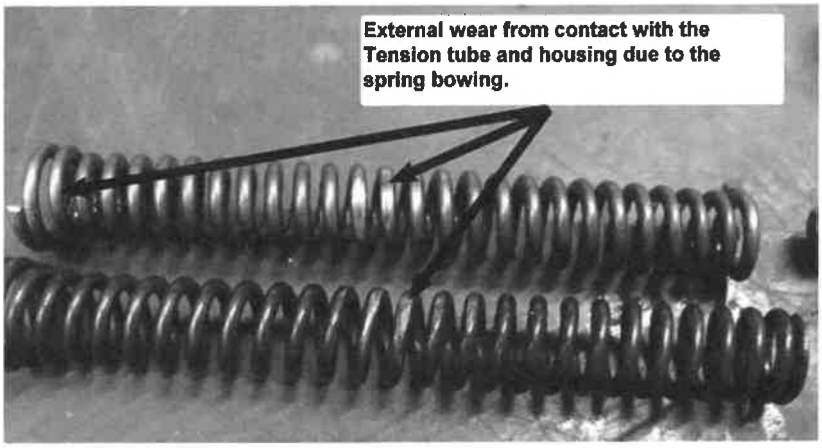
Next day all went well, so confidence built until half way to Bathurst we again stopped for a tea break. It was time to freak out when on starting up again the oil pressure was down a couple of pounds and proceeded to steadily drop a few pound every 20 K's until we arrived in Bathurst to visit the Olsen's in a fine state of concern.

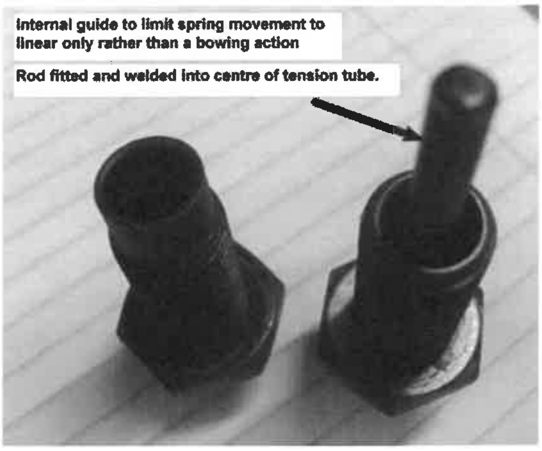
Chris took charge and called up Alan Mitchell in Orange who said *"I have one in the shed so stay where you are, I will be there in 40 Minutes"* Indeed, it took 42 minutes by which time we had the oil filter assembly removed and on the bench. It was quite clear by now that there was no seat regression as the housing is very robust, so it could only be the spring.

Installing Alan's old original 1950's spring brought instant gratification with everything working as normal again and allowing us to do the 4 hour dash to Wagga for our next accommodation without incident.

The car did Tasmania and back to QLD without missing a beat or the oil pressure deviating, which gave me the confidence to pin our woes on a failed T89 spring which was installed during the engine rebuild. The older spring was indeed much more consistent than my one had been as it took into account cold and hot running with the same steady reading. My one always wavered about a bit and gave different readings from cold to hot.

We have since checked a number of used springs and they all show the same wear patterns, which indicate the spring does bow a bit and rub against the housing in 2 places.





Whilst these units have clearly been working for many thousands of miles, I wonder how much wear on the spring is acceptable, ***so I installed a centre guide*** just to eliminate any sideways movement and also installed an old spring along with a pressure switch and warning light.
By the way the only place to fit a switch into the oil gallery if one has a feeder to the Rocker gear, is via a 7/16 UNC plug. Now one can only buy 1/8" NPT or 1/4"Taper BSP switches so an adaptor needs to be made I can only conclude that some after- market springs made, who knows where, might not be quite as good as the original UK manufactured ones and I hope that anyone who experiences this gradual loss of pressure can now proceed to tighten up the adjuster with confidence until a better spring can be fitted. I doubt the spring will fail completely as the dodgy one still has enough tension to operate to complete a journey.The other conclusion is that we have the most generous and helpful members in our club which makes all our journeys and events such a pleasure.

Happy Motoring
Rob Bradford

SORRY! BUT IF I TELL YOU! I MAY HAVE TO KILL YOU!!!!!.

Now that I have your attention (Ed):

Author: Geoff Kelly.

The request came from Tony Knowlson. "Can you write an article telling how you get more power out of the TR engines that you build. However, we don't expect you to tell your secrets."

So here I go minus the secrets.

Gas flow in the cylinder head is where you need to focus much of your attention.

Before you even think about port profiles, valves etc. you need to establish what type of head you have.

I don't mean Low Port, Le Mans or High Port; If you want power, then it is accepted that the High Port head is the starting point.

What I mean is that not all high port heads are the same. Close examination will reveal that many heads suffered from core shift during the casting process.

This means that as you are merrily grinding away at parts of the combustion chamber, you can end up in the water jacket quite easily.

I have found that where you have a wall thickness of say .400" on some heads, others can be as thin as .100". The same can be true for the deck thickness. Some heads can take up to .150" machined off without having to be pinned and supported in the water galleries while others start to lift at high revs indicating a blown head gasket. Only problem is that when you strip the motor down, the head gasket will look fine. Another problem to look for is how accurate the head was set up for initial machining at the factory. When the raw casting was originally machined for valve guides, head stud holes etc. the position of the valves relative to. the centreline of the bore can vary up to 4-5mm from head to head. The further away from the centre of the bore the valve is, the harder it is to achieve good gas flow.

To achieve a successful motor, whether for road or racing, you need good gas flow and speed at a variety of revs, not just maximum revs. If you want to achieve this, big is not always best. Enough said.

Valve springs-

If you intend to rev the motor to 5000rpm or above, you need to invest in different springs and retainers. Spring pressures need to be increased, but tread carefully.

Too much pressure robs horsepower but not enough causes other problems.

Camshaft profiles-

whether flat tappet or a roller cam, total lift, ramp acceleration and plenty of other variables have to be taken into account. While we are at the camshaft, there are so many different grinds available that you end up with a headache trying to get your mind around them. For road engines I use a Wade 240 grind. Idles nicely and still makes power at 5000rpm with the right engine modifications. For racing? I'm sorry, I can't tell you, but I do use a roller cam which gives a very wide torque band. Pulls in top gear from 2800rpm and will still pull 6000rpm in top overdrive!

I'll go through other components in point form and make some comments.

Rocker Gear-

Throw away the two original bushes in each arm and put in decent bushes. Alternately, go to roller rockers but be aware, they work OK in road applications but a design/ manufacturing glitch has to be addressed before you start using too many revs. The external oil feed is a waste of $$$ in my opinion. Roller rockers need only a fraction of the oil supply compare to the original rocker. So why do 'they' market the oil feed as necessary for use with roller rockers? See manufacturing glitch!

Pushrods-

Standard are OK but chrome moly 5/16" are lighter and stronger.

Pistons-

They need to be light, strong, reduced comp. height with modern rings. I use forged pistons with Nissan (I apologise) rings.

Conrods-

Carillo if you have just won Lotto or use Mitsubishi with bushed small ends and get some 'proper' high quality rolled thread bolts.

Crankshaft-

If you are not revving over 6500rpm, the standard item is OK if you balance, nitride, stress relieve etc etc. AND run a harmonic balancer.

Flywheel-

lighten a lot. For racing, make one from a steel billet.

Head studs-

Use the best quality available. You will be amazed just how much old ones or poor quality ones car stretch with lots of revs and compression!

Sump-

Baffles are needed for racing.

Oil Pressure-

Too much pressure causes heat and wrecks bearings, not to mention the horsepower loss. I have raced at 6000rpm with 30psi with no ill effects. Please don't race out to the garage on my say so and wind down your oil pressure! You need to build the motor to suit. On the subject of oil, don't over cool it. Cold oil has wrecked motors.

Hardened Valve inserts for Unleaded-

Everyone has their own opinion on this. Mine, for what it is worth; is that they are just another thing to fall out or come loose in a racing motor. The problem of core shift can make some heads almost unsuitable to use inserts. I use an additive in the petrol.

Carbies-

The standard carbies can be made to produce a lot of horsepower. I use 2"HD's from an E Type Jag. Work well but do take some work to adapt to a TR.

Distributor-

Regraph to suit cam. If using points you need to use the hard to find Mini Cooper 'S' points or else you will get point bounce over 4500rpm. Many times this is incorrectly diagnosed as valve bounce. If you continue to run the vacuum advance then vibration of the sliding plate in the distributor will affect your timing!

Fuel Pump-

If using 6000rpm then go electric.

Fan-

Electric

Exhaust-

Extractors, BUT they must be built with your cam specs, compression etc in mind. Buying a poorly made set not suited to your motor can make you go slower. Stick with the orginal manifold if that is the case.

Clutch-

To my mind, I am yet to find a diaphram pressure plate that has the same feel as the old coil spring p/plate that can be used in a TR. I use the original cover, uprated and it still copes with close to 200bhp with a reasonable light pedal.

The clutch plate? I'm not telling!

Nearly everything that I use in the motors is sourced or made locally. In my opinion, we are just as smart as our friends in the UK or USA in producing innovative high performance solutions for these cars. How do you modify the gearbox, overdrive and suspension? That is for another day but you will be surprised how simple some of it is, especially the suspension, but there are some secrets!

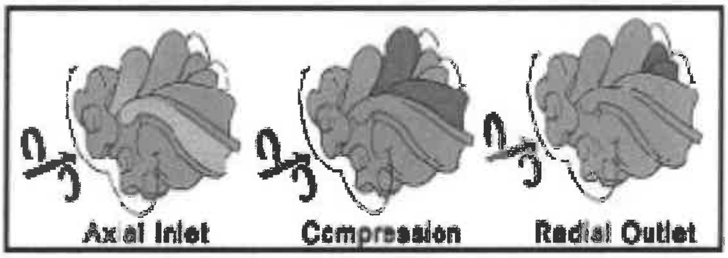
SUPERCHARGING THE TR3

Author: Allan Bare.

Eldred Norman did it in the fifties, yet fifty years on internet searches reveal virtually nothing in the way of successful modern installations for the TR3. Hans Pederson who converted a TR4, and supplies kits for MG, is the exception. His wealth of experience and computer program proved helpful in determining the specifications for the key components he supplied for my project.

My aim (aside from seeing if I could do it) was to produce a reliable road going engine with plenty of torque low down. To illustrate this in layman's language remember that a TR engine with 87mm bore maximized for low speed torque (pulling power) develops just 37 Brake Horse Power (BHP) at 1800 RPM (spec for Ferguson 35 tractor). Simple maths confirms that BHP increases with revs to the 100 BHP you get at 5000 RPM. The fact that BHP increases with engine revs explains why claimed high BHP figures at around 6000 RPM or so are meaningless in the real world. What is important for a road car is how much torque (and BHP) the engine is producing at 2800 RPM (110 KPH) in our TR.

The supercharger (air compressor) that I chose was a Lysholm screw type compressor. This unit effectively squeezes the air fuel mixture between the lobes of two rotors which are shaped to reduce the charge volume as it passes along the axis of the rotors. Although invented in the early thirties, modern technology that produces the varying profile rotor lobes has only recently been made available. The result is a compressor that compresses the air from very low RPM and does not have any wearing parts (rotors do not touch). Compare this with fan or simple lobe type superchargers that provide wildly varying boost pressures with nothing at low revs. The TR has no need for crude "Pop Off" pressure relief valves required by alternate systems.



Keeping the air/mixture charge cool (small volume) is essential for maximum cylinder filling and reduction of pre-ignition (pinking for a Pom or pinging for Aussies). Lack of friction within the compressor, ducted cool air from in front of the radiator, and shielding the exhaust manifold has given excellent results on the TR.

The compressor draws air through a new 1 ¾" SU, exactly as they did it in the fifties. Compression ratio of 9:1 was reduced to 8:1 by fitting TR Register low compression pistons. Existing camshaft timing of around 24/60 was retained. I had previously used a cam of around 30/70. Great at 6000 RPM. No torque at 2000 RPM.

A very special Hans Pederson MGB serpentine belt harmonic balancer was slightly modified for the TR. A flat belt water pump pulley was machined from a billet with an off-the-shelf alternator pulley fitted to the Register alternator.

A Falcon adjustable idler pulley was modified to locate below the water pump. The radiator is standard (thick core) with electric fan placed to allow use of the original crank handle. The manifold was cut and fabricated from a length of 6mm thick aluminium angle section grafted to a TR high port inlet manifold. The compressor spacing allows use of the existing throttle linkage (no cables).

All sounds easy now. I can assure you that it was not, without any direct evidence of a successful TR3 conversion.

Like any performance TR, excessive distributor top end advance had to be reduced by placing sleeves over the distributor advance weight stop pins. A lot of trial and error with SU needles resulted in current use of a "BAG" needle.

Typically each set back would be overcome at around 11PM, seeing me roaring up and down the road sans front apron and bonnet reading the exhaust gas analyser. Not the best for neighbor relations!

The result is increased power at 2500 to 3000 R.P.M., which is just what I wanted. Fuel economy is only slightly down, with slight compressor whine noticeable at low revs. As smooth as a six cylinder. Is it that special harmonic balancer or the compressor drive?

The initial conservative approach of low compression ratio, maximum boost of only 2 ¾" Lbs and an SU resulted in a reliable engine which was smoother in operation than a standard TR.

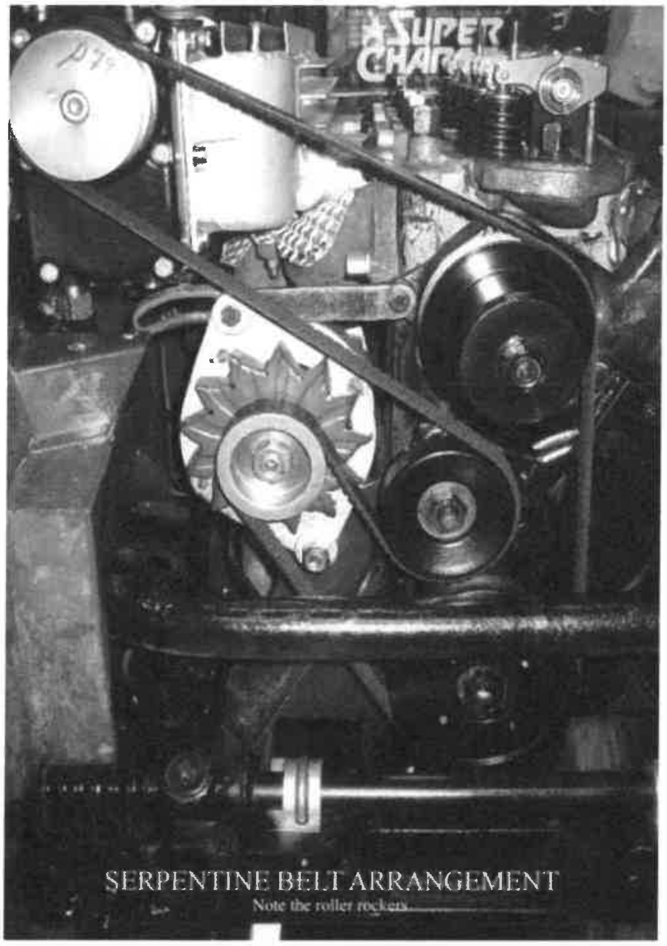
During selection and testing of smaller compressor pulleys to increase compressor revs and boost, Hans was surprised at the low boost readings I was achieving. Theoretical boost, as confirmed by Hans' computer program was dramatically higher than my TR manifold boost pressure.

Conclusion being that the TR engine was flowing more efficiently than expected. Has to be better than an MG! Contributing factors are the TR4 head that originally incorporates larger than necessary inlet ports, combined with my slightly larger inlet valves and the excellent TR4A dual pipe exhaust manifold.

Despite trepidation from Hans due to the excessive theoretical boost, a smaller 63mm compressor pulley has now been fitted, resulting in 5lbs maximum boost, more power and no problems with pre-ignition using 98 octane premium fuel.

In the back of my mind is the fact that the TR low compression pistons have a thinner crown than standard. If I burn a hole in one, I will know that I deserved it!

So far, excellent performance with no drawbacks.



SERPENTINE BELT ARRANGEMENT
Note the roller rockers

Modified Rear Oil Seal

Author: Brian Richards

The rear seal is always mentioned when talking about the propensity of the TR engine to leak oil. When in good condition and fitted correctly, the scroll seal works well whilst the engine it running. When it stops, a small amount of oil will normally leak past the seal as the oil drains back to the sump. This design requires the engine to be running to work.

Any attempt to modify the rear seal will require the crank to be removed from the engine and this is best contemplated when the engine is out of the car.

There are kits from the UK that can be used to update to a lip type seal and as with all the options available, it requires the oil scroll to be ground off the crank.

The rear oil seal sold by the register also requires the scroll to be removed from the original TR crankshaft. However, removal of the scroll from the crank requires the seal area to be built up and ground to size.

The seal is a one piece unit with a split to allow it to be twisted open and fitted over the crank. (It then pushes into the cavity that normally houses the split aluminium seal. A simple flat plate, utilising the six cap screws that holds the aluminium seal in place, is then used to hold it in position. You can modify the old seal by removing the scroll and using the flat part to act as the retainer.

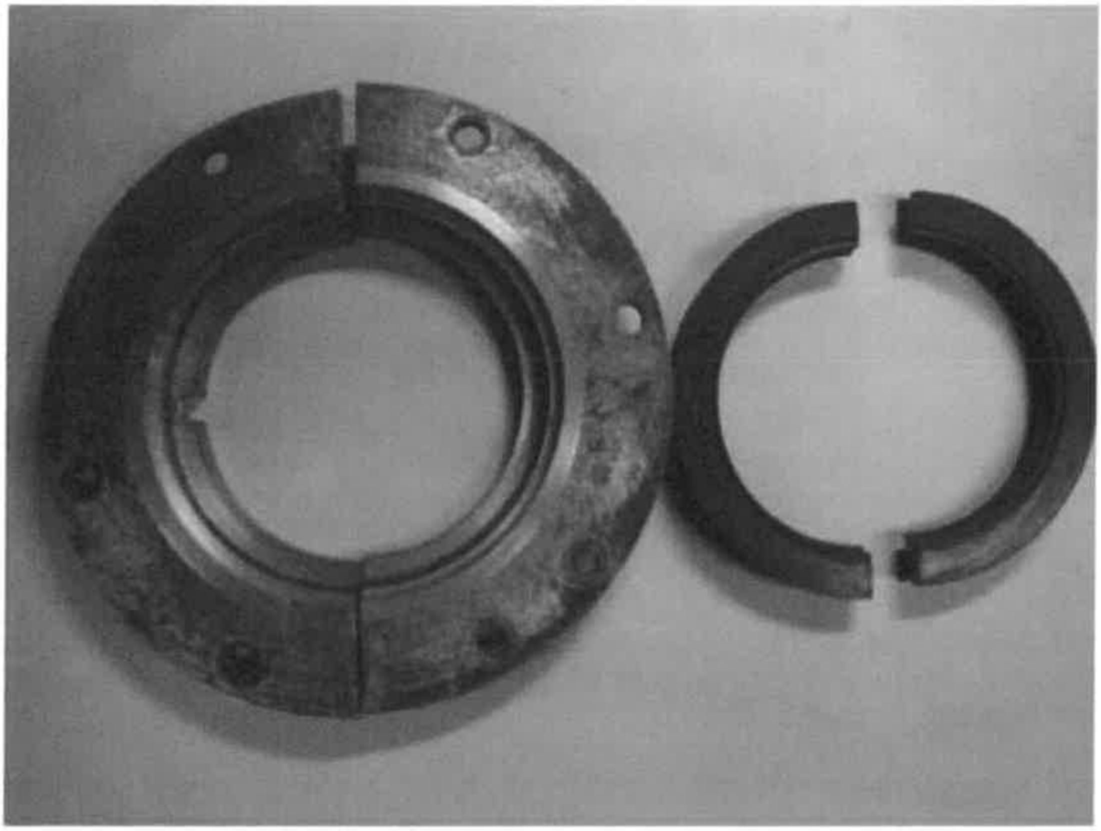
If you are using one of the new TR Register supplied cranks (T8650) then this is the seal you need as the crank is already sized and ground to take this seal. Allan Bare has used this seal on his car with a modified TR crank for some time without problems.

Another local solution is to utilise a Chevy big block seal. This seal is also a split seal (two parts) but unlike the tractor seal, has metal inserts to help it retain its shape.

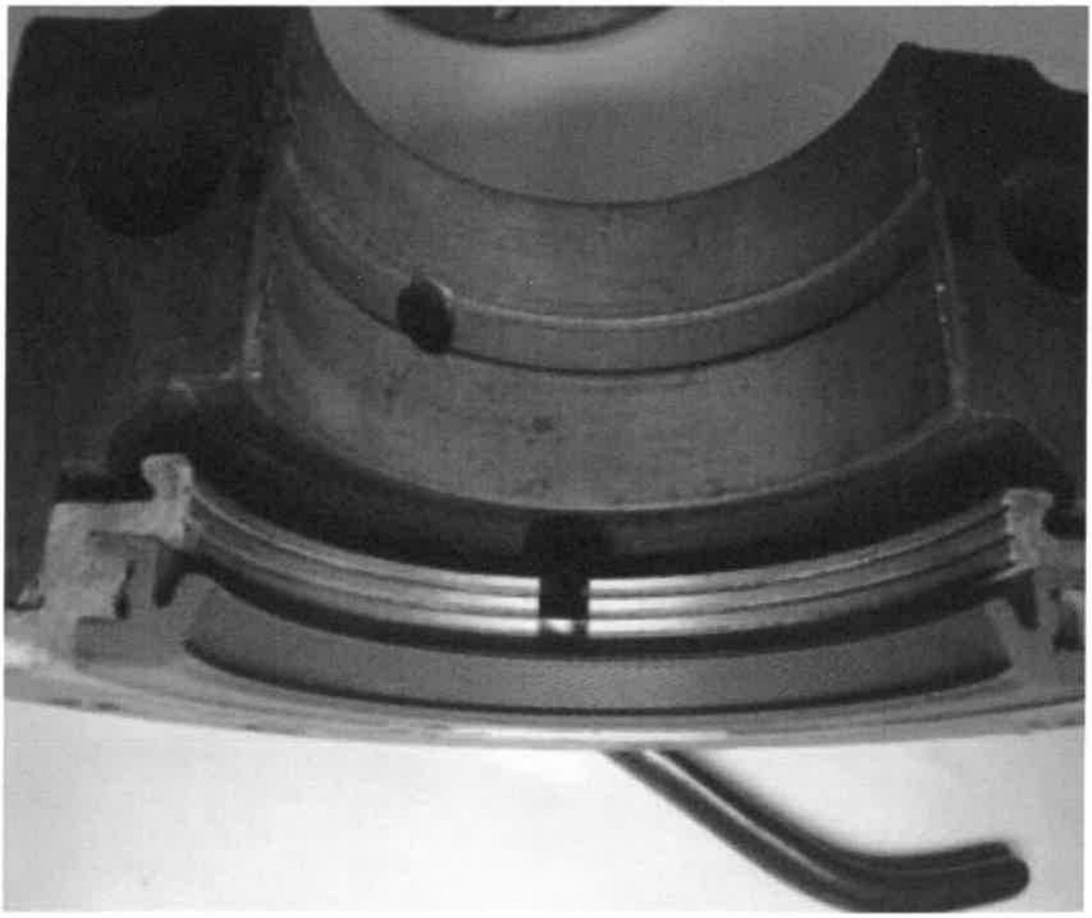
I have put together a kit that utilises an aluminium scroll rear seal, modified to act as a seal carrier for the Chevy seal. The crank has to be ground as for the other seal conversions.

The advantage of this conversion over the Register supplied seal is that the seal is a stronger design and better suited to the higher operating RPM of the TR. Its biggest advantage though, is that it does not require the seal area on the crank to be built up as the size required is less than the current oil scroll and only requires grinding.

The only point to remember is that once tour crankshaft is converted, you cannot go back unless you get the crank built up and the scroll re-introduced or alternatively, fit a new crank.



Modified rear oil seal carrier and Chevy big block crank seal



One half of modified carrier and oil seal installed in rear main bearing cap

CARBURETION

The merits and demerits of SU carbs have been batted around for years. Generally your first urge is to throw these sons of jackasses out in the back ally and get something else. —DON'T DO IT!— A bit of understanding and some do's and don't's can cause them to perform like the champions they really are. Only a couple of things ever really wear out and they are:

1. Throttle shafts and butterflies
2. Jets and Needles

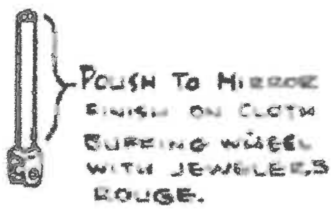
Wobbly throttle shafts must be replaced. Fortunately the bushings in the body seldom goes bad, except in a few radical cases. If the bushings are bad though, you must find that friendly machinist again and have the holes renewed to an inside diameter of .313-.315. New shafts should measure .3120-.3125. Since the chore of refitting the throttle levers requires a good drill press, get him to fit the shafts completely. Trying to drill these shafts with a hand drill usually ends up in some sort of utter disaster.

Refit the throttle butterflies. Be certain that they are centered in the body **BEFORE** tightening the two little screws. These break easily so don't get ham-handed with them. If the space around the perimeter of the butterfly shows an all around halo of light, new butterflies are a must.

JET and NEEDLES

If the needle shows a satin finish and the tapered surface near the base has any longitudinal scratches it is not servicable, nor is the jet. It has been improperly centered and this is the primary cause of needle wear.

Polish the surface of the jet on a cloth buffing wheel with jeweler's rouge to a near mirror finish. Then your new seals have a fighting chance for a long, leak-free life.



JET

fig. 3

Install the needle into the piston with the shoulder flush with the face of the piston. Soak all the cork gaskets and seals in clear water for at least ten minutes before installing them.

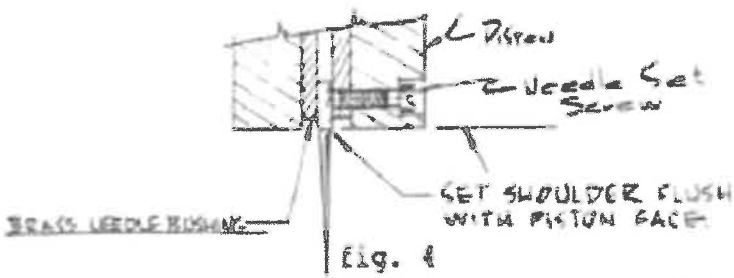


fig. 4

SETTING THE NEEDLE

Speedi Sleeves

by Ken Gillanders

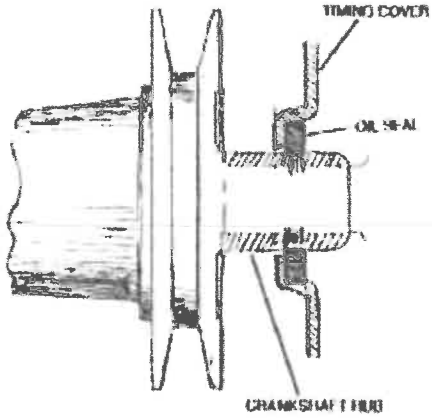
In our never ending search to make our 4-cylinder TR engines more oil tight we cannot overlook some of the problems associated with the timing cover oil seal and the surface of the crankshaft hub that it rides upon. For a time we had a small supply of new old stock hub pieces, however these were soon used up and we are now left to search for alternative methods of repair.

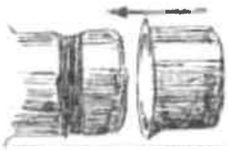
Perhaps this is a good place to explain what we were trying to repair and why. When a circular oil seal runs against a shaft for an extended length of time, a characteristic ring of wear appears on the shaft at the point of contact with the seal. The longer the shaft wears, the worse the ring gets until it becomes a groove deep enough to allow oil to escape the seal. The result is the usual oil leak mess we see so often from the front of a TR engine. Up to this point, all you could do was replace the seal with a new one, which would buy a little time but, without any new hubs to replace worn ones, the repair was very short term indeed. We sometimes tried repairing old hubs by disassembling them, brazing up the grooves and regrinding the exterior surfaces, but this was both expensive and very time-consuming.

Now we have an almost permanent repair. Thin metal sleeves are made by several manufacturers under their own trade names, such as Speedi-Sleeve, Redi-Sleeve, etc., and they are made to be installed over the damaged portion of the shaft to provide a new surface for the oil seal to ride on. They are made thin enough so that they do not cause any malfunction of the oil seal when installed.

The makers usually recommend that all burrs and high spots first be removed from the worn hub with a file or emery cloth. If the shaft is severely grooved it is suggested that the groove be filled with powdered metal type epoxy filler and the sleeve installed before the epoxy hardens. With the shaft properly cleaned and prepared, coat the inside of the sleeve with a non-hardening sealer such as Permatex #3 or Gaskacinch. Then locate the worn area on the shaft that the sleeve will have to cover - it is essential that this worn portion be covered! The sleeve is placed over the shaft with the flanged side going on first. At this point, place the installation tool (supplied with the sleeve) over the sleeve and gently tap it down over the shaft until it covers the worn area and the flanged end is seated at the base of the hub shaft. In rare cases it may be necessary to break off the excess flange with a pair of pliers.

These repair sleeves are available from most of the major Triumph parts suppliers (including BFE with a price of $26.45) and make a very long lasting repair that will do wonders to clean up that messy leak at the front that blows oil all over everything as we drive along.





SPEEDI-SLEEVE PRESSES OVER WORN HUB TO PRESENT A NEW SMOOTH SURFACE FOR OIL SEAL TO RIDE ON

Rules For Adjusting Your Carburetors

The only Triumphs that don't have chronic carburetor problems are those with fuel injection.

Most Triumphs have SU carburetors. Zenith-Strombergs are similar except they have a rubber diaphragm with a small rip in it.

If your carburetors don't leak, you are out of gas. (This rule is similar to the "Triumph test for oil.")

The only time your carburetors run properly is when a mechanic is taking a test drive.

SU carburetor parts are interchangeable. You can replace a faulty part with a new one and the carburetor will run like it always did.

When you are ready to adjust your carburetors, the Uni-Syn will not be where you thought it was.

When replacing needles, the only parts store with the correct ones will be across the bay. (Note: If you live in New York City they'll be in Coventry or on a ship foundering in an Atlantic storm.)

When you get the correct carburetor needles, one of them will be bent.

The Universal SU Repair Kit will work on all carburetors except yours.

A float will only have a hole in it if it is Sunday and the parts store is closed.

No two repair books will recommend the same fluid for the dampers.

Whitworth nuts and bolts are similar to SAE nuts and bolts except that the shoulders are rounded off.

Tightening the jet nut will automatically move the jet off center.

All levers and jets will move smoothly if (and only if) the carburetor is sitting on the kitchen table.

Triumph carburetors are infinitely adjustable. That is, they can be set anywhere from "not quite right" to "totally wrong."

Despite the above, a weekend working on the Triumph carburetors is preferable to fixing the oil leak.

OBSERVATIONS OF AN ITINERANT MECHANIC

BASIC TUNING FOR YOUR TR - (1) VALVE TIMING

'I have found the valve timing of many cars to be incorrect, most owners are unaware of the particular grind of their camshaft.'

CHECKING VALVE TIMING - ENGINE IN THE CAR

VALVE TIMING may be checked in the following manner. Ensure that the timing hole in the crankshaft pulley aligns with the timing cover pointer when #1 and #4 pistons are at TDC. With #7 valve fully open set #2 valve at 0.050in - repeat for #8 valve and #1 valve. Rotate crankshaft clockwise (from front) until #2 VALVE IS ABOUT TO OPEN - OR - #1 VALVE IS ABOUT TO CLOSE (whichever comes first) and note the position of the timing hole in relation to the pointer - then continue turning the crankshaft (if necessary) until the reciprocal situation is attained.

For the above situations the timing hole should be either aligned with the pointer or positioned a little to each side with the hole/pointer measurements approximately the same - variations of more than 0.1in wouuld indicate that attention is required.

0.48in of crank pulley circumference = 10 crankshaft degrees. Remember to reset #1 and #2 valve clearances to original settings.

DETUNING A MODIFIED CRANKSHAFT

To improve touring performance for cars fitted with a modified camshaft it is beneficial to open out valve clearances in order to reduce overlap. E.G. for a 25/65 cam, touring performance can be enhanced by using valve clearances of 0.014 - 0.016in or greater, although some extra valve noise must be expected.

CHECKING YOUR CAMSHAFT GRIND

The following procedure can be used to indicate the probable grind used on your camshaft - use imperial measurement system.

With #1 and #2 valves clearances correctly set, rotate the crankshaft pulley clockwise (from front) until #2 valve is just about to open; mark the flange of the pulley over the timing hole and use inside calipers or other means to measure the distance from this mark to the pointer - continue rotating the crankshaft until #1 valve is about to close and measure again; both measurements should be approximately the same - add the measures together and move the decimal point one place to the right to give the BTC degrees for the inlet valve opening and ATC degrees for the exhaust valve closing - imperial measurements only. DK

OBSERVATIONS OF AN ITINERANT MECHANIC

TALKING HEADS

At a recent motorsport meet I was able to assist a friend change a failed head gasket: it was the engine's first run after an extensive rebuild; the failure of the traditional copper gasket was plainly due to insufficient torqueing of the head bolts although my friend assured me that he had tightened the head bolts carefully and correctly.

The mystery was solved during reassembly when my friend expressed surprise at my insistence on liberally oiling threads and washers before fitting the head nuts - he had always fitted head nuts dry!

I explained that torque specifications for head bolts (and the vast majority of other applications) assume lubricated threads - due to frictional losses, dry thread assembly will reduce the amount and accuracy of torque actually applied - especially at higher values.

There is also a high probability of serious thread damage.

HEAD TORQUEING PROCEDURE

The procedure I use with TR's is to first torque the head to about 40 - 50ft/lb, and then by approximately 20ft/lb stages to 105ft/lb.

The engine is run to operating temperature (180F approx.) and allowed to cool before retorqueing to 105ft/lb - each nut is backed off slightly before torque is applied; I always repeat the final tightening sequence at least once.

After about 500 miles and with a cool engine, I remove, oil, and retighten each nut to 90ft/lb before final torqueing to 105ft/lb.

The nut tightening sequence I use is as given in the manual.

I have found the above procedure to provide excellent insurance against head gasket problems.

SOME NOTES

- If your head gasket has a folded edge on one side only, this must face up.
- Ensure that your replacement gasket does not overlap the edge of the bore - don't use an 85mm gasket for an 87mm bore.
- NEVER use split washers under head nuts; use only plain flat washers and ensure that stud washers #3 and #6 dont interfere with the rocker cover studs. DR

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Adjusting Your Carburetors

I. Basic Adjustment Strategy

The trick to tuning Skinners Union (SU) or Zenith Stromberg (ZS) carbs is to understand that there are two things you need to get right: the air flow, and the fuel mixture. While they are interconnected, they are also independent, and need to be measured and adjusted independently. SU carbs were used on the early Triumphs, while ZS carbs were used on the later ones. Either type of carb can be found on TR4s. The design of each is quite similar, thus adjustment is performed in the same manner for either type. If you would like to read more detailed information about how your SU or ZS carbs work, there are excellent Haynes manuals for each of these carburetors.

Special Tools

- You will probably need to arrange to buy or borrow a Unisyn flow meter. The Unisyn is the usual gauge for getting the air flow balanced between the two carbs. This costs about $20 and is simple to use. It consists of an adjustable opening (same size circumference, but with a disc on a threaded rod that you can screw tighter or looser) that you use to set the level of a little float that rises or falls in a glass tube at the side of the gauge.

- For the fuel mixture, one helpful device is called the Gunson ColorTune (maybe ColourTune, as it's a British co.). This is a spark plug with a crystal pressure- and heat-resistant window in it that lets you see into the combustion chamber while the motor is running. The color of the flame indicates the mixture richness. It costs about $40, and while it's not absolutely essential, it makes life so much easier that it's worth the cost.

  If you don't have a Gunson, the standard directions are included here for determining correct mixture (step 4 of the Adjusting Mixture procedure).

- For some ZS carbs, you will need a special mixture adjusting tool. This is a special two-part wrench that is inserted through the top of the carburetor to adjust the metering needle while preventing the air valve from rotating within the carburetor.

To tune SU or ZS carbs, first locate the following components:

- Throttle linkage nuts. These are the things that connect the throttle linkage (the bar connected to your foot through whatever means your car uses, cables or rods) to the carburetors' throttle levers.

- Throttle stop screws. These set the idle speed for each carb, and are located typically behind the dashpot, near the connection of the throttle linkage.

- Mixture adjusting nut. On early SU carbs, this is the lower of the two nuts at the very bottom of the carburetor. Later SU carburetors of the HIF type have integral float chambers, on which the mixture is adjusted by turning a screw. Some ZS carbs do not have adjustable mixture. ZS carbs that do allow mixture adjustment either. You'll need to experiment (and I explain how) to see which way makes this richer and which way makes it leaner.

- Lifting pins. (SU carbs only) These are little wobbly metal pins under the dashpot. When you push up on the pin, it raises the piston in the dashpot. Find these, they're crucial if you don't have a Colortune. If you don't have them, can't find them, or have a ZS carb, you can raise the piston with a flat-bladed screwdriver pushed down the throat of the carb and twisted or levered to lift the piston.

- The bridge. This is the part inside the carburetor, where the gas jet opens into the airstream. You'll see a needle inside the jet, and the jet itself should be a few fractions of an inch down from the bridge itself. The jet is the brass tube that sits in the center of the bridge, with a tapered needle poking down into it.

- The choke linkage nuts Comparable to the throttle linkage nuts (and usually the same size), but on the linkage that goes between the choke cable and the mixture adjustment mechanism They make sure that both carbs are enriched when you pull on the choke Your car may have no choke linkage, but a split choke cable which connects to each carb, in which you can forget about these

2. Before You Even Touch the Carbs!

Start with the engine warmed up to operating temperature and perform your standard ignition tune-up (points gap, timing, spark plug gap, new condenser, etc) first All of these things can affect the setting of the carbs, which should be adjusted last, if at all! After being properly set, the carbs should rarely need further adjustment If you've got a timing light and a dwell meter, you can verify the ignition components independent of the way the car is running When it's warm, shut the motor off and remove the air filters

Of course, it helps if the carbs are in good mechanical condition as well But you can consider a rebuild once you have gotten things working first!

3. Balancing The Air Flow

If your car has multiple carburetors, the air flow needs to be balanced amongst all carbs before the mixture is adjusted If you have only one carb on your car, you can proceed directly to mixture adjustment!

1 Begin by balancing the air flow To do this, first loosen the throttle linkage nuts Leave them connected, just loosen them half a turn or so

2 Back out the throttle stop screws till you can see that they are just touching the throttle stop Then open each carburetor (that is, lower the throttle stop screw) 1 1/2 turns of the throttle stop screw and start the engine It will probably idle at about 2000 RPM, don't worry

3 Put the Unisyn over either carb and adjust the orifice in the Unisyn till the little float at the side rests at the middle of its graduated tube (Pre-diagnostics if the idle drops and the car wants to die when you slap on the Unisyn, the carb is too rich, if the idle soars upwards, it's too lean) Hold the Unisyn over the carb for only long enough to see the level of the float, then remove it

4 Place the Unisyn on each carburetor in turn to check its flow, adjusting the throttle stop screws until all carburetors register the same position on the graduated tube of the Unisyn (The float will probably move either up or down in the tube, which is why you want to center it in Step 3) When both carburetors flow the same amount of air, tighten the throttle linkage nuts, adjusting for the amount of free-play between the linkage and the throttle stops that your manual calls for (probably about 0.006") Your goal should be to achieve the lowest possible idle with both carbs balanced and the engine running smoothly (Note that the idle speed will very probably rise as you get the mixture correct)

If you've taken more than five minutes to do this, rev the engine to over 2500 RPM (assuming the idle isn't already that high) for thirty seconds or so to clear the spark plugs Then adjust the mixture

4. Adjusting The Mixture:

Note in the following procedure, one "flat" is the basic increment of adjustment, and refers to 1/6 of a turn of the mixture adjusting nut This corresponds to the flat faces on the nut

These instructions are for ZS carbs or SU's with separate float chambers You will need to check in your shop manual to see whether you turn the mixture screw to the right or the left to make it richer or leaner

1. Shut the car off and loosen the choke linkage nuts, if you have any to loosen!

2. Adjust the mixture nuts (screws) fully lean. Check your shop manual to make sure you are adjusting them the right way!

3. Now enrichen each carb an equal amount -- two full turns of the adjustment nuts (screws). Then start the car.

Note: In the following step, you might want to consider adjusting the carburetors one-half a flat too lean, as the mixture will be enriched when you put the air filters (which restrict air flow) on at the end of the tuning process.

4. Raise the lifting pin (or use a screwdriver if you don't have the pins) so that the piston rises no more than 1/16". Listen to the engine's exhaust note and compare it to the following conditions:

- If the exhaust note rises and stays high until you drop the piston, this carburetor is adjusted too rich. Adjust the mixture one flat leaner, then repeat Step 4.
- If the exhaust note falls and the car sounds as though it is going to stall, this carburetor is adjusted too lean. Adjust the mixture one flat richer, then repeat Step 4.
- If the exhaust note rises briefly and then settles back down to something like the original RPM level, this carburetor is set correctly. When you have achieved this setting for all carburetors, continue with Step 5.

5. Tighten the choke linkage nuts, if applicable, so that the choke cable will pull an equal amount on both mixture nuts when you pull the knob.

6. At this time, I find I usually have to adjust the idle again because getting the fuel mixture right usually changes the idle speed. Since you know you have the throttles synchronized, I normally just adjust the idle without loosening the throttle linkage. The easiest way is to screw one of the screws out till it doesnt' even touch the throttle stop, then use the other to get the idle speed right. When that's done, you can screw the other stop screw down till it just touches the stop on that carb and you're set. Replace the air filters and go for a test drive!

5. Special Notes

SU and ZS carburetors are most fuel-efficient when slightly lean, and provide the most power when they are slightly rich. You can use this knowledge to provide a certain amount of tuning for the kind of driving you do. If you learn to read spark plugs, you can get a basic idea of what your engine's condition is and make fine adjustments to the mixture nuts accordingly.

If you have a ColorTune, you simply install it in place of one of the plugs, then adjust the carburetor that feeds that cylinder (the front carburetor for 1 & 2, the rear for 3 & 4). The ColorTune will let you see the color of the flame. White flashes mean too lean, yellow flame means too rich. Blue (like a Bunsen burner) is correct, and blue with a faint orangish tinge is the best for power.

You can also modify your car's throttle response characteristics slightly by adjusting the viscosity of the oil in the dashpot damper. SU and ZS carbs are set up so that a thicker oil will resist the piston's attempt to rise in the dashpot for just long enough that the engine's increased load (when the throttle is opened) will pull more fuel across the bridge; this enriches the mixture and temporarily bumps power up to help the engine achieve higher speed more readily. For light damping, Marvel Mystery Oil is excellent; engine oil can be used for heavier damping.

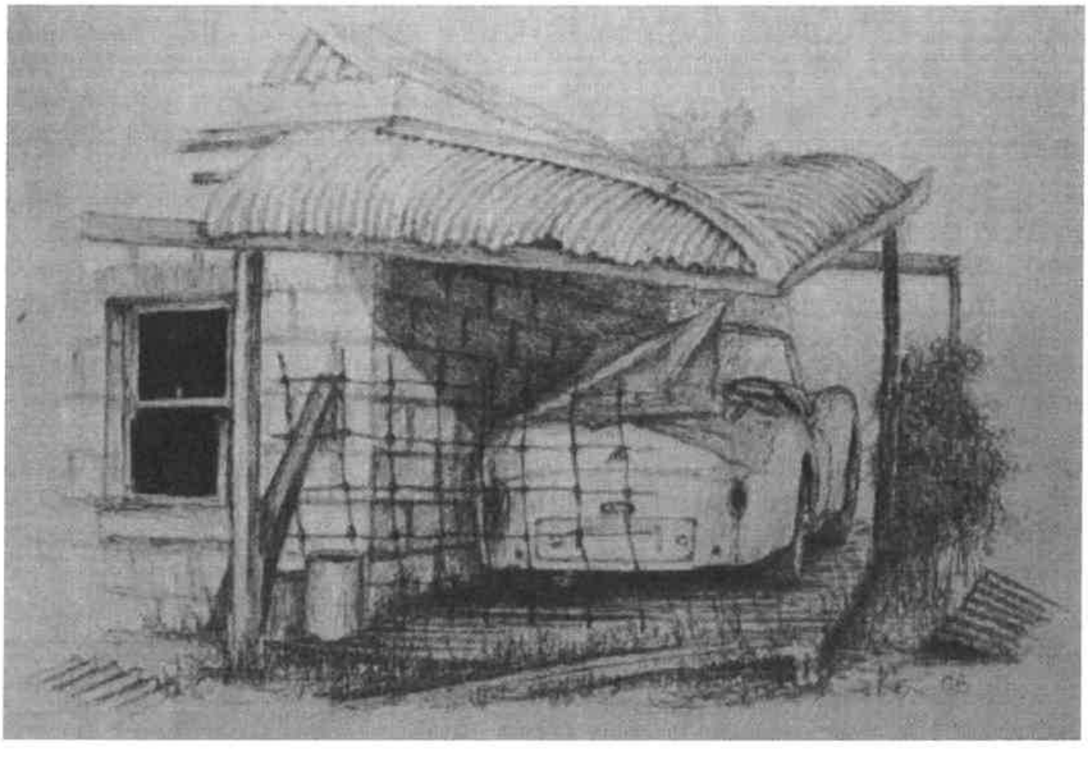
If you modify your engine, you will probably need to modify your needles, as it [illegible] needle profile that determines the mixture curve for different air-fuel loads.

If you experience uneven idle, hunting, or an idle that changes (rises or falls) as the engine's temperature climbs or drops, you probably have vacuum leaks. The most serious fault on most old carbs is wear in the throttle shaft area. To test for this, spray some carburetor cleaner on the outside of the throttle shaft, carburetor cleaner is non-combustible, and if the engine speed drops, it means some of this is getting into the air stream from outside the carburetor. You may also have leaks from the manifolds, from tubing such as the vacuum advance line to the distributor (if fitted), or from other places, the carb cleaner trick works well for locating those leaks as well.

Other problems that SU and ZS carbs experience involve dirt in the dashpot and occasionally in the float chamber. The dashpot is a precision piece of machining that involves very close tolerances so that the piston doesn't stick or bind when it rises and falls. A little grit between the piston and the dashpot can make the car jerk and sputter. Take the dashpot off, wipe the insides down with carb cleaner and a lint-free, clean rag, then reinstall it, getting the screws down tight. Also, don't swap the pistons between dashpots, they're matched to one another so that the clearance between the piston and the wall of the dashpot makes a tight seal but permits easy rising and falling.

Dirt in the float bowl basically shuts off that carburetor (or can make it flood open, depending on whether the dirt is wedging the valve open or closed). You can try rapping on the float bowl with the handle of a screwdriver, but your best bet is to take the cover off, clean out the valve fittings, and reinstall everything, with a new fuel filter for good measure.

Some older SU models also have adjustable floats, in which you need to set the float height (which basically equals the fuel level in the float chamber) by bending a brass rod. These carburetors were replaced in the mid-1960s with carburetors that had fixed, plastic floats which are basically trouble-free unless abused. The stop at the back of the floats can break if they are installed badly, and the brass pin that holds them in place can wear an oval hole in the float pivot. New floats are fairly inexpensive and aren't a bad idea if you're doing a rebuild.



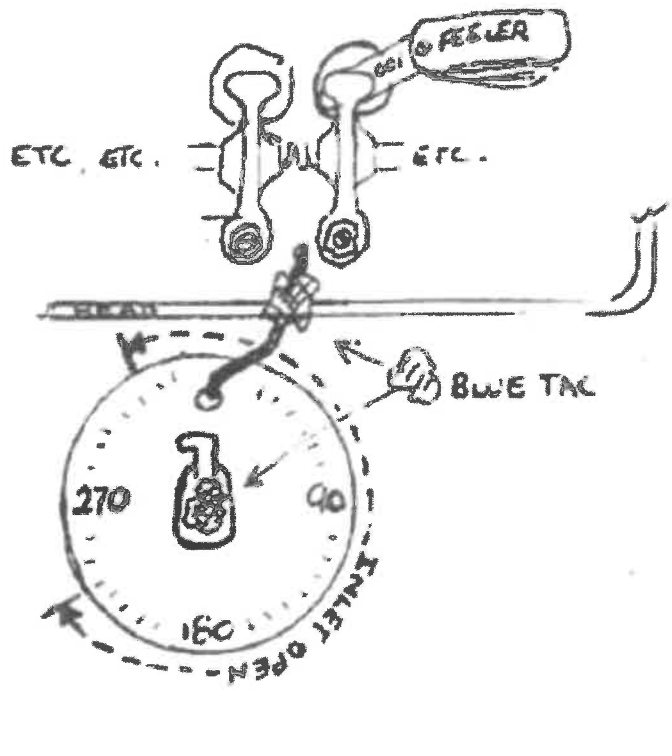
Cam Timing.

A couple of times I've needed to satisfy my mind that previous owners have not used strange cam grinds or put the cam shaft in a tooth or two out. Rather than dropping radiator, crank pulley and timing cover to check alignment etc. Here is an easy way to get a basic cam timing reading.

Set motor at TDC according to timing marks on crank pulley (not a bad idea to check TDC through spark plug hole). Pick the cylinder that has both exhaust and inlet open.
On the distributor rotor stick a protractor, use a dob of blue tack.
On the head fix a bent wire, blue tack is good, to point over 0 degrees on protractor. Valve clearance is set at normal.
Turn motor back at about 90 degrees (or 1/4 of a revolution anti-clockwise if you prefer) inlet valve should now be fully closed.
Roll motor slowly forward until a very thin feeler gauge (.001) is squeezed between the descending rocker arm and the valve stem. The valve is now about to open.
Check pointer over protractor. How many degrees is it before 0 or TDC? Don't forget to double the figure, remember the crankshaft turns at twice distributor speed.
Keep rolling the motor forward with feeler gauge squeezed until it becomes free, the valve is now closed.
Check pointer over protractor again, how many degrees after 0 or TDC is it, double the figure and presto you have the valve timing.

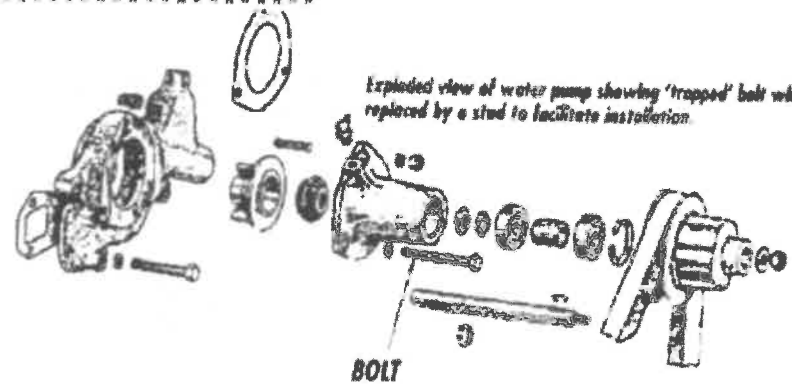
Typically it would be:
2,000 opens 18 BTDC closes 58 ABDC or 238 ATDC (256 duration)
2,500 opens 25 BTDC closes 65 ABDC or 245 ATDC (270 duration)
TR2-4 opens 10 BTDC closes 50 ABDC or 230 ATDC (240 duration)
TR4A opens 17 BTDC closes 57 ABDC or 237 ATDC (254 duration)

Chris Tucker 83391605



A SIMPLE TRICK

KEN GILLANDERS



Exploded view of water pump showing 'trapped' bolt which can be replaced by a stud to facilitate installation.

In the latter part of the 1950's and on into the mid-60's, most mechanics that I was acquainted with, who were working on the then-new sidecurtain TR's, did not understand the "two studs/one bolt" system that held on the water pump of the 4-cylinder TR engine. I am not sure that I do even now, because the bolt, held captive by the water pump pulley, makes pump removal and exchange more work than it should be. The bolt is in the lower right hand portion of the water pump housing, and after you have taken it out, you'll know why.

Most of us, on replacing the pump, substituted a 3/8 stud, 2 3/4" long, with coarse threads on one end and fine on the other. The more savvy technicians used a rocker pedestal stud, threaded a fine nut part way down, until 1/4" of threads were exposed, then ground off the excess until the 2 3/4" length was obtained. The nut was then backed off to clean the thread at the cut edge, and we were ready to go. These worked well, and had the advantage of being readily available from the parts rooms of the dealers where so many of us learned to work on these cars.

The only other tip is that you should coat the threads of the stud with a good amount of anti-seize compound to prevent it rusting into the housing.

Smedley TR2 approaching Longford "Prince of Wales Hotel" corner

The humble dashpot

The significance of the dashpot assembly as found in variable choke carburettors such as the SU and Stromberg 175 CD is often overlooked.

The purpose of the dashpot is to retard the rate of lift of the choke piston when the throttle butterfly is opened and so momentarily richen the mixture during acceleration. this action is generally performed by an accelerator pump in carburettors using fixed chokes.
Another purpose of the dashpot assembly is to reduce piston flutter which can seriously disturb the airflow pattern and cause poor idling; mixture strength can also be difficult to judge.

The dashpot assembly works rather like a single action shock absorber with resistance only being applied to the lifting force. the viscosity of the oil used in the dashpot controls the rate at which the piston rises, and therefore the degree of enriching applied.

Dashpot oil that is too heavy will result in black 'smoke' being exhausted during acceleration. oil that is too light will cause a 'flat' spot, or hesitation.

Ordinary engine oil (20W50) seems to work best for most TR's.

There are several different types of dashpot piston assembly and it is important that a piston assembly is not only matched to its suction chamber but to the engine specifications.

Common faults found are:

1. A vented dashpot piston assembly used with a vented suction chamber.
The vented piston assembly has a drilled cap while the vented suction chamber has an internal drilling through the small external web in the top of the bell.
- This arrangement will cause the carburettor to run rich over its range.

2. A non vented dashpot piston assembly fitted to a non vented suction chamber.
- This arrangement will substantially restrict the opening of the variable choke. the carburettor is only effective at low speed.

3. A dashpot piston assembly that has excessive free piston movement is fitted.
- This allows excessive flutter, causing poor idling due to lean mixture and turbulence.

4. The correct (original) dashpot piston assembly is fitted but engine specification has been upgraded and valve overlaps increased.
- Where valve timing allows substantial overlaps it is important to keep undamped choke piston lift to a minimum. fitting of a small packing washer between the dashpot piston and retaining circlip (allowing clearance for oil flow) can considerably improve a 'lumpy' idling engine.

Tip
When changing dashpot oil, remove the old oil and sludge by using a strip of rag and a long thin screwdriver (flat blade). Fold one end of the strip and push it to the bottom of the cylinder with the screwdriver, then turn the screwdriver to pick up the rag and form a lump which will scrub the cylinder walls, withdraw the rag and screwdriver, tear off the oil soaked rag end and repeat.

Harmonic Balancer

There seems to be a little confusion out there on the actual function of an harmonic balancer. So at the risk of opening up a can of worms, I will try to explain in simple terms just what its function is.

As each cylinder in turn either fires or comes on compression, it exerts a twisting force on the crank shaft, this is what makes the engine work. At one end of the crank we have a large mass in the form of a flywheel. Due to its inertia, the flywheel slows down both the acceleration and de-acceleration of the crank caused be these twisting forces but remember it is only attached to one end.

Now whilst the crank may look solid it does twist, just like a torsion bar. So what we now have is a shaft that has twisting forces applied in a regular sequence along its length with a big damper on one end. This causes the end of the crank opposite the flywheel to twist to a greater degree than at the flywheel end. Whilst the frequency of these torsional impulses will not reach the natural frequency of the crank, it will reach one or more of its harmonics. Just as continually bending a piece of wire will cause it to work harden and break, so the continual twisting of the shaft will cause it to fail. Usually at or near the flywheel end. (sound familiar?)

To counter this, engine manufacturers fit an harmonic balancer. These can take various forms but the most common on cars are the rubber element type. It is made up of two steel elements separated by a rubber sleeve. The inner element is fixed to the crank and as the crank tries to accelerate it has to overcome the inertia of the outer element but because the outer element is attached to the inner element by an elastic medium it is slower to accelerate, and just as it gets going the torsional force is removed and it has to slow down. Again due to its inertia, the outer element tries to keep going and through the rubber sleeve tries to keep the crank going.

The net effect of this can be likened to the job of the shock absorbers on the cars suspension in that the balancer dampens out the torsional vibrations just like the shock absorbers dampen out the suspension's springs.

As you can imagine, a lot of thought goes into the design of an harmonic balancer and they are 'tuned' for a particular engine taking into account such things as, flywheel weight, number of cylinders, length of crank, strength of torsional impulses, etc. Any particular base engine model can have different balancers for different horse power / RPM ratings.

So what's this all got to do with my TR ????

Well it can explain why TR cranks fail, and at the flywheel end.

It should also cause you to think about the damper you may be intending to fit, or why you are fitting one at all.

I think on performance engines they are worthwhile and could save you a crank but for the average user the original set up is fine. The lack of a damper would have been taken into consideration during design of the crank.

They also have no effect on the "balance" of an engine. When you get an engine balanced it is balanced radially, to reduce engine vibration and its resultant stresses. You cannot feel torsional vibration but its resultant stresses are still there.

If you are fitting one then remember that the inner and outer elements are separated by a rubber sleeve and this sleeve will deteriorate over time due to its continual flexing, heat, oil etc. The outer element will then slip on the sleeve so that it does not work correctly. The ignition timing marks are normally on the outer element also, so if the sleeve has failed then the timing marks will not be accurate.

Gearbox, Overdrive & Diff

FITTING A Triumph 2500 GEARBOX & OVERDRIVE to a TR3

by Brian Richards

The TR gearbox is basically a good strong unit that gives long, reliable service and given the synchro technology is some fifty odd years old, a nice one to use. This is especially so when mated to an overdrive.
The only real problem is that with no synchro on first, a marked or chipped first gear is not uncommon.

However it is now at least forty-five years old and most of them have had a hard life in one way or the other due to the very nature of the TR...made fast to go fast. On top of that, it is getting harder to find good, reliable, local and competitively priced repairers who are prepared to take on a troubled TR box.

With any type of failure you are going to be looking at over a $1000.00 to overhaul it. One alternative is to source and fit a Toyota Supra box with the commercial conversion kits that are available. If like me, you want to stay with a box that is still Triumph and has the same feeling as the TR, and then a Triumph 2500 box is the way to go. If you look around they are still available. I purchased one, overhauled it including a new OD clutch, oil pump, and uprated lay shaft for under $1000.00.

The main advantages of the 2500 box are:

- Basically the same size, design, and feel as the TR one.
- Same ratios. The OD ratio is a little different but you will not notice it.
- Synchro on first gear.
- Stronger 2nd and 3rd gear bearings.
- J type overdrive that is less prone to oil leaks than the A type fitted to the TRs.
- They are at least 15 years younger and normally have had an easier life.

The main disadvantages are,

- The lay shaft bearings are more susceptible to failure if worked hard.
- Only OD on 3rd and 4th gear although this can be overcome if desired.
- Incorrect speedo ratio.
- It is not a direct replacement and some modification is required.

The good news is that all the disadvantages can be easily overcome and the results are a very good, strong, and reliable box that is more pleasant to drive (synchro on first) and leave less oil on the garage floor.

The problem with the lay shaft bearings is mainly experienced by people who drive their car hard. It can destroy the cluster gear and feed contaminated oil through the OD. The fix is to fit an uprated cluster gear with two bearings at the rear (the end that fails). These can be made locally by machining your old gear or can be purchased from various sources in the U.K. and the USA. I had mine done locally but it worked out to be about the same price as importing one because my cluster gear was unusable due to a failed bearing.

This problem can be experienced on the TR box but it is not nearly as common.

Areas that require modification are,

Clutch plate. The input shaft of the 2500 has a finer spline than the TR so a clutch plate change is required. You can fit a 2500 plate which is 8.5"diam or one from an Isuzu something or other that is 9.0" diam, the same as the TR. I fitted the Isuzu option from Daikin Clutches P/N R712-531 / DHC532

Clutch throw out bearing, guide and operating fork. The ones on the 2500 are smaller than the TR so you need to swap them over. They are a direct swap, no mods.

Output drive flange. The bolt pattern is slightly different than the TR so you need to re-drill the four holes at 45°

to the old ones. The flange will then have eight holes but apart from having a few more options when bolting up the tail shaft, it is not a problem.

Gear stick. The one on the 2500 is longer and bent. There are two options. One is to cut and shut the stick to the same length as the TR one. With this option you can fit and use the 2500 gear knob that has the OD switch incorporated in it. I took this option.

The other option is to change over the stick from the TR.

Speedo drive. The attachment of the outer cable is by way of a flange whereas the TR uses a screwed fitting. Again, there are two options. The simplest is to have a flange fitting fitted to your current cable, or buy a new one. The cable length required is the same as the original.

The other option is to machine up an adaptor to fit to the flange fitting on the box and then use the original cable.

Exhaust routing. The J type overdrive is smaller than the A type and has a small sump plate to give access to the magnet / filter and other hydraulic bits and pieces. This will require the exhaust to be modified to provide the required clearance for servicing. It cost me $90.00 to have a new length made and that included having a flange fitted to the junction of the exhaust extractors and the next length of pipe. This flange makes it so much easier to remove the extractors if needed, and is gas tight.

Exhaust support. Just how your exhaust is currently supported at the rear of the gearbox will determine what you need to do. If your exhaust is mounted off the gearbox or the re-routing of the exhaust makes it impossible to use the current method, then the following is a good alternative. Fabricate a 'T' piece that bolts between the two rear mounting pads at the very rear of the overdrive, with the leg of the T pointing down alongside the exhaust. Then fit a 'P' clamp to the exhaust and bolt it the leg of the 'T' bracket. This should be done once the box is fitted and exhaust modified. See diagram.

Electrical. This is the easiest to fix. Apart from the fact that the 2500 only uses one isolation switch, the wiring is the same but you will need to fit an earth wire to the solenoid. The A type solenoid only has one wire going to it and utilises its body as an earth. The J type has two connections, one, the main operating one and the other an earth. They both look the same and it does not matter which way they are connected.

If you use the 2500 gear knob and switch, then you will need to make some more extensive wiring changes.

Speedo ratio. Two options again. First is to do nothing. The ratios work out in such a manner that you can take the reading on the speedo, double it and call it Kph. So if it reads 30MPH then you are doing 60KPH. This is correct to within 11/5KPH. I find this is not a problem and in fact find I do not need to do the normal MPH to KPH conversions we do when changing speed zones on the road. The other option is to get the speedo recalibrated, about $80.00.

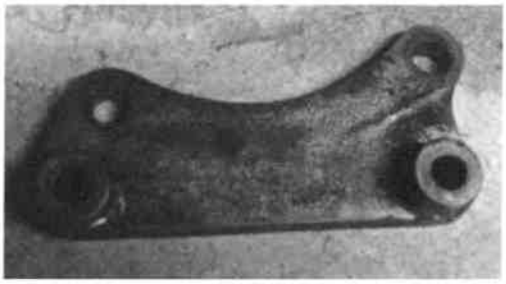
Rear gearbox mount. As the J type overdrive mount is significantly different from the A type, a new rear mount will be required. Again there are two options. The easiest is to purchase a conversion kit from Moss in the U.K. P/N 211361X. I have not seen one, only a drawing from their catalogue so I do not know how it will affect the exhaust or speedo drive. It consists of a replacement mounting plate and new mount. It looks a good option but I do not know its cost.

The other option is to fabricate your own. There have been a number of designs by various members but this is the one I used and utilises a 2500 rear mount. This mount consist of a central plate that bolts to the OD with two plates, one fore and one aft of the central plate and are bonded to this central plate by rubber blocks. Two steel tubes attach these two plates to each other and form the mounts by which it is attached to the chassis. On the 2500 there is a steel plate that is used to attach the mount to the OD. This is not required for the conversion and will require the two mounting holes of the central mounting plate to be elongated slightly to fit over the OD mounting bolts. The forward of the two plates will need to be relieved at its central upper position to allow sufficient clearance from the OD housing. Remember this forward plate is attached to the chassis and must be clear of the OD.

Left and right mounting brackets are then fabricated. These mounts attach to the original chassis mounts. The left bracket attaches to the rear of the mount to give clearance for the solenoid and the right one to the front of the mount to provide clearance for the speedo cable.

Fitting.

Fitting of the box is the same as for the original TR box except for the speedo drive. It will not travel through the cabin as the TR one does, it stays under the floor. You will find a hole in the chassis in just the right position to pass the cable through and line up with the OD speedo attachment. Why these holes are there I do not know but they are there on the TR2, 3, and 3A, very convenient. It is suggested that a short length of hose be fitted over the cable where is passes through the chassis to protect it from chaffing.



Overdrive mount (not used)

Rear Gearbox Mount

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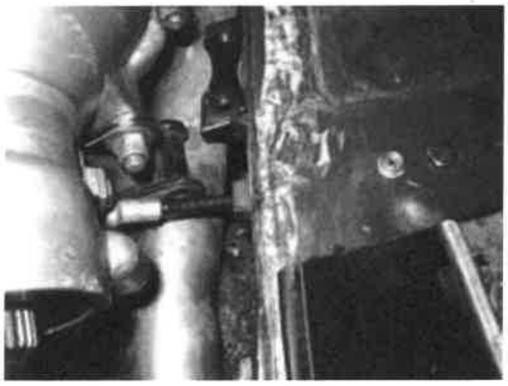

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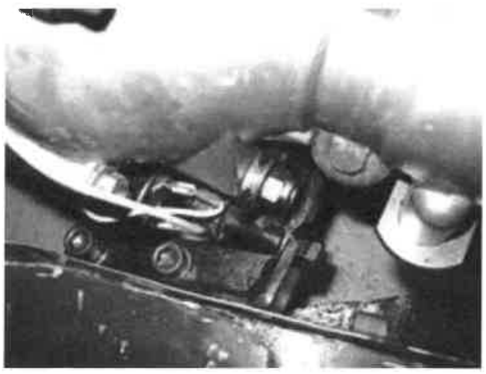

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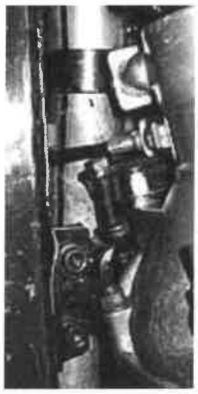

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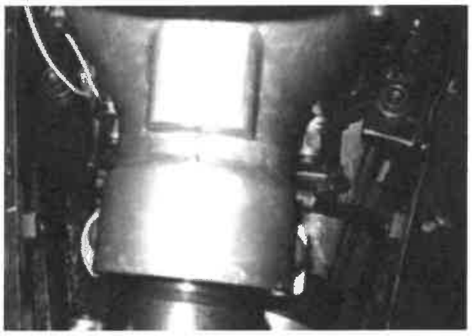

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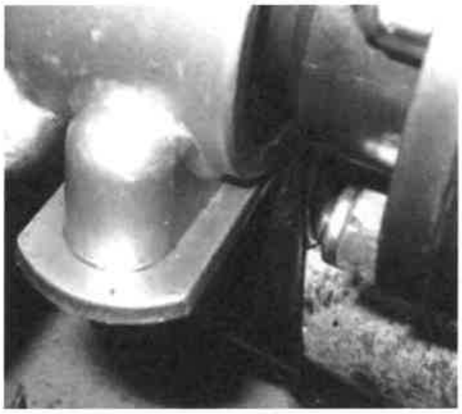

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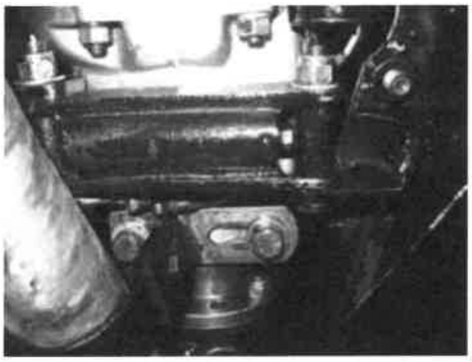

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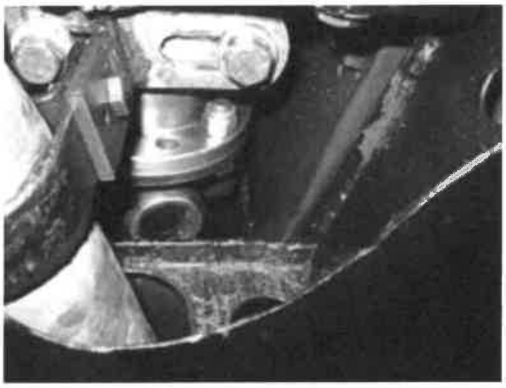

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Repairing a TR Overdrive Solenoid

I was able to repair the solenoid, for those of you who are familiar with the construction you might be able to follow the repair as I try to explain.

Solenoid operation:

First the solenoids are basically two coils, one high current that draws the plunger in and the second a low current that holds the plunger once in place. If you remove the protective boot covering the solenoid there is a plastic cap held in place by two small screws. Once the screws are removed the cap can be lifted. Under the cap are the soldered connections that connect the coils to the breaker contacts. It is similar to the points inside your distributor. During normal operation when the high or pulling coil energizes, it pulls the plunger in to the solenoid's bore. When the plunger bottoms out it strikes a nylon pin located in the centre of the bore. Upon striking the nylon pin it pushed it backwards or to the rear of the unit. This backward movement then pushes against the contact breaker causing it to open the breaker gap. This is the switching mechanism that allows the pulling coil to switch to the holding circuit. I hope this all makes sense for it is my best explanation to how the solenoid works. By measuring the different contacts you can measure the individual coils to determine the health of the solenoid. You should have readings on one coil of 0.44 ohms and 11 ohms on the other coil. My measurements were as indicated.

Now to the repair:

First of all I polished the plunger to remove burrs and potential drag. I then polished the bore of the solenoid.

After removing the plastic cap and exposing the contacts I noticed that the nylon pin had become over heated and had melted. This melting diminishes the ability of the pin to open the breaker gap once the plunger is engaged. I carefully lifted the breaker contact using tweezers and removed the nylon pin. Once removed my first thought was to make a new pin by turning one on the lathe. However the pin is so thin it would flex while turning. So I decide the only thing to do was to modify the original pin. I was able to chuck the pin in the lathe exposing only the end of the pin. I drilled the centre and tapped the pin. I found a 6-32 nylon screw and threaded it into place. This provided the additional length I needed to allow the plunger to open the breaker gap once engaged. I reinserted the pin, re-bent the contact back into the correct shape and correct location and then re-flowed all the solder connections and measured the coils resistance.

The solenoid was reassembled and tested using a 12v power supply. Electrical circuitry is not one of my fortés so I enlisted the help of one of our engineers. He assisted me with all the necessary testing to ensure the unit was working correctly. Prior to installing the solenoid back to the overdrive I applied a small amount of lithium grease to the plunger and the solenoid bore.

One other mod:
If you have ever replaced one of these solenoids, you know that access to the bottom screw is nearly impossible. The first time I tried I spent two hours on my back under the car using a very long screwdriver and flash light. Not this time, I located a scrap piece of octagonal rod about five inches long I turned down about a half inch and threaded it to a 8-32 screw. I could then insert the rod into the bottom hole of the solenoid and turned it into place using a < in socket.

Once the solenoid was installed I adjusted it according to the shop manual making sure to have the correct gap between the adjusting nut and the adjustable stop.

I connected the wiring and applied power to the unit, I repeated the switching several time and it never failed. After engaging the unit many more times decided a test drive was in order, so far so good.. I hopefully prolonged the life of this solenoid for a while however I will obtain a spare for the shelf.

Intermittent Overdrive Operation

On the TT down the south coast last year, the overdrive on my car started to play up. It would not engage immediately, sometimes it only took a minute or two, sometimes a number of kilometres, sometimes not at all. Once it did engage it would always drop out correctly. I do not remember the Register member who put me on to the possible cause but I think it is worth sharing.

Normally, when the overdrive is selected, the main closing coil is activated; this pulls up the plunger and operates the overdrive. This takes a fair bit of current (15 amp) and the solenoid would burn out if it had to carry this load on a continuous basis. To overcome this, they build in a holding coil that requires a lot less current (1 amp). This holding coil is activated and the closing coil deactivated once the solenoid plunger fully engages. Investigation on returning home showed that the rubber buffer that stops the downward travel of the overdrive operating solenoid plunger was missing. These rubber stops live in an oily environment (at least they do in my TR…and I suggest yours) and deteriorate over time. The result of a missing stop is that the solenoid plunger moves out of the housing (closing coil) further than normal when the solenoid is deactivated. When the solenoid is re-engaged, it is not able to pull up the plunger as too much of it is outside the coil.

Driving down the road with the resulting bumps, the plunger would eventually jump up a little and the coil would then pull it in and the overdrive would operate. Not all OD units utilise a rubber stop. Some are fitted with an adjusting screw. I think this applied to the early units only and they changed during production, maybe when they went to the larger pistons.

The fix is simple but awkward. There are three options. Fit a new part, not available, Tap a thread in the boss that holds the stop and fit an adjusting screw and lock nut but this requires removal of the transmission tunnel. It is my preferred option.

The last option is the easiest. From under the car, fit a suitable screw through the hole that held the original rubber stop (the one you would tap a thread in for the second option) with a lock nut on either side. Adjust the screw to give the required clearance, 1/16" with the solenoid relaxed. The lower surface of the casting that held the stop is beveled but the mod will still work well. I thought that mine was an isolated problem but since then I have been involved with three other overdrive problems of the same nature. In one case the coil burnt out. Remember the closing coil is not de activated until the plunger is fully engaged and if you are driving around with the OD switch on but the plunger not fully engaged, and then the full closing current is flowing through the coil with all the resulting heat buildup. BR

Overdrive Spring Issues

I recently rebuilt a member's gearbox and overdrive. This was not the first one I have done but certainly one that gave me a real problem. After the rebuild the member picked up the box and took it home to fit.

A week or so later he called me and said he had just got the box fitted and took the car for a test run and found it would not go into OD. I asked him to bring the car to my place so I could look at it and do all the normal test. This he done and during a test run I noticed that when in OD, it felt and sounded like the clutch was slipping. Also when direct drive was selected you could feel that it went into a solid direct drive just like a normal box coming out of OD. Checked the selector adjustment, OK. I decided that the box had to come out again so the car was taken home and box delivered back to me the next day.

I put it on my test stand and checked the pressure, 420lbs in or out of OD with a momentary drop when OD was selected. Must be mechanical. I pulled the OD from the box and striped it down. Big mistake, I should have more closely inspected it as I striped it as will become obvious later. After inspecting every part and checking clearances, I was stumped. Everything looked good.

A lot better in fact than most other ODs I have attacked. Back to the paperwork. I re-read some documents I had downloaded from the internet about 10 years ago. On about the third document I saw it.......what a fool.

The writer explained how he had built an OD and on test he found that the OD clutch was slipping, just like this one. He also did all the checks I had done and found no problems. He was smarter than me though and investigated the eight springs that push the OD into direct. The oil pressure acting on two pistons push against these eight springs to engage the clutch that takes the unit into OD. His measurements showed that the long spring had the same number of turns (about 31) but had a 0.010" thicker wire than the short springs. Short springs 0.084"and the long springs 0.094".

This means that the long spring binds up (can no longer compress) about 0.310" before the short springs. Now when the springs are fitted, the short springs are supposed to be fitted to the inner guide post on the thrust ring which are closer to the OD adapter plate where the other end of the springs are located. All eight springs are located on the same plane on the adaptor plate but the inner post on the thrust ring are much closer the adaptor than the outer post. He found that if one or more of the springs were fitted to the wrong post, the spring would bind and prevent the clutch from fully engaging.

The spring would act like a stop. Made sense to me.

The springs on my box all looked about the same length. They are supposed to have about 0.10" difference in free length. My springs only had about 0.050" diff. Given the only other difference was the wire thickness, they all look the same and I had mixed one or more of them.

If I had checked the build as I dismantled it, I may have picked up the problem before I had fully stripped it. This would then only required me to pull the OD, change the springs and re fitting the OD. It would not have required to strip it. This is a later box and in the earlier ones there is a noticeable difference in spring length. If you get new ones, they will be the same as the later ones so be careful.

They should be colour coded on one end though, red for the long ones and yellow for the short ones.

Definitely a trap for young players and older pretenders. BR

Leaking Rear Axle Seals

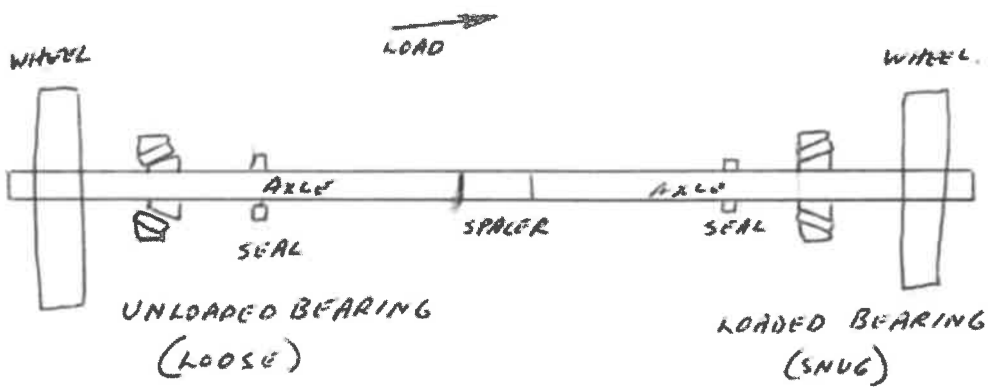
After a number of years running on the track, I decided to have a good look at why my rear axle seals leak. The problem was that on the road there was no leak evident but after a hard day on the track, there was a real leak problem on the loaded wheel.
The loaded wheel being the one on the outside of the circuit. The left seal leaked at Wakefield (clockwise) and the right seal at Oran Park (anti-clockwise).

I had changed the seals a number of times but new seals made no difference. The last time out at Wakefield Park, the leakage finally became too bad to ignore any more. Also I had entered my car in the Tasman Revival meet and did not think I needed to lubricate my rear brakes on one side for the fast Eastern Creek circuit. This meant further investigation of the problem.

When I built the car ten years ago, I had the diff set up by a diff shop but set up the end float of the axles myself. If you look in the manual, you will note the specs are 0.004" - .006". When I checked mine this time, I found it to be 0.008". I had not checked it during past seal replacements as I was not changing the axles or bearings. To understand why this was an issue you need to understand how the axial load on the wheels is handled.

Unlike the Lockheed diff which uses ball races for wheel bearings, the Girling utilises tapered roller bearings. Side loading on the Lockheed wheels is taken up by the wheel bearing (ball race) on the wheel being loaded. You go around a right handed corner and the load on the left wheel is taken up on the left wheel bearing. With the Girling set up it is the opposite. The load would be taken by the bearing on the opposite side of the axle.

The diagram shows the Girling set up. If we follow the thrust from the right wheel it goes as follows. Thrust from the wheel to the axle, through the axle to the spacer in the diff. From the spacer to the left axle, through the axle to the left wheel bearing. It can be seen therefore that no thrust is being taken on the right wheel bearing. The right bearing is only taking the radial load of that wheel.



Remember this is a tapered bearing, like the front wheel bearing. As such the inner race (and axle) of the right wheel bearing would not be running in the centre of the outer race. Providing the end float is within specs, the seals are designed to handle this out of centre condition.

Now, if like mine, the end float was excessive at 0.008", the side play would be much more, because it is a tapered bearing. You know how much side play you can get with a loose front wheel bearing. The rear seals on my car could not handle this extra side play and as such leaked. This time I adjusted the end float to 0.004"and fitted new seals. After three days of competition……not a sign of a leak.

The lesson here is that if your Girling rear axle seals are leaking, check the axle end float.

CLUTCH BLEEDING TIPS

By Norman Nock
reprinted from the Triumph Tribune and Dzus Dnuz

Sounds like a simple job, but I have received many calls from owners of British sports cars. They have rebuilt the clutch hydraulic system and replaced the nylon hose, only to find that they have a very soft pedal that will not release the clutch enough to allow silent engagement of first or reverse gears. Some owners then try replacing both the master and slave cylinders, and even the clutch itself, and still experience the same problem. Eventually they tow the car to the local British car expert and he fixes it. Now, what did he do that the owner didn't?

The reason for bleeding the clutch (or brake) hydraulic systems is to remove ALL the air bubbles from the system. Liquid (brake fluid) for all intents and purposes is not compressible. Any air left in the system will compress or become smaller upon application of the pedal. The resultant soft pedal allows for travel of the pedal without moving the slave cylinder piston enough to completely operate the clutch release lever.

Where is the air in the system and how do we get it out? Air in the respective system will always travel to the highest point. In this case it should be struck in the pipe between the master and slave cylinders. Begin by bleeding the system in the usual way, (with a hose fitted to the bleed screw on the slave and the other end immersed in a clean jar of brake fluid), after you have moved about half a pint through the system, close off the bleed screw with the clutch pedal NOT depressed to the floor.

Now, by hand, push the cylinder piston, using the rod, back into the body of the cylinder. This will cause any air bubbles in the highest point of the pipe to be forced back through the master cylinder and into the reservoir, thus exiting into the atmosphere.

Now, try pumping the clutch pedal a few times. You should have a nice firm pedal. If not, try the same manual pushing of the slave piston again, without bleeding the system again.

A number of Register Members have recently run into problems after attempting to satisfactorily bleed a clutch. Both Darcie & I have suggested the cure mentioned above (& we have printed it in the past).....It usually solves the difficulty & is well worth remembering whenever you bleed any hydraulics. mm.

Clutch Woes

Many TR owners have experienced the dreaded 'broken clutch fork taper pin' syndrome.

A design fault exists in the method of location of the clutch fork to the operating shaft - a square headed taper pin locates the fork on the shaft: the high torsional stresses of clutch operation are applied directly to the shoulder of this pin causing the pin to flex; this flexing leads to metal fatigue in the pin and subsequent failure.

The number of clutch operations before pin failure depends on many factors relating to component fit and load - the question is not IF the pin will fail but WHEN!

I have recently had cause to study this problem closely and as a result have devised a means for extracting the broken pin without damaging the shaft or fork but unfortunately the gearbox must be dismantled to do it.

The chief reason for this article is to strongly advise that a 6mm or 1/4 inch roll pin should be fitted to the fork assembly to reinforce the existing system.

With the fork fitted to the shaft and properly located by the taper pin, a hole for the roll pin may be drilled through the assembly perpendicular to the taper pin and approximately 1 3/8in away from it.

The roll pin should have a minimum length of 1 inch with 1 1/8in preferred.

I believe this modification would be most worthwhile insurance for every TR owner as the inconvenience of removing the roll pin is miniscule compared with the eventual alternative. DR.

Getting it right with TR2 and 3 master cylinder assembly

The Lockheed master cylinder assembly as used on the early TR's consists of a cast iron casing which houses the clutch and brake cylinders as well as a common fluid reservoir. The casing is bolted into a fabricated bracket in such a way that a certain amount of 'fore and aft' adjustment is possible. Aluminium caps seal the fluid reservoir and retain the piston assemblies in their respective bores, one piece forked push rods extend from each bore and are connected by a special cotter pin arrangement to each pedal respectively, independent stop bolts allow adjustment of pedal free play.
A check valve is incorporated in the brake cylinder.

The brake feed pipe is 3/16" 'Bundy' and uses a 3/8" bsf inverted flare nut to attach to the brake master cylinder outlet. The clutch feed pipe is ¼" 'Bundy' and uses a 7/16" unf (20 tpi) inverted flare nut which screws into a special adapter fitted to the clutch master cylinder outlet.

Pedal position adjustment
The mounting bracket is designed to allow positioning of the clutch and brake pedals by fore and aft adjustment of the cast iron casing within the bracket.
The adjustment is carried out by first slackening the two ¼" stop bolts at the front of the bracket, then the two long 3/8" transverse mounting bolts, then moving the casing by means of the two ¼" adjusting nuts on each side of the bracket; these nuts must be adjusted by equal amounts.

Moving the casing forward brings the pedals closer to the driver and vice versa, when finished, tighten the adjusting nuts, the transverse bolts, and set the stop bolts to give about ¼" free pedal movement (at the pedal).

Attachment of push rods to pedals
The push rod fork has two holes for the cotter pin, these holes are usually of different diameters and a special pin must be used.
The head of the cotter pin fits inside the larger hole and to allow load to be shared by each side of the fork; the pin is located laterally by washer(s) and a split pin, a small amount of lateral movement in the pin is normal.

The head of a standard cotter pin does not fit into the larger hole, using a standard cotter pin places all the load on one side of the fork and causes rapid wear of both the pedal eye and the push rod fork, it is perhaps the most common mistake made in setting up this system.

It is important to check that the pedal eye and the fork holes are not worn (ovalled) or damaged.

Fitting of the cover plates
The cover plates are aluminium and are easily distorted by over tightening of the fixing screws, the reservoir cover in particular is a source of fluid leaks.
Bent covers can be straightened in a good vice, they should be fitted with gaskets made of 1.6mm Klingerite or similar. I use 1/16" insertion rubber and use the covers as templates, the top cover is fitted with the cap to the rear and is assembled with non hardening gasket cement, do not over tighten screws.
Tip- cut the top gasket without internal holes, then cut 3 slits so a flap is formed under the filler cap, the flap helps prevent fluid splashes reaching the cap; the flap should face the rear.

Master cylinder assembly
Ensure that the bores are free of scores and corrosion damage, stainless steel sleeves and a final honing with #1200 wet or dry is recommended.

Check that the pistons are clean with particular attention to the double seat of the seal, the seal seat must be smooth and clear of any pitting or damage, check also that the bleed holes in the pressure face are clear.

Lubricate the rubber components, the bores, and the pistons with brake fluid and carefully fit the seals to the pistons with the lips towards the pressure face, do not use any implements (including fingernails) with sharp edges or corners.

Order of component assembly for master cylinders

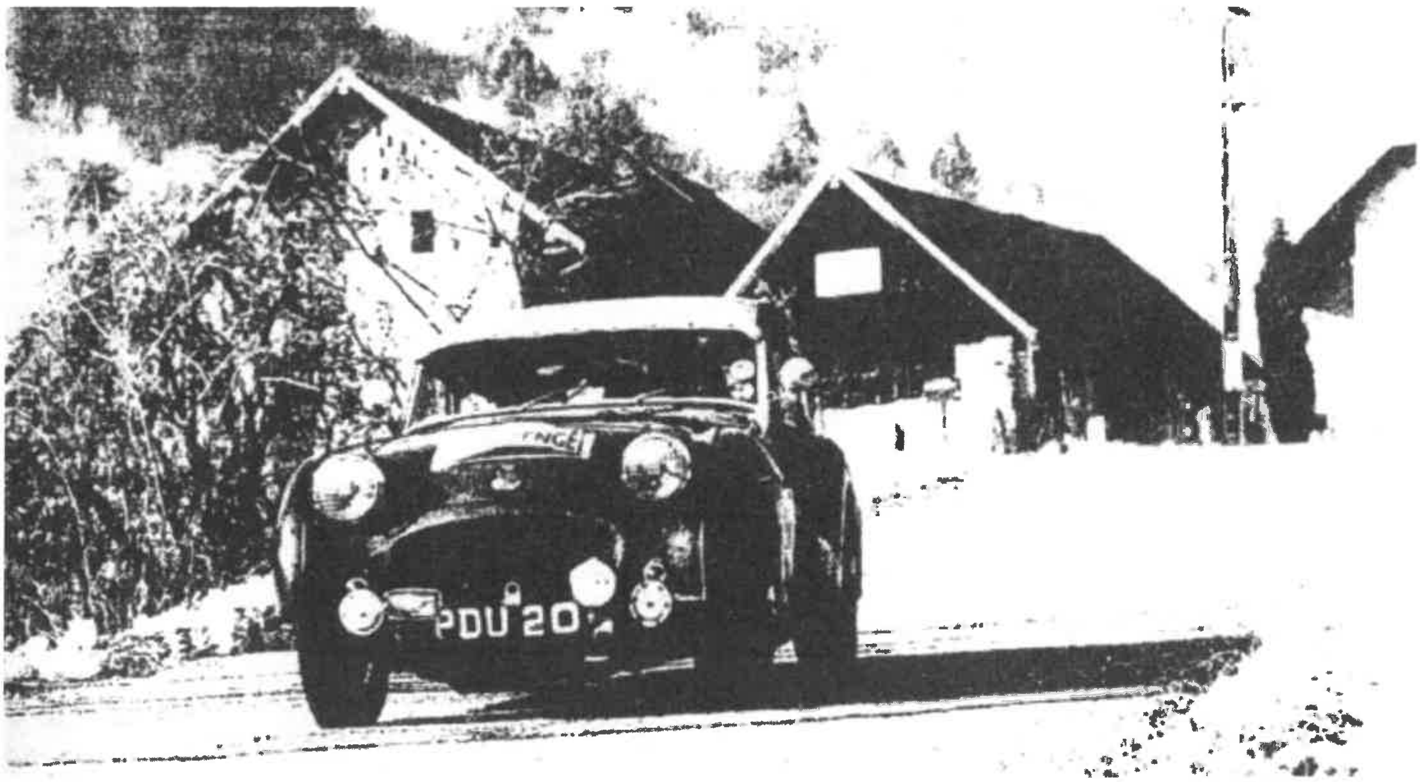
1 Brake cylinder – valve pad, valve body, spring, pressure cup, flat washer, piston/seal
2 Clutch cylinder – spring, pressure cup, flat washer, piston/seal

Notes

- There is a small, round plate on one end of the spring, there is a hole in the plate – a small protrusion in the rubber piston cup locates in the hole
- The valve pad is a rubber ring of rectangular section, the valve body looks rather like a hat, it is fitted so that the spring locates over the hat 'crown' and the underside of the 'brim' sits on the valve pad. The valve assembly is only fitted to the brake cylinder.
- It is vital that the thin section flat washer is fitted between the piston face and the piston cup. The purpose of the washer is to prevent the rubber piston cup from extruding though the small bleed holes in the piston when under pressure, this event will result in sudden and total failure of the brake hydraulic system.
- When fitting the piston cup and the piston/seal to the cylinder, great care should be used when guiding the cup and seal lips into the bore, do not use any sharp or hard edged implements to do this as it is very easy to nick the lips and so compromise the integrity of the assembly.

Fitting the master cylinder assembly to the car
It is especially important to ensure that all mounting bolts are fitted and secure, a loose or missing bolt will allow excessive stressing of the body with the possibility of fractures developing.

A good practice is to apply a caulking type sealant between the underside of the master cylinder bracket and the body, this will prevent any brake fluid spills from being trapped under the bracket and subsequently destroying the adjacent paintwork. DR



A not so bracing experience

"I just can't get it to go into gear!", the voice at the other end of the telephone belonged to an acquaintance with a TR3A, "the gears clash when I try to put it into first and it won't go into any other gear either, the clutch feels alright. I had my son look under the car and he said there is plenty of movement when I press the pedal."

It certainly sounded like a clutch problem. I asked if the car was used regularly, to see if it might be the fairly common problem of the clutch plate bonding to the flywheel with rust after an extended layoff. "I took it for a run last weekend and it was fine", was the reply. "Anyway, I had the clutch replaced a year or so ago and the car has been used pretty regularly since then. I even had them cross pin the clutch fork as you suggested in the Register newsletter".

Further questioning established that the car was used about twice a month but lately he had experienced the odd difficult gear change and an occasional crunching of gears when engaging first. The brakes had been bled several times without improvement and he had run out of ideas.

The symptoms were certainly consistent with a broken clutch fork pin but that possibility had been eliminated by the cross pinning. Could it be possible that the clutch slave cylinder brace or bracket had somehow worked loose or, even worse, could the brace be missing altogether and the bell housing had fractured?

"Brace? What brace ?" was the answer to my question, it looked as though my fears might be confirmed.

"Have your son look under the car again and tell you what parts are actually moving when you press the clutch pedal"

5 minutes later came the call, apparently his son was not very familiar with hydraulic clutch systems and had not realised that the clutch slave cylinder was not supposed to move when the pedal was pressed, hence there was 'plenty of movement' but most of it was in the wrong direction. Closer inspection confirmed that a roughly semi circular chunk of the bell housing had broken away and the slave cylinder bracket only remained attached to the gearbox by the flywheel cover plate.

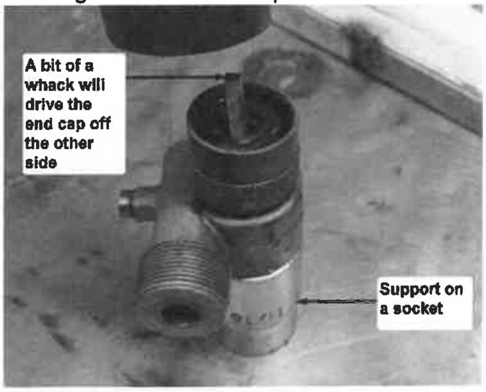
The slave cylinder brace is a very necessary part of the clutch assembly as it transfers the high, repetitious, torsional stresses of clutch slave cylinder operation from a small section of the bell housing flange to sheer stresses on a high tensile bolt in the engine block.

In the final summation of this sorry tale, it seems likely that the critical brace was lost? - overlooked? - misplaced? - but definitely not there when the gearbox was refitted after the work was done on the clutch. The owner was apparently not aware of the existence of such a thing, but then, readily admitted that he was not particularly familiar with the system in question anyway.
A repair was eventually effected by removing the gearbox and welding the broken section back, this was certainly less expensive than the alternative of a complete replacement of the gearbox case, but the integrity of the repair will always be in question and this type of repair is not always possible.

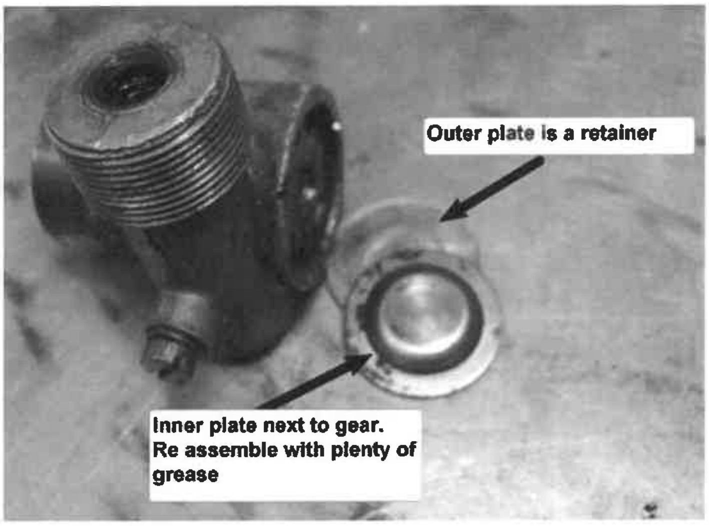
DO IT YOURSELF SPEEDO ANGLE DRIVE REPAIR.

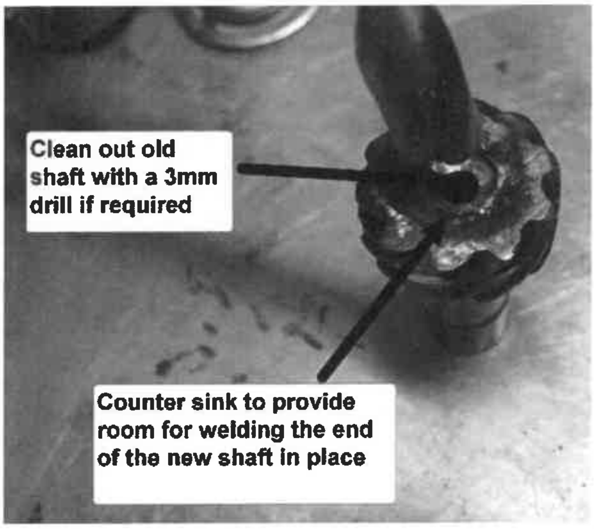
When the angle drive to your Speedo fails and you do not wish to spend the several hundred Dollars for a new one, or find a repairer, take heart, it is not difficult to make it well again
Take an hour of your time and a spare 4mm Allen key, then do it yourself.
The first thing is to determine why it does not work. The most common issue is the rounding off of the male square drive shaft and

sometimes it will be the connection between the drive shaft and the gear.
This is usually quite obvious however the whole thing has to come apart either way.
Support on a socket which is larger than the disc retainer but smaller than the housing and then hitting the end of the shaft will drive the gear assembly and the retainers out of the housing.



Now the shaft or old cable can be inspected and or



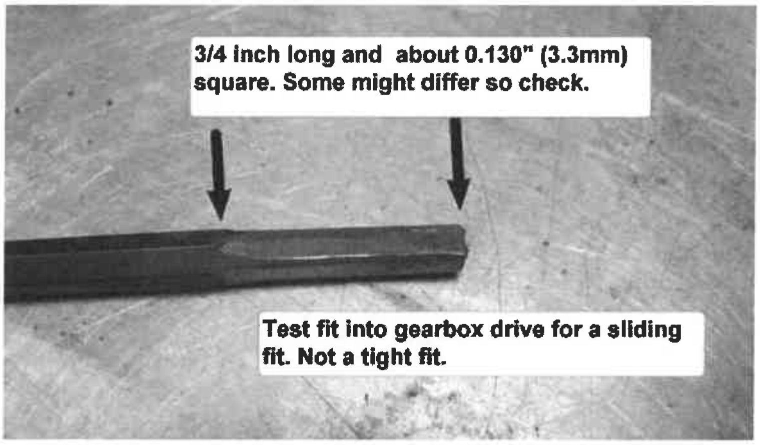


removed. If the weld has failed and the square drive is still good, then just re weld.
The original units had a length of drive cable welded into the gear, however if a new one is required it is easily made using a common 4mm Allen key. They are supplied with almost every DYI assembly item on the planet so should be available for nothing.

You will notice that the top and bottom flats provide a perfect reference surface on a

the grinder guide as you want to remove the 2 side of the Hex to produce a square.
The starting size is 0.155" (4mm) and you want to end up with a square of 0.130" (3.3mm)

Keep checking until you get an easy sliding fit into the gearbox drive
Cut the Allen Key off about 1.6" long, with grinder cut off wheel as it is too hard to hacksaw.
Fit the square end into your electric drill and use a grind stone to turn it down to fit into the gearwheel.
It is quite quick so keep a check on the diameter to obtain a tight fit into the gear. This will be about 0.115"-0.118"



CLUTCH

This clutch is a combination of parts from various other cars, it can be used in Sidescreen cars when a Triumph 2000 gearbox is installed in lieu of the original

1. Clutch Release Bearing (or Throw-out Bearing): The bearing to use is the throw-out bearing for a 1975-1986 Toyota Landcruiser. This bearing has a Beck-Arnley / Worldparts part number of 062-0898. Other part numbers it is listed under are "RCT52S", "RB-0203", and "046", but you can just ask for a 1975-86 Landcruiser Throw-out bearing and you will get the right part. It is a larger OD than the stock TR-6 T/O bearing, but the ID is the same, so it presses onto the stock TR-6 carrier/sleeve.

2. Clutch Pressure Plate: The Pressure Plate to use is the SACHS pressure plate for a 1979-1991 Saab 900 w/non-turbo 2 liter engine. This has a Sachs part number of SC436, and a Saab/Metrix Parts part number of 87-28-123. When you buy this make sure you are getting a Sachs part – Borg & Beck and Sachs were used interchangeably on the 900 series and the Saab part number does not distinguish between the two brands. If you get a Borg & Beck you are getting the same part that you (most likely) just took off your TR-6

3. Clutch Friction Disc: There is no Sachs friction disc for a TR - the Saab has a different input shaft. A TR6 plate can be used but has a slightly less sweep area, also a AH 100/6 plate fitts

Additional hints I gathered:

1. Hone or machine an addition .010-.020 of clearance off the inner bore of the throw-out bearing sleeve. Apparently at higher temperatures, it has a tendency to stick. Also install it with some high-temp grease.

2. Drill a 5/16" hole at a 90 degree angle to the retaining pin (offset from the pin - you don't want to drill through it) through the fork and rod, and install a grade 8 bolt and nut as additional insurance from the pin breaking.

LAYCOCK LACUNAE

I thought that it might be interesting to put down on paper the various engine revolutions in a Sidescreen TR when using Laycock Overdrive with an alternative geared overdrive i.e. 22% or 28% in combination with a 3.7 to 1 or a 4.1 to 1 diff ratio.

There are two basic factors which are used to work out the various engine revolutions. As you know, when working out the base price for goods purchased with GST added, you divide the purchase price by 11. This same sort of factor is used in working out engine revolutions with either 22% of 28% overdrive fitted.

These factors are:- 22% factor is 5.55
28% factor is 4.57
We shall see how these factors work below.

Standard/Triumph specifications for Sidescreen TRs' are 500 RPM per each 10MPH in top gear. However, this figure was applicable when the old cross-ply 550.15 tyres were fitted. Today everybody has radials fitted, with the most popular size 165 R15. This tyre, with its lower profile has approx. 3% less diameter. Thus the figure which we use here is 515 RPM per each 10 MPH.

Hence, engine revolutions without overdrive engaged for TRs' at 60MPH are:- 3100
Engage standard 22% overdrive and maintain 60MPH, the engine revolutions will fall.
Thus 3100 divided by 5.55 = 558
Subtracting 558 from 3100 = 2542 engine RPM
Therefore, for every 10MPH. the engine revs are 424.
Consequently, if the TR is now travelling at 70MPH, the engine R.P.M is 7 times 424, which equates to 2968 Engine revolutions.

The TR has a 28% overdrive , but still with a 3.7 to 1 differential.
Engine revolutions are maintained at 3100. RPM. This still gives 60 MPH with no O/D.
Engage overdrive and maintaining 60MPH the engine revs will fall.

Thus 3100 divided by (factor) 4.57 =678
Subtracting 678 from 3100 = 2422 engine revolutions with overdrive engaged.

Although we have dropped the engine R.P.M. to lower than the 22% overdrive, our power output has dropped considerably. Let us therefore fit a 4.1 to 1 differential to our vehicle to restore the power balance.

TR now has a road speed of $\frac{60\text{mph}}{1} \times \frac{3.7}{4.1}$

Still no overdrive engaged and our road speed is now, from the equation above 54.15 mph.
To increase the road speed to 60mph, we must now increase this road speed by 60mph minus the 54.15 mph arrived at above which equates to 5.85mph.

Thus the equation $\frac{5.85}{54.15} \times \frac{100}{1}$

This equates to 10.8%

In other words, we must increase our engine revolutions by 10.8% to maintain our 60mph road speed.

I.e. 3100 + 10.8% = 3100 + 335
= 3435 RPM at 60mph

NOW ENGAGE 28% OVERDRIVE

Engine revolutions will now be $\frac{3435}{4.57}$

This equates to 752

Therefore 3435 minus 752 = 2683 engine RPM at 60mph or 447 RPM for each 10mph.
Consequently, if driving at 70 mph the engine revolutions are now
447 x 7 = 3129 RPM.

TO SUM UP:--

Overdrive %	60mph No O/D	60mph O/D engaged	70mph No O/D	70mph O/D engaged
22% with 3.7 diff	3100	2542	3617	2968
28% with 3.7 diff	3100	2422	3617	2826
28% With 4.1 diff	3435	2683	4008	3129

You can see that by using a 28% overdrive combined with a 4.1 differential, you can only increase your engine revolutions at 60mph by 141 and at 70mph the increase is only 161. Using the same formula, 80mph is 184 revs. Extra or, if you like, 100mph is 230 extra.

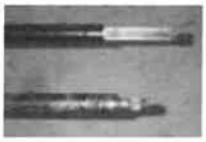
This shows that there is very little difference in cruising speeds with the overdrive engaged, but you have a huge increase in power when disengaging the O/D. Very good for rallying etc. In the New England and similar country where you are going from tablelands down to the coast and back. Magic!

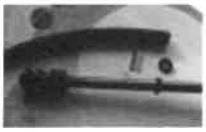
Finally, it is important to realise that the above figures are mathematically correct. If you're Speedometer or RPM gauges differ from the tables above, it must be remembered that these mechanical gauges (as opposed to the electronic design of modern gauges) are 50 years old and may need recalibrating. One of the problems of Jaeger Speedometer is the instability of the needle. This, apart from general wear, is brought about by the internal odometer operating arm moving backwards and forwards to rotate the number tumblers. This caused a slight braking effect at each cycle, which translates to needle instability in slightly worn mechanisms. This problem can be remedied by your friendly local top-line instrument maker.

THE BUSH MECHANIC.

Steering

TR2/3 Steering Box Overhaul

			
Here's our subject, a one-piece TR3 steering column and box. The box overhaul is the same for later cars with split columns.	Adjustable wheel column shown at the top, standard wheel column at the bottom (one piece). The outer tube is 51-15/16" for the adj. wheel, and 52-9/16" for the std. wheel.	Using a 1-1/16" socket, remove the drop arm nut. Don't forget to straighten the bent tabs on the locking washer first!	Pull the drop arm off using a pitman arm puller as shown. The fork tool on the right should NEVER be used as you may bend the rocker shaft inside the steering box and destroy the worm gear.
			
A 1/2" wrench is used to remove the 2 bolts from the mounting casting. Then slide the mount casting off of the steering box.	The 1/2" wrench is then used to remove the 3 bolts which hold the top cover in place.	Remove the top cover and pull the rocker shaft out of the steering box.	A 1/2" wrench or socket will remove the 4 bolts from the end cover. Save all of the shims that you'll find between the box and cover.
			
After removing the end cover and shims, you'll find the lower bearing and race. Remove them and the inner column and worm gear can be removed.	The oil seal at the bottom of the box should pop out easily.	To remove the rocker shaft bushing, slip a 1" O.D. washer through the lubrication slot at the bottom of the steering box.	The 1" O.D. washer will sit perfectly on top of the bushing, and pass through the bore to push the bushing out of the box.
			
I use a socket that is slightly less than 1" O.D. (and extension) to push on the top of the 1" flat washer.	You'll need a press or some other means to apply steady pressure to push the old bushing out of its bore.	Here's how the bushing will come out of the bottom of the box, followed by the washer and socket.	Disassembly complete, it's time to start cleaning parts
			

Use caution if having parts chemically or heat stripped. This joint appears to be sweat soldered.	Concours restorers should take note of the yellow paint marking on the drop arm and the date code stamped on the end plate.	Here's a different steering box with the same yellow paint marking on the drop arm.	More yellow paint marking on the steering box. I've found this on every box I've ever inspected.
			
If any wear shows on the rocker shaft peg, it can be replaced. Wear on the shaft just above the splines means that a complete new rocker shaft is needed.	Using a deep socket to support the rocker shaft arm, press the old peg out of the arm. I just love the lifetime guarantee on Craftsman tools!	Take your time to assure that the new peg is lined up perfectly before pressing it into the rocker shaft arm. A large vice is ideal.	Back to the press; use another 1" O.D. washer and assorted sockets to press the new rocker shaft bushing into the steering box.
			
The new rocker shaft bush will have to be reamed out to fit the shaft. I'm using an adjustable 7/8" reamer, ENCO # 334-113. GO SLOW!	Install the new lower oil seal next.	Install the 2 anti-rattle rings on the inner (one-piece column only) next. I forgot to order these, so I cut acceptable substitutes from 5/8" heater hose.	Install the upper bearing race and bearing. Be sure that the race is fully seated and the bearing is orientated correctly.
			
Slide the inner column and worm gear into place, and check that the bearing and race remained in place.	Install the lower bearing and race, gasket, shims, and end plate. Add or subtract shims until there is no end play. A small bit of pre-load is O.K.	The felt upper column bush is next. Any small children in the area will receive a vocabulary lesson when you install this on an adjustable wheel column!	Now install the rocker shaft. Check to see that the peg is fully seated in the worm gear. Then install the top cover. Leave the top adjusting screw finger tight for now.
			
Install the mount casting in the proper orientation, then the drop arm. Align the drop arm with the marking on the end of the rocker shaft.	Install the locking washer and nut to retain the drop arm. One side of the washer is bent down over the drop arm, and 2 other places are bent up along flats on the nut.	Now that everything is back together, and you're done wrestling with this monster, it's time to paint.	Install in your car, fill with oil, and adjust the top adjusting screw so that you feel just a slight drag on the steering wheel near the centre of its travel. Above all, enjoy your improved steering!

Don't have access to a press or don't want to buy a reamer? Send your disassembled steering box and rocker shaft here and we'll install the rocker shaft bushing and ream to size for you.

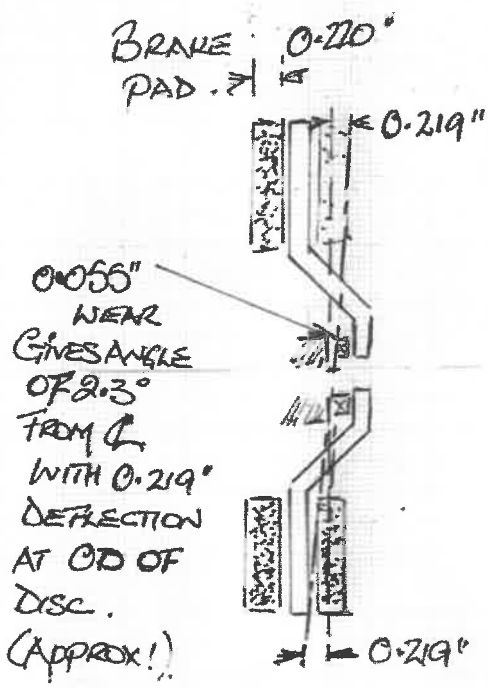
Stronger Front Axles

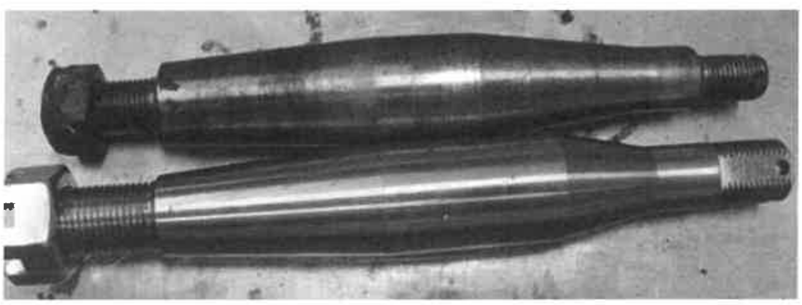
The euphoria of resurrecting a TR and racking up 40,000 miles remains strong even after having to develop the habit of constantly pumping the brakes when involved with and spirited mountain driving. This is a necessity when one lives in mountain regions where going for a fang means lots of "OOOH bother" moments when going for the brake to find they only work properly on the third pump.

Old salt TR men know this of course and just sigh with a comment like “Well talk to Uncle Jack”. So who is “Uncle Jack?” and what does he know that we do not? Well he was Jack .W. Drews who was a Vintage racer in TR’s.

Being keen to understand the issue, I thought it might be a good idea to try and quantify what was happening before seeing what Uncle Jack had to offer.

The first piece of evidence came to light when taking the hub off and seeing how the ***steel housing for the rear felt seal*** behind the inboard bearing was worn on one side. Curiosity prompted a similar check on the other hub only to find a similar wear pattern. The left hand side was worse by 10%. There was 0.050” worn off the RH side and 0.055” worn off the LH side. This is consistent enough to conclude that axles are flexing upward by a multiple of that.





Based on the 2" dia of the seal housing and the .055" wear I calculated an angle of 2.3 Deg which by my bush geometry equates to a deflection of 0.219" or 0.220" at the OD of the disc. The brake pads are about 0.2 to thick on my car at the moment so I estimate that there is a full pad thickness to be pumped up before the brakes become effective. This is enough to produce many an "OOHH Golly Gosh" moment when least expected. Lady navigators restrict the use of more appropriate expressions!

The evidence was sufficient to check out "Uncle Jack" *(prices shown here for Tony Drews kit).*

He manufactures a kit to reduce the flexing of the front axles with higher strength axles combined with spacers between the bearings to stiffen up the whole assembly.

I thought I might purchase one of these kits and see what it was all about. The Kit is also available from the Roadster Factory under Part number HP661. The price is about US$300.

The kit come with 4x .001", 2x .002", 4x .005", 2x .007", 2x .010" and 2x .015" shims and everything is BIG Note: the following instructions are included in the kit The objective of the kit is to install the spacer and shims so that the outer nut can be tightened very tight, there will be no play in the hub bearings, and the hub will still spin freely. Ideally you should end up with zero clearance in the bearings.

Remove the old spindle.

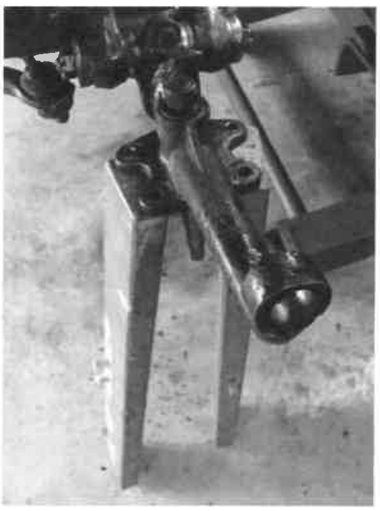
This is usually (but not always) pretty easy and can be done on the car. Remove the bolts that hold the upper ball joint in place, swing the upright down and onto a wood block, for example, screw the inner nut to the end of the threads, and hit the end of the stub axle HARD.

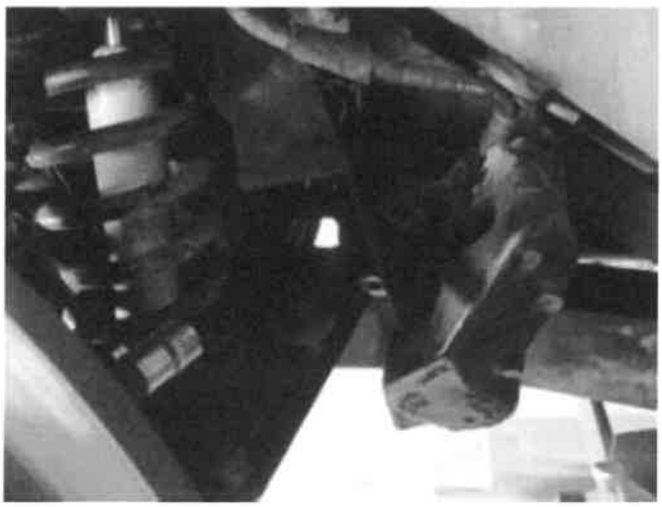
The old stub axle usually falls out.

Well, YES and NO. A few big hits with a copper mallet and bingo, the RHS was free. Not so the LHS

The other side, which had a new axle used during the resurrection, was not easy to remove. Basically I had to unscrew the whole assembly about 17 turns and take it to a machine shop to be pressed out.

Belting thinks with big hammers is not something I feel comfortable with so unscrewing the assemblies and taking them to a press has more appeal.





It is all quite basic, like hanging up the brake caliper but then one really has to remove all the backing plates and other hanging bits before the assembly can be pivoted down or removed if required.

I digress - continue with the instructions

* Remove the felt seal and the inner bearing from the hub.

* Wipe the grease off of the faces of the inner and outer bearing so that you get an accurate reading of the tightness in the shimming step.

* Install the inner cone bearing, spacer, and hub in that order.

* Then install a .015 shim and the outer bearing, D washer, and castellated nut.

* Torque the nut to 50 ft lb. Spin the hub. It should spin freely. Grab the brake rotor and wiggle it side-to-side and top-to-bottom. Start decreasing the thickness of the shims until there is no play but the rotor and hub spin freely even with the nut tightened to 50 ft lb. Most customers report needing about .007 shim thickness to achieve that. (yes that was spot on for the first hub but not so for the second one. DO NOT ASSUME ANYTHING. Measure carefully as there will be variations)

* Remove hub and spacers, re-install the felt 'seal, and reinstall the hub, spacer, and shims. Install the washer and castellated nut. Torque to 40-50 lbs. It might be necessary to use a shim under the washer to get the right pre-load on the nut with the cotter pin fitted, or sometimes it might be easier to take a smidge off the nut.

* Finally install the Dutzt cap.

All the old salts have nothing but praise for Uncle Jack and his upgrade for the TR. By all accounts it has been the best thing they ever did to their cars and works a treat. After testing the car quite vigorously in Tasmania I can confirm that Uncle Jack was indeed on the right track. Multiple high speed hairpin bends and brutal steering wheel action sometimes on full lock diminished the availability of a full brake pedal by about half but it was always there when needed. Under normal non brutal but vigorous driving the brakes are a pleasure and my co-pilot assures me that decorum has returned

Cheers Rob Bradford

FITTING MY RACK & PINION AND WHAT IS THAT BUMPSTEER STUFF?

Well I finally came to the task I had read and heard so many horror stories about, Setting up a rack and pinion steering on my 3A.

I pondered many issues during the 29 years our car has languished under several houses waiting for the incentive, time, money and place to restore it.

The Front LH tower and chassis were badly damaged so I had fabricated replacements with the aid of stringlines, plumb bobs, builders levels and guesswork as a substitute for experience, how this work would affect the final set up was what I was about to find out.

Horror stories about Castor variations and the dreaded Bump Steer abound, so I spent much time reading everything I could find and asking anyone who would listen.

The problem was that every "expert" I spoke with gave me a different story and so much of the stuff I read I did not really understand, well it sort of made sense but added to all the other stuff made me more confused. In the end I decided to try visualising what actually happens at the tyre centre when the suspension oscillates.

Perhaps the first thing to do would be to find out how the steering was set up originally, so I fitted the original system hoping find out something useful.

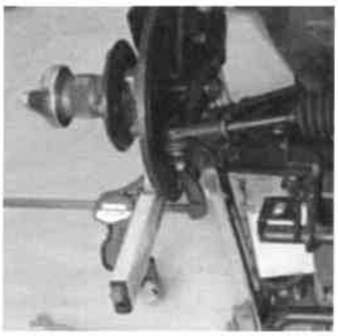
One thing I recall being told was that it was important to have the tie rods and lower suspension arms parallel to one another throughout the full stroke of the suspension.

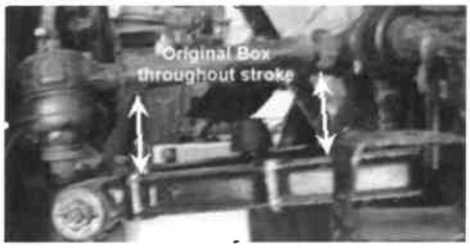
Well this seemed to be the case with the original. So what next?

Now most if not all the horror stories I have heard stem from "Bump Steer" so it seemed reasonable to try and first measure what the original suspension did, but how?

Being a thoroughly modern old fart it was on to Google to find out how one measures such things, only to find there are some bump-steer gauges on the market which use all manner of pivots, brackets, clamps, mirrors and dial gauges. All I had to do was part with vast sums of money and wait for delivery.

Then after further thought, the solution became obvious; perhaps Bunnings might be able to help? Well $19.00 later I returned home with a small Laser level which was duly clamped to the brake disc and with the aid of a piece

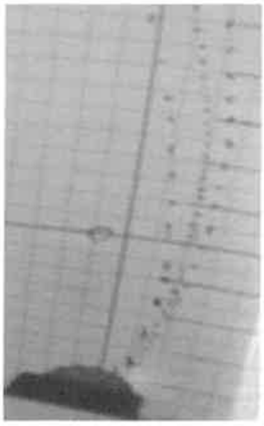


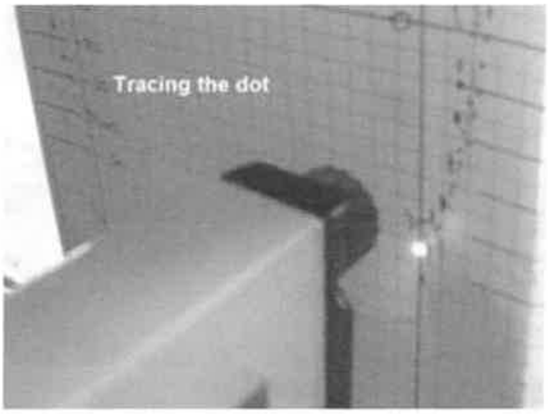


of graph paper clamped to the vertical portion of my engine stand we had a simple device which should allow me to trace the path of the wheel if I remove the springs and then jacked the assembly up and down between the 2 bump stops

By my reckoning all I had to do was carefully trace the dot to see what was going on.

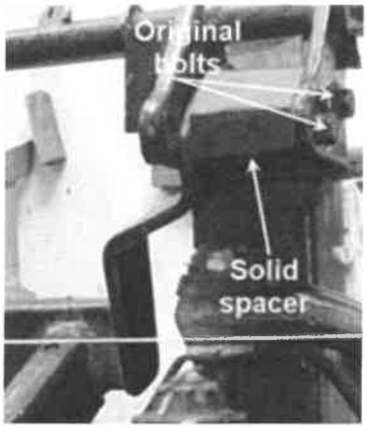
There was one more thing to do, I needed a "Normal" at rest reference point. The obvious source of such precise information is the TR Forum where there lurks all manner of profound experience. In a flash we had a reply that it was 38mm between the lower bump stop rubber (new one) and the outer edge of the stop bracket. this also equated to the tip of the grease nipple being level with the bottom of the chassis and on the basis of a full travel scale of 100mm was at -30mm.





This all proved very successful if not a little tedious. I am still in some doubt if using a jack gives a completely accurate result for bump and rebound, however as long as whatever I did was consistent it seemed reasonable that the result would be not far off the mark.

So now I find that the original steering gave me 4mm of toe out between -30mm and +10mm then went to toe in between +10mm and +50mm (Top Bump Stop)



So now to fit the new rack and see how it compares.

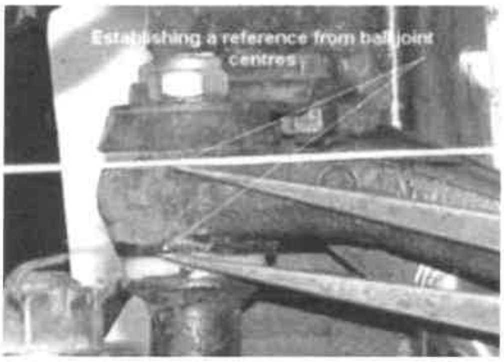
The Rack was an Mk11 Escort unit from Pedders and the kit was from the reputable Mr Goodall so I was confident I had all good stuff. The Rack bracket fitted perfectly however I also made up a solid spacer out of a bit of very mature hardwood, as I thought this would approximate the stiffness with original box and idler.

At this point I found that the rack bracket could be moved up and down quite a lot by pivoting on the bolts before tightening them up fully.

Perhaps this is intentional to allow for vertical set up, so this was a good time to begin measuring things.

I decided to make 2 reference points which were; The Centre of the lower trunion and the rear face of the lower suspension arm. The Centre of the front lower trunion was also 131mm above the bottom of the chassis. These would be referenced against the centre of the rack and the outer ball joints.

From my research, texts and Google, I determined that Bump Steer is when your wheels steer themselves without input from the steering wheel caused by a difference in the arc scribed by the outer ball joint compared to the arc of the axle, so if the tie rod is shorter than the suspension then the car would toe in over bumps. Some bump out can make the car more stable on corner entry. Bump in is almost always undesirable.

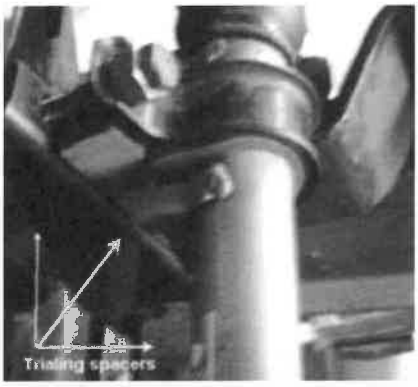


Most of the texts and illustrations I came across relate to race cars and refer to all manner of imaginary lines and instant Centres which all look very nice but how can this be relevant and measured with what I have and how many options for adjustment would I have on the TR even if I did understand all this stuff and was able to put it into practice.

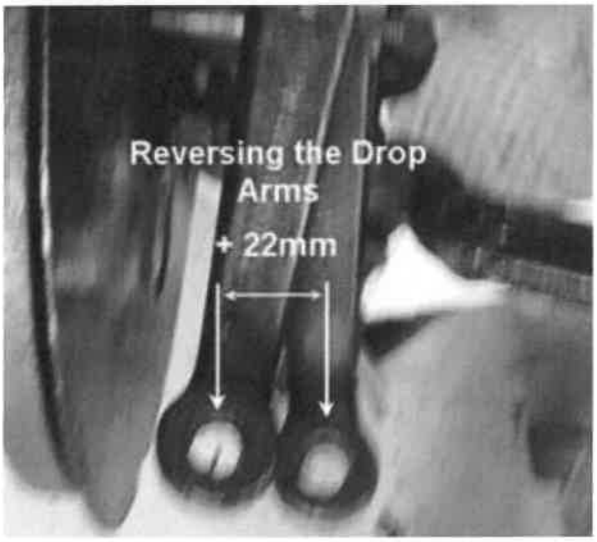
Having shortened the tie rods on my new rack in accordance with the instructions supplied with the Bracket Kit, I set up the rack, it was time to start doing some tests and measuring stuff

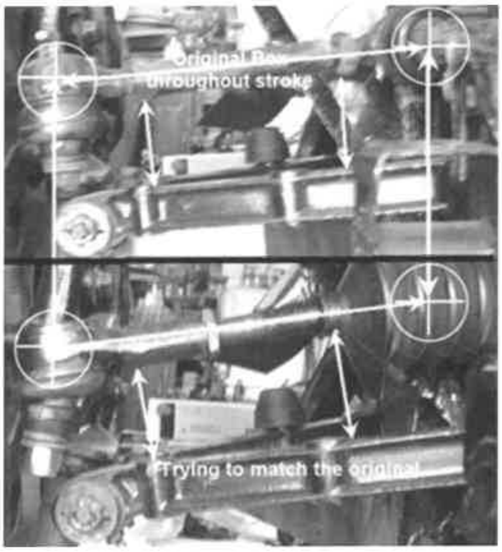
so I could begin to make sense of it all.
Firstly it seemed reasonable to try and match what I started with because surely I could not go far wrong if I could match what Triumph designed. Well this was not going to happen because the outer pivots on the rack are further apart than the original which means the arc of the tie rod will be shorter and could cause above mentioned toe in during travel.

This became obvious when I found that I could not make the tie rod and suspension arm remain parallel and I started to get toe in after only 37% of suspension travel.
Now was the time to see what happened when the position of the rack was altered. The bracket had some movement in it so that was a good start.
At every change I measured the same references and made a dotted line for each side on graph paper using the same scale. Having exhausted the movement in the bracket I made up some wooden spacers of differing thicknesses, some were tapered.
The idea was to be able to position the centre of the rack at a position in space where I got the least amount of variation; however the position of the rack mounting was at angle so using ordinary spacers moved the rack centre both upwards and forwards.



Many spacers later and I came to the conclusion that I had to do something else as I had exhausted every combination and still could not match the original.
At about this time most of the advice I got was related to using TR4 drop arms and or bending them. Well if different drop arms make a difference what would happen if the existing ones were simply swapped from side to side?
It looked to me that it would increase the effective length of the tie rod by moving the ball joint further out which was at least likely to reduce the toe in effect. Reversing the arms increased the effective length of the tie rod by 22mm each side which immediately halved the deviations I had been getting.





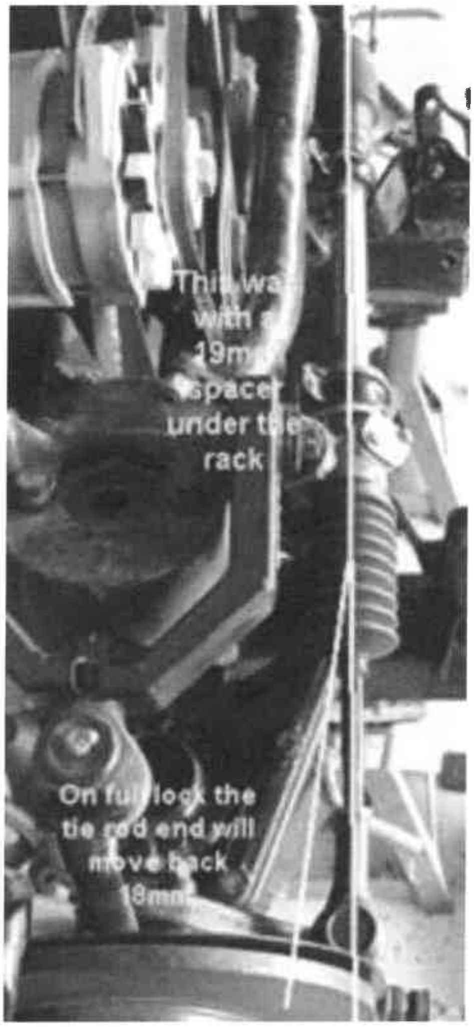
This was very encouraging but since I had shortened the new rack tie rods I found I needed new tie rods which were at least 22mm longer. Unfortunately spare tie rods are not available for the rack I had bought as it was an Asian equivalent and basically throw away. The only option was to go back to small4 spares and order a genuine Escort Mk11 rack and set it up for the right length.

Now it was also mentioned somewhere that the drop arms are set up for Ackermann and cannot be reversed, however on close inspection I found there is an offset angle which looked to me more about preventing the ball joint from fouling the drop arm at full travel, as there are differing theories, some of which suggest that the TR has no Ackermann consideration.

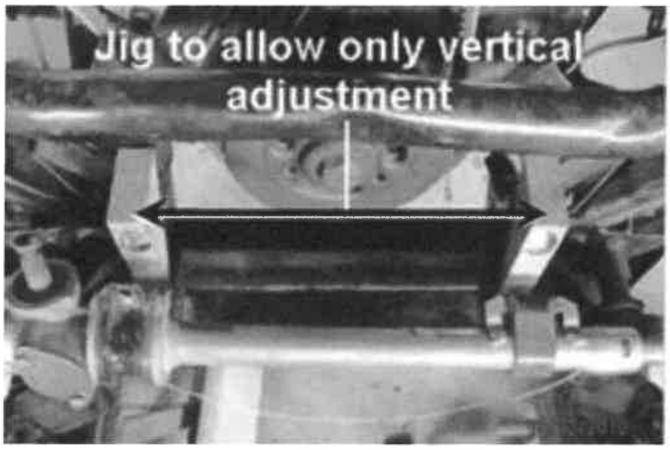
I tried to measure this and found the centre point of the drop arm intersection was miles way from away from where I thought it should be so just checked to see if there was ample clearance between the ball joint and the drop arm at full travel each way when the arms were reversed. I found there was. At this stage it looked like I had some positive

direction and needed to evaluate all the data collected so far in order to make some decisions.
Dale Thompson at Smithees in Sydney was interested in the results and confirmed that the traces matched what they had discovered which was encouraging and confirmed that my conclusions had some basis for proceeding.

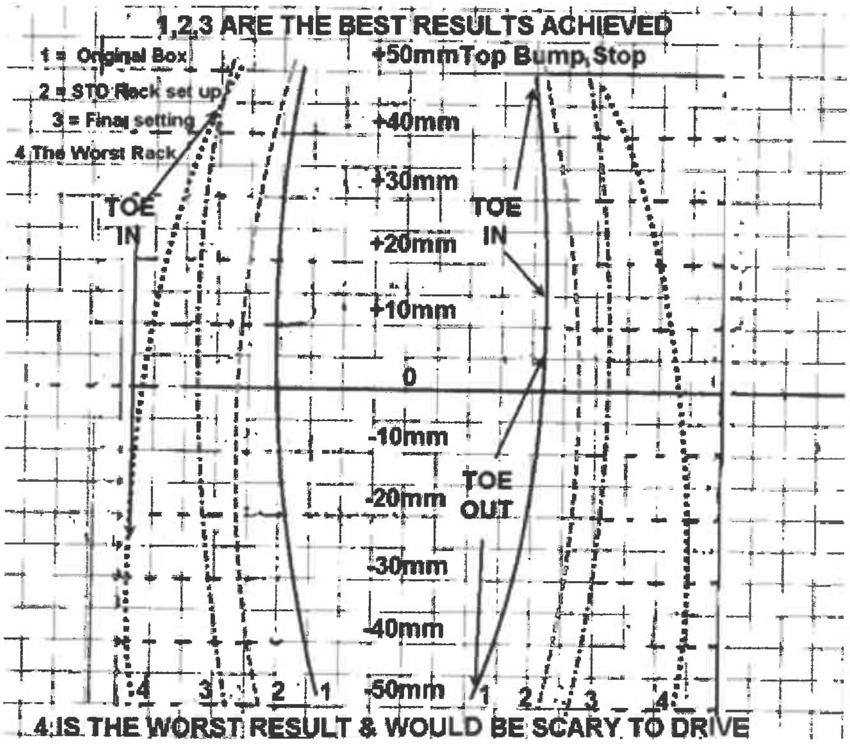
In order to limit the rack adjustment to vertical only I made some tapered pads for the rack mount which were used to find the limits of vertical movement, however in the end I found that I also needed to move the rack forward anyway to have a straight line between the tie rod ball joints.



I made an assumption that during normal road use, the suspension would oscillate about 50% of full travel, so it seemed reasonable to try and get the least amount of variation during the first 50%.The results so far indicated that the height of the rack was the most critical in determining where the chord of the arc was, however it also seemed that the fore and aft movement also had some effect. The end was near but I could not get the same curve on both sides, so tried using a different number of spacers on each side which worked well.



The final outcome was to use 3mm metal spacers drilled to fit behind the rack so that I could either add or subtract spacers as required in case there were any issues when the ultimate test of road use came.



This chart shows what results I got:

No 1: The original TR steering box

No 2: The best results with standard drop arms and no spacers

No 3: The best result with reversed drop arms and spacers 19mm RH 16mm LH

No 4: The worst result rack achieved. This is probably what causes Scary stuff.

The flatter no 3 curve with less toe in that I was looking for.

The real test is how the car drives and I can happily confirm that on its first outing to the Toowoomba concours and after tour there was no hint of bad manners or any tendency to wander. It remains to be seen how it compares with other cars.

It turned out that lady luck must have been on my side as final alignment test showed

Castor was LHS=00.00' RHS=00.09' Camber was LHS = -20.02' RHS= +1033'

Toe in was then adjusted to -0.2mm.

I would like to acknowledge the patience and generosity of Terry Goodall in explaining the theory behind his mounting kit. Terry explained that his original mounting kit was designed specifically for use with the TR Fan extension so is deliberately low, he also confirmed that ¾" higher would be about right for best efficiency, which is confirmed by my results. I would also like to thank Dale Thompson for his encouragement and confirmation of my findings.

The big question now is was all this worthwhile and why do we convert our TR's to Rack and pinion in the first place?

Just getting the rack in right place is only part of the smorgasbord of issues to consider when going down this path but perhaps that is a question to be explored in another story.

Rob Bradford

Wheels & Suspension

Bump Steer

Bump Steer is when your wheels steer themselves without input from the steering wheel. The undesirable steering is caused by bumps in the track interacting with improper length or angle of your suspension and steering linkages. Most car builders design their cars so that the effects of bump steer are minimal. However, you must still take care to bolt on your suspension carefully so as not to create unwanted bump steer. Make sure that you are always using the correct components for a particular car. Bump steer must be designed into the car and cannot be adjusted out if improper parts are used or if pivot points are moved without considering bump steer design principles.

In order to accomplish zero bump the tie rod must fall between an imaginary line that runs from the upper ball joint through the lower ball joint and an imaginary line that runs through the upper a-arm pivot and the lower control arm pivot. In addition, the centreline of the tie rod must intersect with the instant centre created by the upper a-arm and the lower control arm (See diagram below).

The instant centre is an imaginary point that is created by drawing a line from the upper a-arm ball joint through the a-arm pivot where it is intersected by an imaginary line that extends from the lower ball joint through the inner control arm pivot. Where the two imaginary lines intersect is the instant centre.

Sounds complicated? Really it is very simple. To achieve zero bump the front end must be designed correctly. The tie rod must travel on the same arc as the suspension when the car goes through travel. Simply matching lengths and arcs to prevent any unwanted steering of the front tyres.

To exaggerate, if the tie rod were only 10" long and the suspension were 20" long then when the suspension traveled the tie rod angle would shorten much quicker than the suspension arc. In this scenario the tie rod would shorten much quicker through travel than the suspension and the car would toe in drastically over bumps. The shorter arc of the tie rod would pull on the spindle and toe it in through travel.

When designing a car, if the centreline of the outer tie rod lines up with the centreline of the lower ball joint, and the inter tie rod lines up with the lower pivot point then the length and angle of the tie rod and suspension will be the same resulting in zero bump. Most car builders design their cars in this fashion.

Bump Steer Measurement

Your front suspension must be complete and set for racetrack conditions before you can measure the bump steer. All components must be tight and in proper position and you will need a quality bump steer gauge.

1. Set the car at ride height.
2. Use the proper size tyres and air pressures.
3. Caster must be set.
4. Camber must be set.
5. Toe in must be set.
6. Tie rod lengths must be set.
7. Steering should be centered (tie rod ends centered on inner pivot points lower ball joints).
8. Steering must be locked down.
9. Measure from the ground to the lower ball joint or other reliable reference point. Write the number down.
10. Remove springs and disconnect the sway bar.
11. Return the suspension to the proper height by using your reference number to the ground.
12. Obtain a supply of bump steer shims.
13. Bolt on the bump steer plate to the hub. Level the plate and note where the dial indicator is on the bump steer plate so that you can quickly return to the correct ride height.
14. Jack the suspension through 2"-3" of both compression and rebound travel and write down your results.
15. Shim as needed.

C. Making Bump Steer Corrections

Now that you have measured your bump steer you will need to adjust, shim or relocate the suspension components to get the exact reading that you desire. Below are some tips that will quickly guide you through the corrective process for cars with front steer style suspension.

Symptom
Cure

Symptom 1. Toes out in compression and in on rebound all in one direction.
Cure 1. Decrease shim on outer tie rod or lower the inner tie rod.

Symptom 2. Toes in on compression and out in rebound all in one direction.
Cure 2. More shim at outer tie rod or raise the inner tie rod.

Symptom 3. Always toes in both compression and rebound.
Cure 3. Lengthen the tie rod as it is too short.

Symptom 4. Always toes out on compression and rebound.
Cure 4. Shorten tie rod as it is too long.

Symptom 5. Toes out on compression, then in on rebound and then starts back towards out with more rebound travel.
Cure 5. Less shim at outer tie rod and shorten tie rod.

Symptom 6. Toes in on compression, then moves out on rebound and then starts back towards in with more rebound travel.
Cure 6. More shim at outer tie rod and lengthen tie rod.

Using the Bump Steer Gauge

Selecting a good bump steer gauge makes the process easier. I like the bump steer gauges that utilize only one dial indicator. One dial indicator bump gauges do the math for you and you avoid having to watch two dial indicators move at the same time. Sometimes when the bump is way out of adjustment it takes two people to watch both of the indicators. The one indicator design is much easier to use.

When you set up your bump steer gauge with the car at the proper height set the dial indicator at the centre of the bump steer plate and be sure that the indicator is set in the middle of its range. You want to avoid running out of indicator travel.

Once the indicator is set simply jack the suspension through 2"-3" of compression. Stop at each inch and record your reading. Repeat the process through rebound and record those numbers at each 1-inch interval.

If the front of the bump steer plate is moving towards the engine then you have a bump in condition. If the front of the plate moves away from the engine then you have bump out. The dial indicator will see small amounts so watch it carefully and note your results.

How Much Bump Steer?

Ideally you should run as little bump steer as possible. Most of the tracks we see today are old and bumpy. Bump steer on these rough surfaces causes the car to be unpredictable.

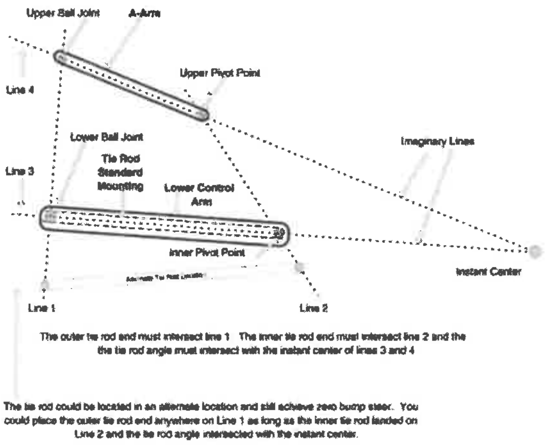
Some bump out can make the car more stable on corner entry. Bump in is almost always undesirable.

Some people use small amounts of bump out to create entry stability and an Ackerman type effect in the centre of the turn where as the bump setting causes the LF to turn a bit farther than the RF as the RF compresses and the LF extends.

My recommendation is to run .005 to .015 thousands of bump out but never allow the tyres to bump in.

If you want Ackerman in the centre of the turn then add Ackerman while maintaining proper bump. If you use bump to obtain some Ackerman effect the car will be unsettled as it goes over each bump, which will break the contact patch from the racing surface.

If the design of your car does not allow for such precise bump adjustments then more bump out is better than any bump in. However, strive to get the best bump numbers even it if means replacing parts. Excessive bump over .050 can slow your car down.



Camber

Camber is the tilt of the tyre as viewed from the front of the car. If the top of the tyres lean toward the centre of the car then you have negative camber. If the top of the tyre tilts out away from the centre of the car then you have positive camber.
Adjusting camber can have a dramatic effect on the cornering of your car. Most oval track racers run negative camber on the right side of the car and positive camber on the left. Optimum camber settings will result in more speed and ideal tyre wear.
Camber is measured with a caster camber gauge and is usually easily adjusted with shims or adjustable upper a-arms. Always check the toe when making camber or caster adjustments.
The amount of static camber that you should run is a result of testing, pyrometer measurements, front suspension geometry and discussions with your car builder. Remember that poor camber settings will cause excessive tyre wear. Camber settings set to extremes can reduce the braking ability of the car.

Caster

To understand caster you need to picture an imaginary line that runs from through the upper ball joint and extends through the lower ball joint. From the side view the imaginary line will tilt forward or backward. The tilting of this imaginary line is defined as caster.
Caster is measured in degrees by using a caster camber gauge. If the imaginary line described above tilts towards the back of the car, at the top, then you will have positive caster. If the imaginary line tilts forward then you would have negative caster.
Positive caster provides the directional stability in your racecar. Too much positive caster will make the steering effort difficult. Power steering will allow you to run more positive caster. Negative caster requires less steering effort but can cause the car to wander down the straightaway.
For oval track racing most racers run more positive caster on the right side tyre than on the left. The caster split helps pull the car down into the turn, helps the car turn in the centre and helps it stay hooked up on exit.
How much caster should you run? The amount and split depends on the type of car and track conditions. The details should be worked out with your car builder and through testing.

PRINCIPLES OF THE CENTRE-LOCK WIRE WHEEL

Possibly because of childhood experience with bicycles, the need to maintain correct spoke tension is fairly widely appreciated. What is equally widely misunderstood, however, is the all- 'important bit in the middle of the wheel. Since the Rudge-Whitworth pattern of locking hub has been in use for more than half a century, this is a little odd. One possible explanation lies in the fact that it is apparently simple to the point of crudity and, therefore, is frequently abused through failure to appreciate finer points. I confess that my understanding came only recently, after reading a very lucid description in *The Autocar Handbook* of 1918!

Let us take a closer look at this assembly, referring to the central portion of the wheel as the "wheel centre", which is fitted to the "hub" and fixed in place with a 'locking cap'. The first thing to be appreciated is that the wheel centre does not come into contact with the brake drum. There is, in fact, a clearance of about 1/8" when the wheel is fully home. It is the inner taper of the wheel which comes into contact with the back taper of the hub. Notice the taper which is formed on the outer surface of the wheel centre. This engages with yet another tapered surface formed on the inside of the locking cap. When the wheel is fitted to the hub, and the locking cap screwed on, it is therefore centralised and held between two pairs of tapers.

The only other contact between hub and wheel centre is provided by the splines, which carry the driving and braking forces. The locking thread, on the hub and cap, is right- handed on the left (near) side of the car and left-handed on the right (off) side. One of the endearing mysteries of the wire wheel is that the spokes are not, and indeed never can be, in compression. The weight of the stationary car is suspended from those spokes which are uppermost in the wheel when the wheel and locking cap are loosely fitted, therefore, the upper portion of the outer taper is pulled firmly into contact with that of the locking cap taper, and the lower portion of the locking cap thread is in contact with that of the hub.

A slight clearance then exists between the tapers at the bottom, and also between the threads at the top. As the car moves forward, a different portion of the wheel rim takes the weight, and relative movement occurs between wheel centre, locking cap and hub. The effect of this is to tighten the locking cap, and the locking action continues until there is firm contact between the tapers all round when it ceases.

The clearances involved are, of course, minute, but the locking action is nevertheless completely positive and entirely automatic. There are people who deny the very existence of the locking action, and presumably attribute the left and right hand threads to sheer cussedness on the part of the manufacturer. They are, no doubt, the people who bash their locking caps with heavy hammers.

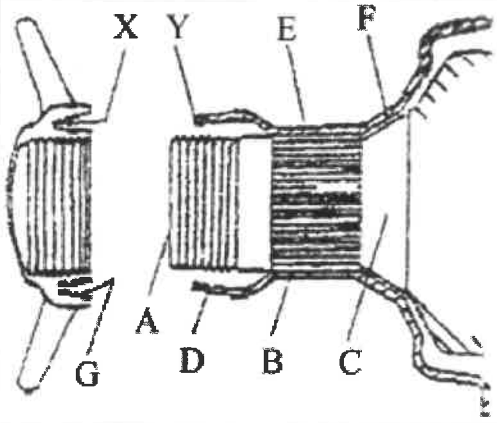
The earliest instructions that I have been able to trace advise leaving the locking cap finger-tight, and no more. A later recommendation is to hammer the locking cap tight, check for slackness after twenty miles, and tighten again if necessary. "Hammer them tight" means the application of a lead, copper or hide mallet, and a little common sense, with the wheel locked up. Not a murderous attack with a blunt instrument when the wheel is on the jack.

The tapers and splines must be kept scrupulously clean. As for checking the tightness occasionally, this is obviously a good idea. Most pre-war instruction manuals advise putting some oil in the groove of the locking cap. Opinions differ as to the advisability of oiling the back taper on the hub, but in my experience this gets oily anyway if the splines are lubricated. And lubricated the splines must be, for it they rust, the wheel can become quite literally immovable, which is awfully embarrassing when a puncture occurs.

What is the effect of over-tightening? We have seen that the wheel is held in place between two pairs of tapers, and does not touch the brake drum. Excessive tightening of the locking cap will, therefore, force the wheel centre farther on to the back taper of tie hub, expanding it and thus making it, eventually, a sloppy fit on the hub, The outer taper tends to be compressed, and the locking cap itself will actually expand to a small extent. This may cause the locking cap to contract the outer spokes or "bottom out" in the hub, in either case preventing proper tightening. An incidental calamity is that the inner spokes tend to be slackened and the outer ones over tensioned, thus pulling the wheel rim out of shape as well.

A sloppy wheel centre soon starts to "fret" on the hub. The splines wear rapidly, even the back taper begins to wear, and eventually the whole assembly - wheel, hub and locking cap - is fit for the scrap-yard. In advanced cases, the wheel may turn on the hub by half-a-spline, jamming behind the unworn portion of the splines, and becoming completely impossible to remove.

How the wheel centre is held in place on the hub.



A - Locking thread on hub (left or right hand thread).
B - Driving splines on hub.
C - Back taper of hub,
D - Outer taper on wheel centre.
E - Driven splines of wheel centre.
F - Inner taper of wheel centre.
G - Taper in groove of locking cap.

Armstrong Shock Absorbers Fix

OK so we went to the trouble of getting our Armstrong Shocker done up and upgraded by the best in town and after a little while, well 20 thousand Miles, we are sick of the crashing noise from the rear bump stops when touring with a full load of shoes and hats.

Time I say to consult Mr Google and likewise every expert known to man and see if there might be a home grown solution which does not entail removing and sending said Armstrongs to experts who are going to charge like wounded bulls and not likely to divulge their secret recipes.

Armstrong lever arm shocks were originally available in a variety of damping grades. The variations being made primarily in the valving but they were originally designed to use hydraulic oil in the viscosity range of ISO 30 to ISO 100 (equivalent to SAE 10W to SAE 30W) which according to the TR manual does not need to be changed.

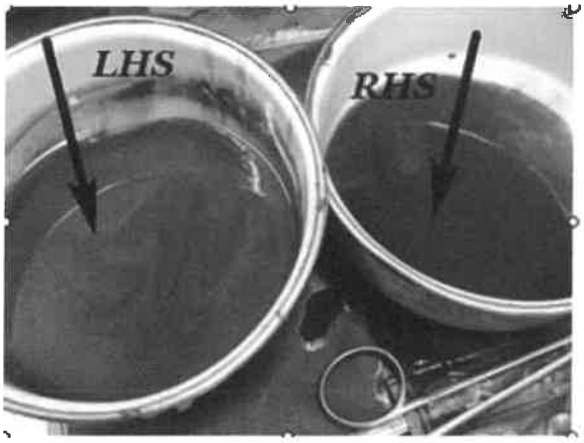
The way these devices work is that there are two pistons pushing oil back and forth through an orifice. This orifice is small, so there is resistance to flow due to the viscosity of the oil in the piston chambers. If the size of the connecting hole was not allowed to vary, the damping would be TOO strong for sudden jolts, so to accommodate sudden jolts, the oil is allowed to force its way through 2 larger spring-loaded valves, one to control the upward jolts and another to control the downward return of the suspension to its rest position.

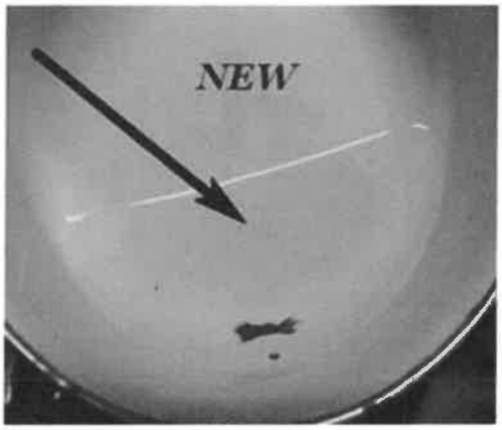
When these units were new, there were alternate compression springs available, however these are not readily available so in order to adjust damping today, we can tighten the nut holding the rebound spring and insert spacers (washers) under the compression spring.

My research found 2 sources that pretty much agree on what modifications to make, which were to tighten the nut on the rebound spring and install a 0.040" to 0.080" spacer under the compression spring at the bottom of the bore.

Armed with this Google expertise I decided to remove the devices and investigate what my performance enhanced units had to offer. I suspected that the energy input to a small amount of fluid during operation was so intense that it could not be possible for the shockers to maintain performance without maintenance which is contrary to the TR manuals advice.

First job, drain the oils. Black and burned is what we find. Now compare this with some fresh Fork oil.

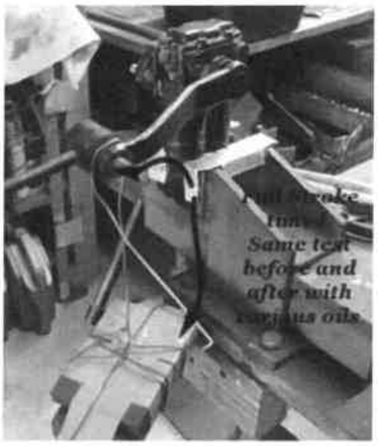


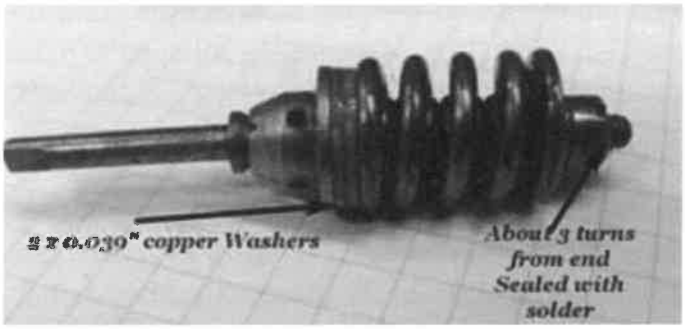


Imagine allowing your engine to operate on this sludge? How long will it last?

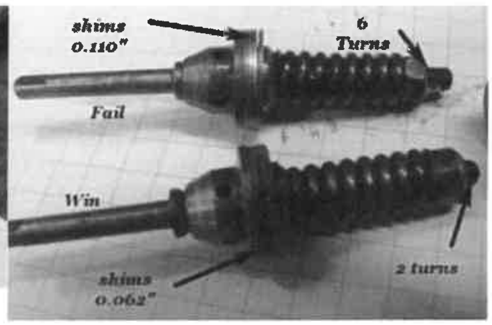
Let us have a look at my high performance upgrades and see how they compare with Dr Google.

The first thing to do was to compare what performance was dependent on the oil, so I conducted some base line tests on the original shockers using a weight and a timer to determine how long it took for 1 stroke.





The next thing was to have a look at what upgrades had been done: As it turns out, spot on, what our local race technologies had done was as per the famous TR Kastner recommendation. 2 x 0.039” copper washers under main spring. **Maximum 0.080”**

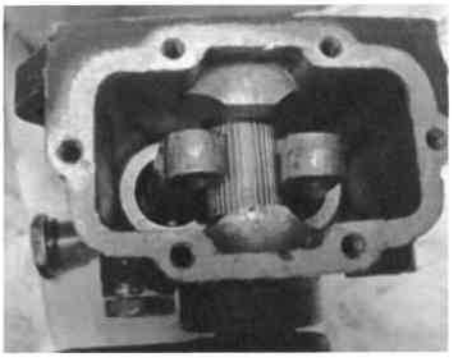


Now I happen to have a destroyed Shock absorber to compare. This one had totally failed and had stripped splines between the main shaft and the bellcrank.

The reason? Well: Both relief valves were suffering from coil bind before they were half open which would have created massive stress on the splines which of course failed.

Notice the difference in the 2 valve designs.

Something to watch for if you decide to pay an expert to overhaul your shock absorbers. Ask for confirmation that they are a matched pair.



So now all that is left is the oil. Much investigation and assistance from Greg Parker provided me with a smorgasbord of inside information.

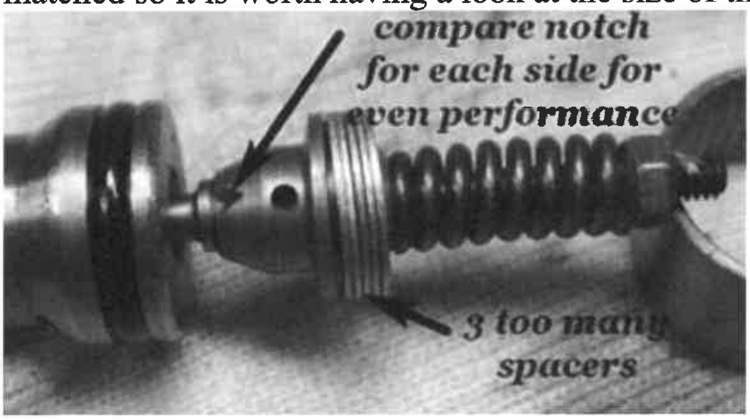
I had previously bought some Harley Davidson Screaming Eagle Fork oil after interviewing a Harley workshop Tech who advised me that this was the best of the best and they used it in every Harley. **No information is readily available for Harley about the oil spec as this is secret.**

Greg advised:
"Harley Type E is 5 wt , Harley Type B is 10 wt, Harley Type H/D is 20 wt, Screaming Eagle is 15 wt, Screaming Eagle Heavy is 20 wt , In the motorcycling world, we have different fork and rear suspension fluids.

As a broad rule in the fork oils we have 5 wt. 10wt, 15wt and 20 wt (in years gone by here was also a 30wt)"

Note: 30 Wt was recommended for higher performance by Armstrong but these oils are not readily available today.

My tests used the 15 wt standard screaming Eagle oil and I got a 25% improvement on rebound and a 50% improvement on compression however the 2 units were not the same? Inspection found that the valves were different from left to right. I happened to have a spare which matched so it is worth having a look at the size of the notch in each valve as the performance upgrade and overhaul clearly does not include testing and matching performance. This shot also clearly shows the reason for failure. DO NOT go there.



Conclusion;

1. Change the oil every 10K Miles with 15 grade standard screaming Eagle for standard performance.
2. Use 20 Wt screaming Eagle heavy on standard shockers to get a 50 % improvement.
3. Shim a max of 0.065" washers and use 20wt oil for a high performance rally race type outcome.

4. The cost: $19.00 for 1 Pint of oil which will suffice for 3 oil changes in both rear shockers.
5. Before sending your shockers off to the experts have a go and save enough to take the navigator out for dinner.

So HOW do we go about it?

Unfortunately this means removing the shock absorbers but well worth the effort.
I often hear tales of woe with regard to keeping the bolts tight and the need for special spanners, however this simple modification has worked well for me. (Weld a bar onto the head of the bolt to stop it turning.)
Inserting the bolt from the outside with no chance of it turning allows a washer and locknut to be easily fixed with a socket from the inside and torqued accordingly.

Simply remove the plugs and drain from both ends while moving the lever back and forth. Flush the system out with paraffin or hydraulic oil until there is no residue then fill the bottom and top using the same actions to get all the air out. Make sure there is no air left and then finally fill to the bottom of the plug and refit.
A 4000 Mile trip to Targa Tasmania fully loaded with navigator and a multitude of hats coats and shoes proved highly successful with no crashing against the bump stops and great rear end control... of the car of course!
Rob Bradford 2015

Knock On – Fall Off

If you do not fully believe that you do not need to belt the hell out of the spinners when fitting wheels or that they do really need to be fitted to the correct side….let me tell you a story.

There is this member I know fairly well who departed home with his wife for the Xmas in July BBQ at Mal Munro's about 100kms south of Sydney. It was a typical Sydney winters day, clear, still and about 22C, the best for TRing. About 5km from home he turned left at a set of lights and as he accelerated up the hill the front of the car dropped and he heard that horrible sound of metal on road. The front left wheel had departed and the car was dragging itself up the road. Close inspection revealed that the spinner had come off and the wheel had parted company when the car turned left. The unfortunate member walked back up the road for about 100 meters but was unable to find the spinner. The wheel fortunately was just near the car.

Who knows where the spinner came off; it was the left turn that finally caused the wheel to come off. When the wheel came off, it ran on the disc causing a flat spot but it did not prevent the car from being driven home. The problem was that the car was so low to the ground the original jack that was being carried could not be used.

A good Samaritan in a Commodore stopped with a scissor jack that fitted under the chassis behind the rear wheel. This allowed the car to be lifted high enough for the TR's jack to be fitted and the car lifted. Now the simple job of fitting the spare which was an original steel wheel. The spline adaptor was removed and the wheel fitted. He then removed all the "stuff" behind the seats so the 5 ½" wheel could be carried home.

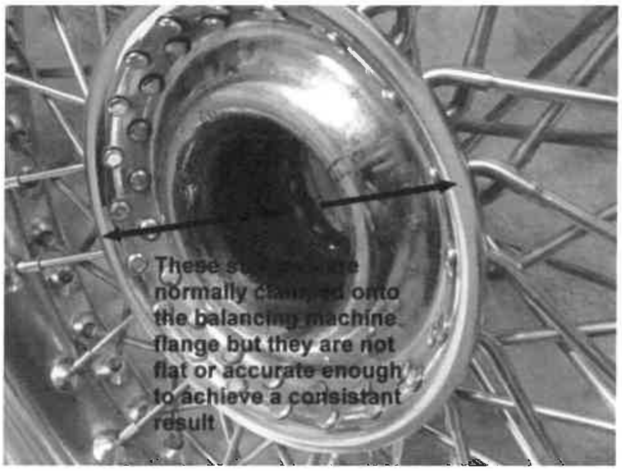
One of the drawbacks of running wide wheels. After packing away everything, he attempted to drive off. Attempted being the operative word. That front wheel would not turn. Thinking the worst, he looked at the problem and realised that the great aluminium four pot caliper was fowling the wheel. Unpack and jack the car again. This time the rear wheel was removed and the spline adaptor from the rear axle was transferred to the front axle along with the 5 ½" wheel. The steel spare was then fitted to the rear. All packed again and this time it moved without any crunching or grinding. As about one hour had passed by this time, he drove home and changed cars to the trusty but not nearly as exciting, MX5. To add a little insult to injury, he had an audience. There had been an accident up the road and the people in the backed up traffic just sat there and watched the drama. On arrival at Mal's, the waiting crowd expected to hear that either the four adaptor nuts had come off or the complete hub. No one expected the spinner. Later that night, Bob Slender called the member and suggested that the spinners may have been on the wrong side.

No…never but wait till I check. Sure enough the left adaptors were interchanged with the right. Oh….you have guessed, yes it was me. A small out for me is that as I run alloy wheels on the track and wire on the road, I change my wheels/adaptors about six or seven times a year, No excuse though. This does go to show that the running wire wheel will tend to turn and tighten the spinner. If on the incorrect side, it will tend to loosen the spinner. I work on my nephew's classic race cars (F5000, CanAm Lola, and Indy cars) and they all run centre lock wheels. They also run left and right, just like the TR. Not sure the alloy wheels would self-tighten but they are harder to remove than fit. Fortunately, as the wheel was almost outside the mudguard before it parted company; there was only minor damage to the mudguard. There was no real damage to any of the suspension except for some grinding of the sway bar link but it did not need replacing. There had been some contact with the reinforcement on the bottom of the chassis under the suspension tower.

All in all, I got out of it lightly, only a pair of new disc. I hate to think of what would have happened if it had occurred a little later at 110kph on the freeway. For a start, my wife would never get in it again. BR

IT IS ALL IN THE BALANCE.

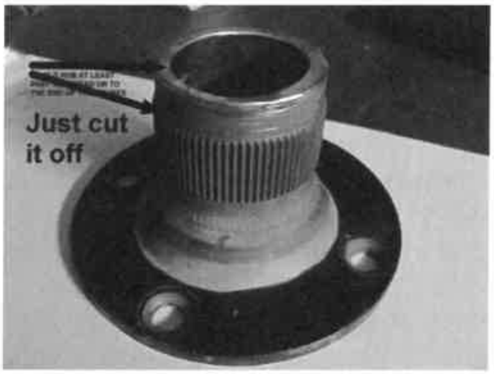
Everyone likes to live a balanced life, particularly when one is wearing spoked wheels wire wheels like our good TR friends. What we need is the pleasure of driving wire wheeled TRs which do not vibrate our lunch into foam with the potential for most unsavoury outcomes. The trouble it seems is finding someone who can properly balance a wire wheel on the machines that are now almost universally used.



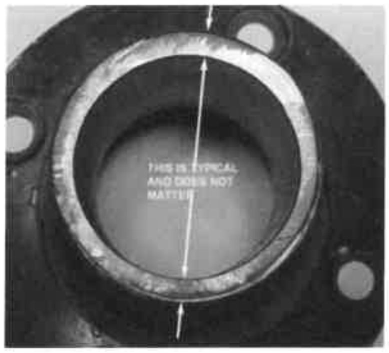
Most modern balancing machines use a spring loaded cone to centre the wheel, which is then clamped hard against a flat flange and thus relies on the wheel having a flat & true surface on the back in order to get the wheel running true on the balancing machine spindle.

Our spoked wheels do not have any true and flat surfaces on the back, they use a female and male cone arrangement which is incompatible with the balancing machines and leads to constant issues with accuracy. An ideal solution would be to produce an inexpensive adaptor so that our spoked wheels can be balanced and provide a uniform result for every balancing operation.

There is no doubt many a defunct worn out splined adaptor languish in sheds around the country, who are just itching to become loved once more. These old unloved items have the potential to be easily turned into the very item to avert the foamy lunch for ever.



Take a hacksaw and cut the end off a worn out adaptor preferably near the end of the splines.



Fear not the revelation that the adaptor appears to be offset or wonky, just get out the hacksaw and chop it off at the end of the splines, or at least before the thread.

The critical issue is to make the back of the adaptor concentric with the front so that a cone on the balancing machine can always centre the adaptor accurately.

In some cases our adaptors are reasonable however it is necessary to put the adaptors in a lathe and trim the back to make sure.

Sidescreen Dec13/Jan14.

This adaptor cost $20.00 for machining and when tested on the digital balancing machine proved to run spot on.
I am confident that I will get much better results from now on, as I will have all my wheels balanced using my own adaptor.

Perhaps there might be an opportunity to have a batch of old worn out splined adaptors given a new lease on life.
Rob Bradford

HOW OLD – AND DANGEROUS – ARE YOUR TIRES?

During a recent Concours, the discussion wandered on to near disasters when tires failed catastrophically on Register TR's.

It seems that there have been at least 3 such incidents within the last year, which prompted me to do a little research and put some stuff together. I am not a tire expert so all the information is gathered from other sources and discussions with tire professionals.

For years, people have relied on a tire's tread depth to determine its condition. But the rubber compounds in a tire oxidize and deteriorate with time, regardless of the condition of the tread. An old tire poses a safety hazard.

The age warning also applies to spare tires and "new" tires that have never been used but are old.

What Happens to a Tire as It Ages?
"If you take a rubber band that's been sitting around a long time and stretch it, you will start to see cracks in the rubber," That's essentially what happens to a tire that's put on a vehicle and driven. Cracks in the rubber begin to develop over time. They may appear on the surface and inside the tire as well. This cracking can eventually cause the steel belts in the tread to separate from the rest of the tire.

Aged" tires are often unsuspectingly put into service after having served as a spare, stored in garages or warehouses, or simply used on a vehicle that is infrequently driven. In many instances these tires show no visible sign of deterioration.

How Long Does a Tire Last?

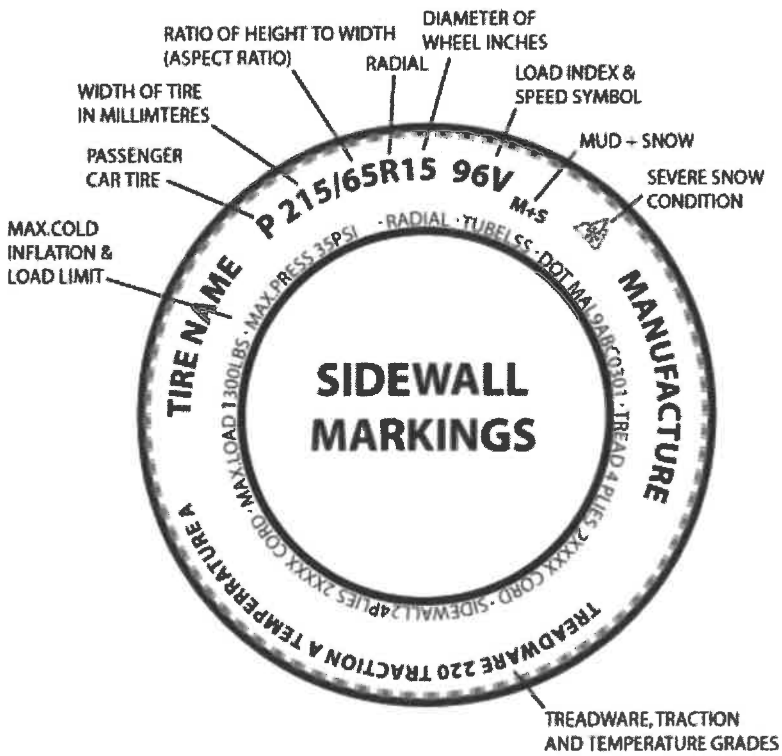
Mercedes, BMW, Audi, VW, Nissan and Toyota all advise their customers to replace tires six years after their production date. Most quality Tire warranties are 5 years.

Heat: Tires age more quickly in warmer climates and environmental conditions like exposure to sunlight and coastal climates can hasten the aging process.

How To Determine the Age of a Tire
The sidewall of a tire is littered with numbers and letters. They all mean something, but deciphering them can be a challenge.

Tires made after 2000 have a four-digit DOT code. The first two numbers represent the week in which the tire was made. The second two represent the year. For example: 5107 means the tire was completed the 51st week of 2007. Tires with a three-digit code were made prior to 2000 and are trickier to decode. The first two digits still tell you the week, but the third digit tells you the year in the decade that it was created. The hard part is knowing what decade that was. Some tires made in the 1990s — but not all — have a triangle after the DOT code, denoting that decade. But for tires without that, a code of "328" could be from the 32nd week of 1988 — or 1978.

Reading the



Sidewall Markings & Speed Rating

The speed rating of any tire is a measurement of the top safe speed the tire can carry a load under specified conditions. It is also an indication of how the tire will handle at lower speeds. A higher rated tire will give you better traction and improved steering response even at 50mph.

Below is a listing of common speed ratings:

Q = 99 MPH, 160km/h

S = 112 MPH, 180km/h

T = 118 MPH, 190km/h

U = 124 MPH, 200km/h

H = 130 MPH, 210km/h

V = 149 MPH, 240km/h

Z = 149 MPH, 240km/h and over

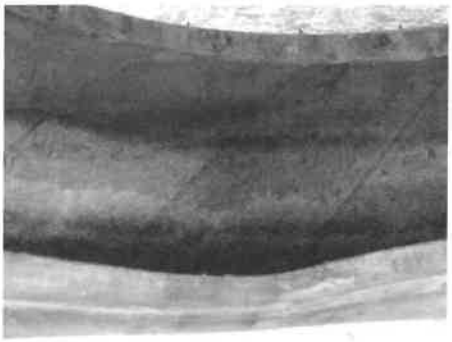
W = 168 MPH, 270km/h

Y = 186 MPH, 300km/h

Never mix tires with different speed ratings on your vehicle.

Installing tubes in tubeless tires fitted to Wire Wheels.

Older tube type tires were nearly as smooth as a baby's bottom inside whereas a tubeless tire has quite pronounced ridges on the inside.



Tubes reduce the flexibility of tubeless tires, and tubes tend to squirm around inside the casing as they flex under load thereby increasing rolling resistance and consuming a bit more energy and with the added internal friction this extra energy is turned into heat in the tire. The heat will be sufficient vulcanise the tube to the casing with almost certain failure.

Modern tire fitters are not trained in fitting tires with tubes, so they do not use enough TALK to coat all surfaces of the tube to reduce the friction and heat buildup.

(I had 3 out of 4 tubes do this on my car because the tire fitter did not use enough TALK when fitting the tubes. I have also had a number of reports from register members who confirm they have experienced the same problem)

As a rule of thumb, if you put tubes in tubeless tires you should de-rate the tire by one letter grade, or about 18 mph (30 kph) off of the rated 10-minute top speed.

Oversize inner tubes are a definite no-no, as any fold or wrinkle in the tube is almost guaranteed to split the tube. When installing inner tubes, inflate and deflate the tire a couple of times to allow the tube to settle in to a comfortable position without wrinkles or excessive stretching. NEVER leave any manufacturer's stickers inside the tire if you will be using tubes.
Cheers Rob

Brakes

Handbrake Conversion. *By Brian Richards June 2015*

I do not know if it is my shape but I find the hand brake lever a real pain in the leg on long trips. There is a left foot rest in my car but in reality it simply replaces the dip switch which I used to use as a foot rest so I do not think it aggravates the situation.

My issue is that the lever applies pressure to one point on my left calf. After a while this becomes annoying. I always feel that if there is a problem, fix it or learn to live with it. Well I thought I would look at fixing this one. This started my search for a suitable hand brake replacement.

I considered an electric replacement but after some research of the two options I decided to simply move the lever to the tunnel. Of the two electric options, the most suitable would have been an electric linier actuator that applies about 600lbs pull to the original hand brake cable and could have been attached to the chassis near the original hand brake mount. This is an aftermarket kit (about US$400) from the USA that is used on hot rods, kit cars etc. The other option is the one used on today's cars such as those of the VW group. This system uses an electric actuator built onto the rear calipers. This would only work on cars with rear disc, which I have, but there is a real space issue.

After a good search through Pick & Pay wreckers, I settled on a unit from a 2001 Honda CRV. With this car there is no centre console so the dress trim around the lever is a stand-alone unit which is what I needed. Also the mechanism is all above the tunnel. This meant that the only protrusion through the tunnel are the two mounting bolts and as such there would be no clearance issues with the drive shaft.

I purchased a lever and trim, took it home and had a good think about it. It all seemed to fit in well except I needed to shorten the two mounting legs to lower the height of the mechanism by about3/8". This was required to get a better fit for the dress trim. I shortened the legs and made up two steel plates with nuts welded to them to act as captive nuts for the mounts. I drilled the two mounting holes and attached the two plates in place with two small screws. This allows me to remove and refit the lever without needing to get under the car. Mounting these two plates was a bit fiddly as it was achieved without removing the drive shaft.

I worked out that the original cable would fit OK if the inner cable was shortened. To mount the outer cable I modified the rear dress trim mount/outer cable holder of the Honda unit so that it would hold the outer cable and still act as the rear dress trim mount. This was then mounted on the tunnel. To attach the inner cable, I had to fabricate one small piece and used the original TR clevis to attach it to the Honda adjustment screw. This allowed me to have an adjustment that is in the car and is easily accessible by removing the trim.

My car is a late TR3A with the occasional seat so I was able to bring the cable through the vertical face of the seat straight onto the lever. Not sure how this would work out with an earlier body. With the trim on, there is about one inch of outer cable exposed and I cover this with a short piece of black hose to camouflage it. If I was doing it again I would mount the unit one inch further back so there would be no cable exposed. It is not noticeable so I did not bother to remount the assembly.

All that was left was to fit the front dress trim mount and refit the carpet. The only Honda unit I could get was grey so I used a good quality vinyl paint to paint it flat black. Even with the ½" taken off the mounts, the trim sits about 1/4"above the tunnel. To disguise this I used a layer of foam under the carpet. This works well and the finished job looks as though it is an original fitment. The only mod to the original TR cable was to shorten the inner by about eighteen inches. All the rest of the TR hand brake assembly is unchanged.

The finished job looks like an original fitment and does not look out of place. Importantly, with the TR, it does not affect the load area or interfere with the driver or passenger. A job that only took about half a day but made a real comfort addition to the car. I have now done three trips to Goulbourn (about 400KM return) along with some other trips and really enjoy the absence of the hand brake lever.

TR2 - 3 - 3A "BRAKE DOWN"

MODEL	COMMISSION NOS	FRONT BRAKES	TYPE	BORE	REAR (DRUM ALL MODELS)	BORE	MAKE	COMMENTS
TR2	TS1-TS5481	10"x2 1/4"	DRUM	15/16"	9" X 1 3/4"	0.875"	LOCKHEED	Prototype TR2's had 9" drums all round. Unexpected performance necessitated change to 10" front drums
TR2	TS5482-TS8636	10" X 2 1/4"	DRUM	15/16"	10" X 2 1/4"	0.875"	LOCKHEED	Rear drums upgraded to 10". Commission numbers here are different from accepted figures. Research has shown that these commission numbers are correct - Triumph Parts Book (4th Edition) is incorrect
TR3	TS8637-TS13045	10" X 2 1/4"	DRUM	15/16"	10" X 2 1/4"	0.875"	LOCKHEED	Change over to TR3 retained same set-up
TR3	TS13046-TS15331	11"	DISC "A TYPE" CALIPER	2 1/8"	10" X 2 1/4"	0.75"	GIRLING	First production car in world to have disc brakes fitted. Flat piston head in rear units.
TR3	TS15332-TS22013	11"	DISC "A TYPE" CALIPER	2 1/8"	10" X 2 1/4"	0.75"	GIRLING	Rear pistons changed to slotted type
TR3A	TS22014-TS33403	11"	DISC "A TYPE" CALIPER	2 1/8"	10" X 2 1/4"	0.75"	GIRLING	Initial TR3A's carried on with similar set-up to late TR3's
TR3A	TS33894-TS34403 510 Vehicles in all	11"	DISC "A TYPE" CALIPER	2 1/8"	10" X 2 1/4"	0.75" or 0.625"	GIRLING	Haphazard installation of rear unit bore size. This was a further attempt to cure rear wheel lock-up.
TR3A	TS34404-TS56376	11"	DISC "A TYPE" CALIPER	2 1/8"	10" X 2 1/4"	0.625"	GIRLING	Settled on smaller rear unit bore. Results still not completely satisfactory.
TR3A	TS-56377-TS82346	11"	DISC "B TYPE" CALIPER	2 1/8"	9" X 1 3/4"	0.75"	GIRLING	Rear drums changed back to original TR2 drums with original unit bore size. This combination proved reasonably satisfactory and more or less remained until the end of TR3A production in 1962.

N.B. Some very late TR3A's kept the 9" rear drums, but with reduced rear unit bore size to 0.70". Apparently this was the beginning of the new TR4 braking system. At the same time, the front disc diameter was reduced to 10 3/4". Slightly reduced front braking ability necessitated the corresponding rear unit bore reduction.

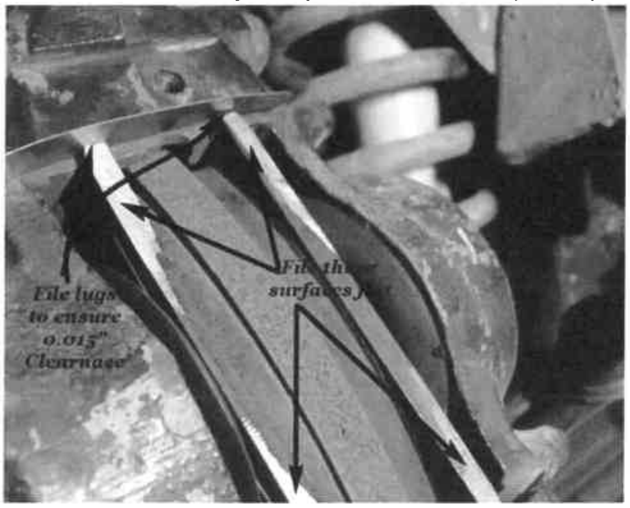
SQUEALS OF ANGUISH

Squealing brakes are bad when they belong to someone else but when they belong to the TR, it becomes intolerable.

The brakes on NPY have squealed intermittently since the beginning, so the first step was to consult Mr Google and every other know expert and proceed to spend up big on all the special ant-sqealing devices known to man. There were various special gels, followed by special silicone pads, new springs, swapping pads from side to side and despair.

I finally decided that brakes do not make a noise for no reason, although by this stage I was inclined to believe that perhaps that might be the case. Noise from any source must be created by vibration so perhaps there might be a way of determining what might be the cause. Perhaps like a musical instrument, there are pivot points which amplify vibration.

On closer inspection I found that the steel backing plates of the pads were quite uneven and rough which presented in some cases a very thin pad for the anti-squeal springs to bear against. A quick few strokes with a file created a nice flat surface to maximise spring contact.



The next step was to see if there were any pivot points which turned out to be a shiny point on the forward tip of the backing or locating lug of each pad.

Another quick session with a file on each lobe ensured a good clearance between the Lug and the calliper housing.

So far so good. No squeals except for the delight of the navigator on some of the Targa Tasmania stages we just did.

Electrical

Generators and Voltage Regulators

This article is first draft of theory and operation of generators and Lucas voltage regulators. The generators on old English cars seem always to be marginal when driving at night with running and head lights on. Probably the best answer to this problem is exchanging the generator for a more modern (and higher output) alternator. The Vintage Triumph Register website has details about much of the nuts and bolts of an exchange. In addition, it has an article by Dan Masters about the theory and operation of alternators (www.vtr.com). I have borrowed heavily from Dan's work when writing this article. I refer you to his wonderful diagrams used in his alternator article as they apply directly here too. Anything you find useful I owe to him, and all errors are of course my own.

Generator - Theory of Operation

In order to understand the theory and mechanics of mechanical voltage regulators, you must understand how a generator makes electricity. The basic principle is that moving a wire through a magnetic field induces electrical current flow in the wire. The faster you move the wire, the greater the voltage that is induced. A generator essentially moves a loop of wire through a magnetic field around and around. Through one half of a full revolution a positive voltage is created, in the second half a negative voltage is created. Since generators were created before semiconductors were readily available, there had to be a mechanical way to avoid making the wrong polarity voltage. This was readily answered by reversing the connection on the wire loop as it entered the negative phase. The commutator inside the generator performs this function.

The magnetic field could be created by permanent magnets within the generator, but they are expensive and bulky and heavy. Additionally, they cannot be modulated to maintain a constant output voltage. It is more effective, cheaper and lighter to use some loops of wire to do the same thing. Just as it is possible to create a current in a wire by moving it through a magnetic field, it is also possible to create a magnetic field by moving a current through a wire. In order to make the field stronger you can loop the wire back on itself many times. This way a small current can create a large magnetic field. This is an electromagnet. In a generator this electromagnet is called a "field coil". It is a series of loops of wire (a coil) which creates the magnetic field.

Now we have a device that creates electrical pulses of the correct polarity. The voltage coming out is proportional to the speed of the turning of the generator, and the magnetic field strength of the field coil. As the engine RPMs increase, the voltage from the generator also rises. Unfortunately, the electrical systems in a car like a fixed voltage. If the voltage is too high the battery will overcharge and boil over, light bulbs will burn out and the coil will melt. There must be some way to control the voltage output.

Voltage Regulator - Theory of Operation

For the purpose of an automotive generator the use of a field coil makes it possible to control the voltage output. We cannot easily control the speed of the generator since this is directly linked to the engine speed. We can control the current in the field coil. Increasing the electrical current in the field coil will make the magnetic field stronger. Decreasing the current will reduce the magnetic field. The voltage regulator performs this function. The voltage regulator also performs some associated functions. It cuts the generator out of the circuit when the voltage from the generator is less that the battery voltage. This prevents the battery current from running backwards through the generator, discharging the battery. There is also a mechanism to prevent too much current being drawn from the generator which might overheat or otherwise damage the generator. In some models of regulators there is one relay (called a "bobbin" in voltage regulators) for each of these functions. In the TR2-4 series, and other models as well, there are only two bobbins. One of the bobbins serves two functions in this case.

The first bobbin we will discuss is the simple "Cut-out relay". It should be more properly described as the "Cut-in" relay because it keeps the generator out of the charging circuit until it is generating sufficient voltage for the bobbin to close contacts cutting the generator into the charging circuit. It is set to cut-in at 12.7 to 13.3 volts. Once in the circuit it will stay in until the generator output actually drops well below battery voltage (11 to 8.5 volts). This may never happen even at a very low idle.

In the TR2-4 series the second bobbin provides two functions. The primary function is to regulate voltage by reducing generator output by reducing the current in the field coil. The secondary function is to prevent excessive current output from the generator, again by reducing output. There are two separate windings on the bobbin to provide these two functions. In three bobbin regulators the voltage and current regulators are separate but functionally identical to what is described here.

When the voltage is below a certain set point there is a direct connection of the field coil to battery (actually battery plus generator) voltage. This gives the maximum magnetic field strength possible and thereby allows the generator to produce the greatest voltage possible. When the voltage exceeds a set point, the bobbin opens a contact which puts a resistor in line with the field coil and reduces the current running through the coil. This reduces the magnetic field strength, and in turn reduces the generator output. The contact is opened and closed frequently so the electrical system essentially sees the average of the duration of high and low voltages.

In the TR2-4 two bobbin system, the current regulation is performed by a separate winding on the same bobbin as the voltage regulator. This winding carries the full current output of the generator. The wire is wound so that increasing current through the wire will tend to open the contacts and lower the current in the field coil.

Regulator Adjustment
The only adjustments that you can make to the regulator are the contact gaps and the set points. I will quote the Triumph workshop manual regarding the adjustments. Their description is concise and thorough. I will add my comments in italics where additional explanations may be in order.

The control box (regulator) contains two units - a voltage regulator and a cut-out. Although combined structurally, the regulator and cut-out are electrically separate. The voltage regulator relay (bobbin) can be identified as the coil with just a few turns of heavy gauge wire around it. The cut-out relay has many more turns of the same heavy gauge wire.

The regulator is set to maintain the generator terminal voltage between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawal of a resistor in the generator field circuit.

Cleaning Contacts
(i) Regulator Contacts: used fine carborundum stone or silicon carbide paper (sandpaper 400 grit or finer).
(ii) Cut-out Relay Contacts: used a strip of fine glasspaper, never carborundum stone or emery cloth.

Voltage Regulator-Electrical Setting
It is important that only a good quality MOVING COIL VOLTMETER (0-20 volts) is used when checking the regulator. The pulsing nature of the voltage will prevent a digital voltmeter from settling on a single reading

Remove the cover and insert a thin piece of cardboard between the armature and the core face of the cut-out (contacts) to prevent the contacts from closing.

Remove and join together the cables from the control box terminals A and A1. Connect the negative lead of the voltmeter to the D (output) post on the generator.

Start the engine and slowly increase its speed until the voltmeter needle flicks and steadies, at about 2,000 RPM. The voltage reading should be between the appropriate limits given in Table 1.

If the voltage, at which the reading becomes steady, occurs outside these limits, adjust the regulator by turning the adjusting screw 1/4 turn at a time clockwise to raise the voltage or counter clockwise to lower. The adjusting screw can be found on the back of the regulator facing the firewall.

Adjustment of regulator open-circuit voltage should be completed within 30 seconds otherwise heating of the shunt windings will cause false settings to be made.

Remove the cardboard.

NOTE: The voltage that you see in Table 1 is not the actual operating voltage of the generator and electrical system. It is the voltage that is only used for setting purposes.

Voltage Regulator-Mechanical Setting

A copper separator, in the form of the disk or square, is welded to the core face of the voltage regulator (the coil with just a few heavy gauge wire windings) and affects the gap setting between the core-face and the underside of the armature as follows:

When a round separator is used, the care gap should be 0.015" (0.38mm). Win a Square separator is used, the inner gap should be 0.021" (0.53mm).

To adjust the air gap:
Slacken the fixed contact locking nut (on top of the bobbin) and unscrew the contact screw until it is well clear of the armature moving contact.

Slacken the voltage adjustment spring-loaded screw (on the back of the regulator) until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws.

Insert the gauge (feeler gauge) of sufficient width to cover the core face, and of the appropriate thickness, between the armature and copper separator.

Press the armature squarely down against the gauge and re-tighten the two armature assembly securing screws. Without removing the gauge, screw in the fixed contact adjustment screw until it just touches the armature contact. Re- tighten the locking nut.

Re-check the electrical setting of the regulator.

Cut-Out -Electrical Setting

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment. To check the voltage at which the cut-out operates, remove the control (regulator) box cover and connect the voltmeter between the terminals D and E (the right-hand-most two spade terminals). Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7 to 13.3 volts.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this, turn the adjusting screw (found on the firewall side of the regulator) in a clockwise direction to raise the voltage setting or in a counter clockwise direction to reduce the setting. Turn the screw only a fraction of the turn at a time and test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible, because of temperature rise effects. Tighten the lock nut after making the adjustment. If the cut-out does not operate, there may be an open circuit in the wiring of the cut out and regulator unit in which case the unit should be removed for examination or replacement.

Cut Out - Mechanical Setting

Slacken the adjustment screw (on the fire-wall side of the regulator) until it is well clear of the armature tension spring.

Slacken the two armature securing screws.

Press the armature squarely down against the core face (copper sprayed in some units, fit with a square of copper in others) and re-tighten the armature securing screws. No gauge is necessary.

With the armature still pressed against the core face, adjust the gap between the armature stop arm and the armature tongue to 0.032"(0.81 mm) by bending the stop arm (the stop arm is the metal all arm on the very top against which the moving armature contact arm (called the "fixed contact blade") rests).

Adjust the fixed contact blade so that it is reflected 0.015" (0.38mm) by the armature moving contact when the armature is pressed against the core face. Re-check the electrical setting of the cut-out.

Table 1. Open Circuit Settings

Ambient Temperature	Open Circuit Voltages
10C (50F)	16.1 - 16.7
20C (68F)	16.0 - 16.6
30C (86F)	15.9 - 16.5
40C (104F)	15.8 - 16.4

Wiring Colour Code Table

Many British designed vehicles use colour coded cables to assist in identifying the various circuits in use. This is an extract from BS-AU7a 1983 Colour Code for Vehicle Wiring, from the British Standards Institution, 2 Park St., London W1A 2BS.

(Note that these colour codes may not apply directly to older cars. For example, the wipers on cars up to 1980 (at least) are not on a separate fuse circuit, so they are not orange, but green. Check the schematic for your car to be certain)

MAIN	***TRACER***	***PURPOSE***
Black		All earth connections
Black	Brown	Tachometer generator to tachometer
Black	Blue	Tachometer generator to tachometer
Black	Red	Electric or electronic speedometer to sensor
Black	Purple	Temperature switch to warning light
Black	Green	Relay to radiator fan motor
Black	Light green	Vacuum brake switch or brake differential pressure valve to warning light and/or buzzer
Black	White	Brake fluid level warning light to switch and handbrake switch, or radio to speakers
Black	yellow	Electric speedometer
Black	Orange	Radiator fan motor to thermal switch

MAIN	***TRACER***	***PURPOSE***
Blue		Lighting switch (head) to dip switch
Blue	Brown	Headlamp relay to headlamp fuse
Blue	Red	Dip switch to headlamp dip beam fuse
		Fuse to right-hand dip headlamp
Blue	Light green	Headlamp wiper motor to headlamp wash pump motor
Blue	White	a) Dip switch to headlamp main beam fuse
		b)Headlamp flasher to main beam fuse
		c)Dip switch main beam warning light
		d)Dip switch to long-range driving light switch
Blue	Yellow	Long-range driving light switch to lamp
Blue	Black	Fuse to right-hand main headlamp
Blue	Pink	Fuse to left-hand dip headlamp
Blue	Slate	Headlamp main beam fuse to left-hand headlamp or inboard headlamps when independently fused
Blue	Orange	Fuse to right-hand dip headlamp

MAIN	***TRACER***	***PURPOSE***
Brown		Main battery lead
Brow	Blue	Control box (compensated voltage control only) to ignition switch and lighting switch (feed)
Brown	Red	Compression ignition starting aid to switch
		Main battery feed to double pole ignition switch
Brown	Purple	Alternator regulator feed
Brown	Green	Dynamo 'F' to control box 'F'

		Alternator field 'F' to control box 'F'
Brown	White	Ammeter to control box
		Ammeter to main alternator terminal
Brown	Yellow	Alternator to 'no charge' warning light
Brown	Black	Alternator battery sensing lead
Brown	Slate	Starter relay contact to starter solenoid
Brown	Orange	Fuel shut-off (diesel stop)

MAIN	***TRACER***	***PURPOSE***
Green		Accessories fused via ignition switch
Green	Brown	Switch to reverse lamp
Green	Blue	Water temperature gauge to temperature unit
Green	Red	Direction indicator switch to left-hand flasher lamps
Green	Purple	Stop lamp switch to stop lamps, or stop lamp switch to lamp failure unit
Green	Light green	Hazard flasher unit to hazard pilot lamp or lamp failure unit to stop lamp bulbs
Green	White	Direction indicator switch to right hand flasher lamps
Green	Yellow	Heater motor to switch single speed (or to 'slow' on tow- or three-speed motor)
Green	Black	Fuel gauge to fuel tank unit or changeover switch or voltage stabilizer to tank units
Green	Pink	Fuse to flasher unit
Green	Slate	a)Heater motor to switch ('fast' on two- or three-speed motor)
		b)Coolant level unit to warning light
Green	Orange	Low fuel level switch to warning light

MAIN	***TRACER***	***PURPOSE***
Light green		Instrument voltage stabilizer to instruments
Light green	Brown	Flasher switch to flasher unit
Light green	Blue	a)Flasher switch to left-hand flasher warning light
		b)Coolant level sensor to control unit
		c)Test switch to coolant level control unit
Light green	Red	Fuel tank changeover switch to right-hand tank unit or entry and exit door closed switch to door actuator
Light green	Purple	Flasher unit to flasher warning light
Light green	Green	Start inhibitor relay to change speed switch; or switch to heater blower motor second speed on three-speed unit
Light green	White	Low air pressure switch to buzzer and warning light
Light green	Yellow	Flasher switch to right-hand warning light; or differential lock switch to differential lock warning light
Light green	Black	Front screen jet switch to screen jet motor
Light green	Slate	Fuel tank changeover switch to left-hand tank unit; or entry and exit door open switch to door actuator
Light green	Orange	Rear window wash switch to wash pump; or cab lock-down switch to warning light

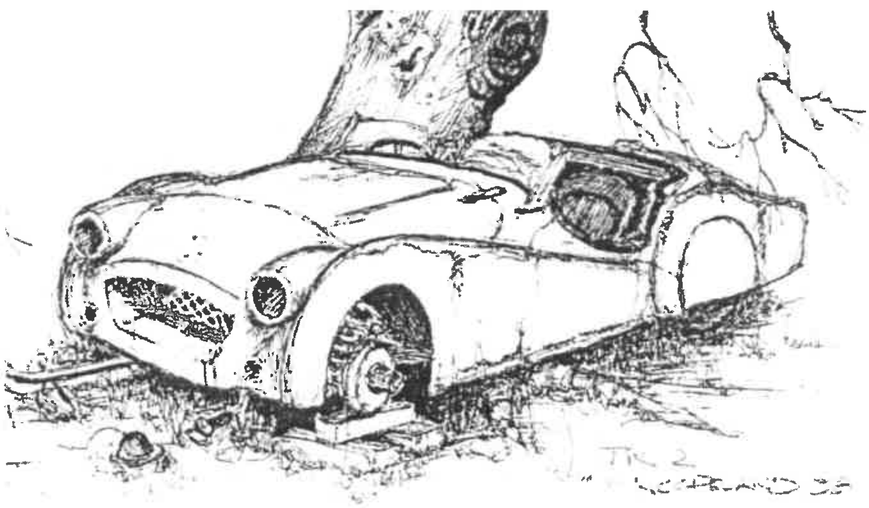
MAIN	*TRACER*	*PURPOSE*
Orange		Wiper circuits fused via ignition switch
Orange	Blue	Switch to front screen wiper motor first speed timer or intermittent unit
Orange	Green	Switch to front screen wiper motor second speed
Orange	Black	Switch to front screen wiper motor parking circuit, timer or intermittent unit
Orange	Purple	Timer or intermittent unit to motor parking circuit
Orange	White	Timer or intermittent unit to motor parking circuit
Orange	Yellow	Switch to headlamp or rear window wiper motor feed, timer or relay coil
Orange	Light green	Switch to headlamp or rear window wiper motor parking circuit timer or relay coil
Orange	Pink	Timer or relay to headlamp or rear window wiper motor feed
Orange	Slate	Timer or relay to headlamp or rear window wiper motor parking circuit
Pink	white	Ballast terminal to ignition distributor

MAIN	*TRACER*	*PURPOSE*
Purple		Accessories fed direct from battery via fuse
Purple	Brown	Horn fuse to horn relay when horn is fused separately
Purple	Blue	Fuse to heated rear window relay or switch and warning light
Purple	Red	Switches to map light, under bonnet light, glove box light and boot lamp when fed direct from battery fuse
Purple	Green	Fuse to hazard flasher
Purple	Light green	Fuse to relay for screen demist
Purple	White	Interior lights to switch (subsidiary circuit door safety lights to switch)
Purple	Yellow	Horn to horn relay
Purple	Black	Horn to horn relay to horn push
Purple	Pink	Rear heated window to switch or relay
Purple	Slate	Aerial lift motor to switch up
Purple	Orange	Aerial lift motor to switch down

MAIN	*TRACER*	*PURPOSE*
Red		Main feed to all circuits mastered by side lamp switch
Red	Brown	Rear fog guard switch to lamps
Red	Blue	Front fog lamp fuse to fog lamp switch
Red	Purple	Switches to map light, under bonnet light, glove box light and boot lamp when side lamp circuit fed
Red	Green	Bulb failure unit to right-hand-side and rear lamps
Red	White	a)Side lamp fuse to right-hand side and rear lamps
		b)Side lamp fuse to panel light rheostat
		c)Fuse to panel light switch or rheostat
		d)Fuse to fibre optic source
Red	Yellow	Fog lamp switch to fog lamp or front fog fuse to fog lamps
Red	Black	Left-hand, side lamp fuse to side and tail lamps and number plate illumination
Red	Pink	Side lamp fuse to lighting relay
Red	Slate	Lamp failure unit to left-hand side and tail lamps
Red	Orange	Fuse box to rear fog guard switch

Slate		Window lift main lead

MAIN	***TRACER***	***PURPOSE***
White		Ignition switch or starter solenoid to ballast resistor
White	Brown	Oil pressure switch to warning light or gauge, or starter relay to oil pressure switch
White	Blue	Choke switch to choke solenoid (unfused) and/or choke to switch to warning light, or electronic ignition distributor to drive resistor
White	Red	Starter switch to starter solenoid or inhibitor switch or starter relay or ignition (start position) to bulb failure unit
White	Purple	Fuel pump no 1 or right-hand to changeover switch
White	Green	Fuel pump no 2 or left-hand to changeover switch
White	Light green	Start switch to starter interlock or oil pressure switch to fuel pump or start inhibitor switch to starter relay or solenoid
White	Yellow	Ballast resistor to coil or starter solenoid to coil
White	Black	Ignition coil contact breaker to distributor contact breaker, or distributor side of coil to voltage impulse tachometer
White	Pink	Ignition switch to radio fuse
White	Slate	Current tachometer to ignition coil
White	Orange	Hazard warning lead to switch
Yellow		a)Overdrive
		b)Petrol injection
		c)Door locks
		d)Gear selector switch to start



Installing Driving (or Fog) Lights in an old British Car without Destroying the Wiring Harness or Annoying Oncoming Traffic

First, make sure what sort of light you have. Hooking them up in the garage is probably not the best way to determine this, unfortunately. A fog light should have a very distinct upper cutoff (probably a horizontal edge) where the light stops - the point of a fog lamp is to keep the light low, so it can't reflect off the water droplets and back into your eyes. A driving lamp won't have such a cutoff - it's just a bright beam, tuned for long distance rather than breadth.

Common sense (and the law, in some more enlightened climes) dictates that you want to wire driving lights in parallel with your high beams - they'll only be on when your lights are on (and you've selected them); if you dip your beams, the driving lamps will turn off, too. I like to wire fog lights in parallel with the parking lamps, so that if the conditions get really bad and/or the cutoff on your low beams isn't all it could be, you can run the fogs alone.

This is pretty easy. You need a switch of some sort to turn them on/off, a relay, and a fuse. The discussion proceeds with the (slightly more complicated) driving lights, with commentary on fogs at the end.

Please note that many of the details below are oriented towards installing these lamps in a Triumph TR4A - because the person that prompted me to write this up asked specifically about that car (and because I have just a bit of experience with that model). The wiring colors and most of the details of finding places to insert in the harness should apply to most British cars and the general principles to most any car.

A lot of people like to use a lighted bat-handled toggle switch for this application, because then you have a visible reminder in the car that the things are switched on. If your lamps are amber instead of white, you might not care about this; some of the lighted switches are pretty bright inside the generally dim British cockpit. Your choice. The Mini and Morris Minor of the mid- to late-60's used toggle switches on the dash; I know Holden makes a repro of this, and you might well be able to get them from Mini City in the East or Mini Mania in the West.

For a more modern interior, you might want to use one of the lighted square push/push switches that Dave Bean sell, complete with the international symbol for "driving lights".

Or just pick up a switch you like from Radio Shack or the local auto parts store.

All vendors mentioned in this article can be contacted by information found in The Monster List.

Figure out where you want to mount it - I have mine mounted on the radio blanking panel. That's not a horribly convenient place to reach, as it turns out, but it's not awful. I chose a switch that has too small a handle, too, so it takes some groping around to reach.

For this kind of application, I really like the Marchal 514 relay; it's bombproof, and it has an internal fuse. I buy them from Dave Bean Engineering; get a couple of the unique fuses, too. Not cheap, though. (If you object to having French electricals in your British car, Lucas makes the fairly good all-metal 28RA relay, but you'll need a separate in-line fuse holder, and it will all be more of a nuisance to mount. Whatever you do, make sure you use a fuse!) Marchal makes a lovely chrome toggle switch, too.

This relay is easy to mount, since there's just a single tab with a pre-punched hole. Pick some reasonably accessible spot under the driver's side dash; you want to be able to get at the fuse easily, and all your wiring is there. Chances are that there's a bolt or screw that you can undo and use to mount this without drilling any holes.

If you want to do this "right", you want to get properly colored wire! You can get this from British Wiring. The wire running out to the lamps should be blue with a yellow tracer, 12 gauge (28/0.30 outside the US). You'll also want a few feet of thinner blue with white (16 or 18g will do, 9/0.30), the same of blue/yellow, and some 12g brown with blue.

The idea is that you will use the brown/blue to supply the main current to the relay; you get this from the same place the lighting switch does. The lighting switch has a similarly colored wire coming into it; if you trace this back, you will find a Lucas barrel connector (under the steering column). If you replace this two-hole (what Lucas calls a "single") sleeve with a "double", you can now connect four wires together, of which you need three - the original two, plus the one running to the relay. Connect to the terminal marked 30/51 (#1 on the 514 relay). (Please see note at end for a warning and alternative.)

Both British Wiring and The Roadster Factory sell the sleeves and bullets. Lots of people dislike them, but I find them to be quite reliable when installed correctly - either soldered, or crimped with the proper tool (British Wiring sells this, too). If this is not something you plan to do often, just solder the connectors with rosin core solder and a good soldering gun; otherwise, the crimping tool is a good investment, and you probably just want to buy a selection of bullets and sleeves.

OK, you've got power to the relay. At the other end, you need to run power to the lights - that's the blue/yellow wire. You can run it out the firewall along the main harness; if you want to keep it out of sight, run it underneath and use a loop of black electrical tape every 6 - 8" to support it. It will be mostly invisible. You can add another double connector at the top of the radiator with the rest to split the wires to the two lamps, just like all the others. Connect the other end to the terminal marked 87 (#2 on the 514).

Now, you need power for the switch. You only want to have power on this switch when there is power to the high beams; that way, the driving lamps get turned off when you dip the mains. Find the wire that feeds the dashboard high beam indicator and trace it back (it's blue with white) to a connector. Again, you should be able to substitute a single sleeve connector for a double, and run the extra (blue/white) wire to the switch. Run the thin blue/yellow from the other terminal of the switch to the coil terminal on the relay (marked 86, or #3 on the 514).

Depending on how you mounted the relay, you may need to run a separate ground from the other side of the relay coil (85) to the frame; the easiest way to do this is with a short black wire run to bolt on the frame, probably the same one that's holding the relay. The true Lucasite would buy a ground clip to place under this bolt, and use a bullet connector on the end of the black wire. The 514 has an integral ground terminal, #5, so you can jumper that to #4, which is the 85 terminal.

For fog lamps, you do much the same, except that you get power for the switch from the parking light circuit (red) and run red/yellow wire from the relay to the fog lamps. The sizes and hookup are otherwise identical.

That's it! Now that they're working, please aim them.

I would probably hook up the switch and relay first, and make sure you can hear the relay click on and off when you actuate the dip switch and the dash switch. Then run the 12g wires to/from the relay and lamps...

Note that when you've got all these lights running (plus heater and wipers) you may well be exceeding the capacity of your stock alternator and the supply wiring to the lighting switch. Do the math (8 amps per 100W of lights) and check under-dash wiring. You may wish, instead, to supply power to the relay(s) directly from the battery. This won't solve the capacity problem, but will keep you from melting the wire size in your car. The only possible downside is that the current drawn by the auxiliary lamps won't be properly indicated on the ammeter.

ALTERNATOR

We chose to change to an alternator, preferably Bosch which has a much thicker mounting bracket than Lucas. One with the correct arrangement and shape of mounting bracket is the Bosch BXD1242 which was used on the Holden Astra, Datsun 180B and 200B and the Nissan Pulsar (81-87). It should be possible to get one from a wrecker but we purchased new ones for long term reliability. They are rated at 60Amps which allows for plenty of additional electrical accessories. The regulator unit is also simple and cheap to replace.

To mount this alternator, all that is needed is a replacement front spacer and a bolt. Again, the spacer is a simple machining job. It replaces the generator front mounting bolt which goes through the front engine plate. The new spacer locates into the hole in the engine plate and is drilled to accept a 10mm bolt (not 3/8") which needs to be 160 - 170mm long and with 2 nuts and lock washers. You may have to dig around to find one as there are plenty 150mm long but not so many in the 160 -170 range. The rear hole of the existing generator bracket need easing out to 10mm with a file.

The mounting bolt goes through the front alternator bracket, through the machined spacer and engine plate, through the rear alternator bracket, through one nut and lock washer, through the rear bracket and finished with a 10mm nut and lock washer on the outside. Tighten the outside nut fairly tight so that the alternator is quite stiff to move. Then tighten the inside nut against the bracket to lock everything in place. Notice that the rear alternator bracket and tube piece is (correctly) free to move.

I salvaged the adjusting arm (water pump casting to alternator top arm) from the one on the old generator which had been considerably butchered in the past. A visit to a wrecker might find a better type - needs to be a bit straighter but still nice and thick like the original one. A tiny cranking of the bracket by a millimetre or so was necessary to get everything true. The bracket fits behind the top lug on the alternator.

The correct belt is an 11mm x 1005 (eg Bosch 11A1005). The final solution does have a slight misalignment between the water pump and balancer pulley of a few millimetres but this has not proved to be a problem. The water pump and alternator pulley should run in the same plane as they are relatively close.

The alternator has a built in regulator so some simple changes are needed at the old regulator. At the voltage regulator join all the thick wires together - ie. A1, A and D. I removed them from their terminals, made a 3 way joiner out of thin brass sheet and taped them in a compact bundle. Take the thin wire off D and join it to the thin wire off F (tape these as well). Leave the Black earth wire on its terminal (not doing anything now). Get your auto-electrician to check - charge rate should be 14V.

Good Luck - Rick Fletcher and John Buck

Battery Preservation on the Occasionally Used Car

How batteries work, what makes them fail and how to extend the life of your battery

How the battery works:
A typical 12 volt car battery is made from 6 cells. Each cell has two sets of lead plates in a bath of sulfuric acid. Filled with the acid "electrolyte" and charged, one set of plates become positive plates and the other set of plates become the negative plates. The positive plates have a porous construction with red lead paste in the plate pores. The negative plates are also porous but are left bare and become spongy and grey in color. The color difference may be the origin of the red and black terminals we come to expect on batteries with the red lead plate being the red positive terminal and the grey plate being the black negative terminal. Opposite plates are held apart by insulating separators. Each cell is in its own compartment so the electrolyte does not mix between cells. Each cell produces about 2 volts. The positive plate from one cell is connected to the negative plate of the next cell and so on to add the 2 volts of each cell up to about 12 volts from 6 cells. (MGB people with two 6 volt batteries can take all the battery voltages mentioned below down by a factor of two for each battery.)

There have been many improvements and variations to the original design worked out in the mid-1800's. Old liquid electrolyte batteries ("flooded" batteries) needed to be topped up with distilled water to replenish the water in the acid electrolyte. These batteries used Lead alloyed with about 12% Antimony to strengthen the plates. These batteries tend to release a lot of hydrogen and oxygen gas, depleting the water from the acid electrolyte. The out-gassing was reduced with the change to lead-calcium alloy plates with only 2% Calcium alloyed into the lead. Reducing the gas production reduces the loss of water and makes the battery more "maintenance free". This is why we no longer need to regularly top up the battery with distilled water.

The separators are used to hold the plates at some distance apart so "+" and "-" plates do not short to each other. The separators also need to be porous so the electrolyte can pass through and be in contact with both plates. These separators have evolved from wood to porous plastics to glass fiber.

Variations on the design of the lead acid battery include the glass wrapped plate, the "gel cell" battery and the "AGM" or the Absorbed Glass Mat battery. The glass wrapped plate uses fine glass fiber wrapped around the plates of the battery. This glass wrap aids in holding the lead plate in its desired shape when deeply discharged and helps to hold the shape of the plates during recharge. This extends the life of a battery that is frequently deeply discharged. These are sold as a "deep discharge" battery for golf carts and marine use. The "gel cell" uses a sulfuric acid that is gelled so it is no longer liquid. This prevents spillage, can operate in any orientation and can extend battery life slightly by limiting the loss of sulfate from the plates. There are some disadvantages to both with reduced capacity or reduced maximum current available for starting an engine. The AGM battery uses an extremely fine glass fiber matt as the separator into which the liquid electrolyte is wicked. In this battery there is no liquid electrolyte except that wicked into the glass fiber. The battery becomes non-spilling and further limits the sulfate migration. The result is they have a uniquely low self-discharge rate amongst lead acid batteries. Manufacturers are quoting 2% to 3% per month and my testing of early AGM batteries has shown even lower rates. An apparent disadvantage to the AGM battery is an increase in the weight of the battery for the same capacity. This may slow the predicted "all cars will soon use AGM batteries" I have been hearing from battery manufacturers.

Causes of battery aging:
The problems limiting battery life centre around the fact that as the battery is discharged the lead in the plates changes to lead sulfate and when recharged it does not perfectly return to its original configuration. In the liquid electrolyte batteries, some of the lead sulfate precipitates down to the bottom of the battery. This material is lost from the process and reduces the sulfate and lead available in the battery. Eventually it builds up in the bottom of the battery to the point that it creates a short between the plates. This increases the self-discharge rate of the battery until it will no longer hold a useful charge. The deeper the battery is discharged and the longer the battery is left in a discharged state, the more sulfate builds up and

the shorter the battery life. If the battery is completely discharged, the battery becomes "acid starved" with all the sulfate from the acid consumed. The electrolyte is now nearly pure water and the battery cannot easily be recharged. Adding a small amount of acid to each cell can restart the charging process but if there is too much acid in the battery, the plates corrode to the point that they disintegrate when the battery is fully discharged. Lead acid batteries also tend to self-discharge. This means even if fully charged they will eventually discharge themselves. This discharge is typically 5% to 15% per month even without any use.

Another aging problem is a result of the loss of water from the acid electrolyte in the battery. Although the water loss is now greatly reduced, it is still possible to have a low level in the battery. This leaves more concentrated acid and if the level is low enough to expose the plates, the exposed part of the plates are no longer available to function as a battery. Refilling the battery will only partially restore function to this part of the plate. If you should find a need to top up a battery use only distilled, de-ionized water.

The connections inside the battery can be weakened by shock or over-charging of the battery. This can lead to a very weak connection which fails when a heavy load is placed on the battery. This load can be either due to charging the battery at a very high rate or discharging a battery at a high rate such as when the starter tries to start the car. Either way it can cause the battery to literally explode. The high current flow in the weak connection causes the connection to fail and heat up or spark. This ignites the hydrogen and oxygen that inhabits the inside of your battery. I can vouch for the fact that pure hydrogen in perfect combination with pure oxygen is very explosive. The gas inside the battery can have exactly this mixture. When it explodes, it is particularly nasty as it not only throws bits of the battery around at high speeds but also coats everything with the battery acid. Lead, Lead Sulfate and Lead ions in the electrolyte are not good for you either. The potential for an explosion is a good reason not to have your battery rapidly charged as some garages will still do and a reason to stand clear when someone puts jumper cables on a weak battery and tries to start the car. The battery may be weak due to a failing internal connection.

So what can we do to extend the life of our batteries in our collector cars?

First, keep the battery fully charged.
Use of a trickle charger or a "float" charger on an infrequently used car battery can keep the battery fully charged and reduce the degradation of the plates, thus extending the battery's life. Leaving a battery discharged can ruin a good new battery in weeks to a few months. Keeping a battery with a float charger on it may extend the life of an infrequently used battery from 2 or 3 years to 6 to 8 years.

There is a debate going about which is best for a battery, recharging weekly or float charging. In theory the float charge minimizes any change to the plate dimensions and maximized the battery life but some argue that continuous float charging continues to cause some out-gassing and drive off small amounts of water from the electrolyte. Since a battery will not self-discharge significantly if held above 12.9 to 13 volts I believe the best approach is a slightly lower float charge voltage. The difference in battery life is probably insignificant compared to leaving it only partially charged for just a few days. The longest life I had from a battery in one of my old cars was one that I charged every few weeks. That battery still started a big V8 after 9 ½ years of service so maybe there is something to not float charging. I find that I forget to charge the batteries and I leave them for 3 or 4 months between charging. This is much worse than any difference in float charging versus charging every few weeks, so I opt for float charging. I reduce the float charging voltage by putting a diode from Radio Shack on one charger lead and therefore dropping the commercial float charger from 13.6 to 13.8 volts down to 12.9 to 13.1 volts. If you try adding a diode, make sure you put the diode in so the current can flow. Putting the diode in backwards will stop the charger from float charging the battery. You can check by measuring the battery voltage with and without the charger. Whether this is beneficial is still an unanswered question. Battery manufacturers all call out a slightly different float voltage level with liquid electrolyte the lowest around 13.4 and gelled batteries the highest at around 13.8 volts.

The major "no no's" on batteries include:
Over charging or continuous charging – this is death to a good battery. This is easily done by leaving an

older charger on the battery longer than needed to fully charge the battery. It drives the water out of the electrolyte, increasing the acid strength and lowering the electrolyte level. The exposed part of the plates dry out and are destroyed and the wet parts of the plates are damaged by the higher acid concentration. The new “automatic” chargers prevent this by charging to the 14.4 to 14.6 volts needed to charge a battery and then when the charging current (or charge rate) reduces, the automatic chargers will reduce the charge voltage to a lower “float” charge voltage, thus preventing over-charging.

Too fast discharge – This can heat up the connections between plates or in extreme conditions heat up the plates and cause warping which causes shorts and kills the battery. Usually you will only have this problem if the battery is too small for the application. Size the battery to your car.

Too fast a charge - This causes faster gas production inside the battery than the battery can burp out and causes uneven charging in the battery. The result is irregular plates, faster plate degradation and a drastically reduced life of the battery. A good rule of thumb for most lead acid car batteries is to recharge at no faster than a four hour rate. For a 60 ampere-hour battery as in the typical small car battery, this is 60 amp-hours divided by 4 hours or 15 amperes. So a 6 or 10 ampere charger is fine. Don’t put a 200 ampere car starter on a battery and try to recharge it in 20 minutes. You can put a lot of charge back in a battery in a hurry but you won’t have much of a battery left when you are done.

Over heating - A hot battery is a short life battery. Keep any heat shields or add some to prevent the battery from absorbing radiated heat from an exhaust manifold. This is one reason some car manufacturers removed the battery from the engine compartment.

Contamination of electrolyte with non-sulfuric acid, salts and minerals – almost any impurity in the electrolyte will shorten the life of the battery. This includes most “battery additives”. Use only distilled or de-ionized water to top up.

Low electrolyte levels - Too low and the exposed part of the plates will dry out and become worthless, too high and you will weep or burp acid and corrode your battery terminals and mountings. Also be careful not to add too much acid. Doing so and deep discharging will completely deplete the lead in the plates and destroy the battery when recharged.

Complete discharge - OK this is hard to avoid if you leave the lights on overnight. Just don’t wait days or weeks to recharge the battery, do it right away. Complete discharge causes electrolyte conversion to water. If this happens you may recover the battery by extended charging or in severe cases add just a very small amount of acid to each cell to get the electrolyte to start functioning again.

Freeze damage to your battery. A reasonably charged battery has electrolyte with a high specific gravity indicating a high acid concentration. High specific gravity electrolyte will not freeze at most temperatures to which we will ever expose our cars. However, since a discharged battery is left with nearly pure water as the electrolyte, it can freeze. As you might imagine this is death to your collection of plates, separators and battery housing. Keeping your battery charged during the cold months will prevent this.

A few Hints and Myths

The Concrete Myth:
There is a popular belief that leaving a battery on concrete will cause the battery to be ruined. In all the research and readings on batteries I cannot find one valid reason why this has any scientific validity. I have even tried it by storing identical batteries, one on concrete and one up on a bench. There has been no measurable difference in performance or life. I believe this myth comes from leaving a battery on the floor and forgetting to recharge or float charge the battery. A battery not float charged is a battery that self-discharges. A discharged battery does not live long. It should make no difference if on concrete, plastic, in your car or strung up from the nearest tree limb. If you let it sit, it will go dead and will not recharge. Keep you batteries charged!

A Painfully Learned Lesson

Don't connect a new "automatic" style battery charger to your car without a good battery also attached. Not even for a second. I found out, somewhat painfully, that some of these new chargers, will produce voltage spikes of 50 volts or more without a battery attached. Once connected to a good battery, the spikes are gone. Putting this high voltage on your older car will probably not do much unless you have an electronic ignition or possibly an electronic clock. On a more modern car, connecting one of these chargers without a battery attached can destroy some car computer "brains" or damage "always on" circuits for digital clocks or alarm sensors. It does not take much of a load on the charger to reduce this to a safe level but modern car electronics have such low drain that they don't create enough load to eliminate the voltage spikes. If you disconnect your battery and don't want to lose the computer memory, don't use an automatic charger. While a small battery or other drain on the charger will help hold down these spikes, it's best to wait until you have re-connected your battery before connecting the charger.

TRIUMPH ELECTRICAL SYSTEMS

This brief article seeks to explain the technicalities of the Triumph electrical system. It will help in understanding the complexities of the electron flow that mystifies some of us.

Faust Carello, Joseph Lucas and Robert Bosch are often referred to as the 'Princes of Darkness'. This is really unfair and displays an inability to comprehend the basically simple principles of the automotive electrical system.

Forget all that nonsense you have read about magnetic fields and the flow of electrons along a conductor. For that is what it is, NONSENSE, a myth put about by electrical 'engineers' to support their lavish lifestyles and crazy theories at our expense. The reality is SMOKE.

When you think about, it all becomes startlingly obvious. Smoke makes all electrical things function. If the smoke escapes, then the thing stops working. Just think back to the last time that you had to grovel down beside that oil soaked Triumph sump to replace the starter motor. Did it not start to emit smoke before it ceased to operate? Of course!

The battery stores up lots of smoke dissolved in the battery acid . This is why they were once called accumulators, back in the Gloria days, until it became apparent that budding home mechanics were likely to twig to the secret. Naturally, if you try to dissolve too much smoke in your battery it will escape through the little holes in the top. This is why the new style batteries with the sealed tops explode when they get too much smoke in them.

The wiring carries the smoke from one device to another, pumped around the system by the alternator. When the wiring springs a leak, it lets all the smoke out and everything along that piece of wire stops. The starter motor needs lots of smoke to make it work properly, so it has a very thick wiring going into it.

Simple, isn't it?

Reprinted from the Club Lotus Newsletter.

Conversion to Negative Ground

From *The Triumph Standard* — SCTOA Sep '89

Is conversion from a Positive Ground to a Negative Ground worth it? If you're a purist, maybe not. But if you would like to add some modern electronics such as an AM/FM Cassette player, Radar Detector, or a CB Radio you may want to consider converting to a Negative Ground. True, a power inverter could be used, but what kind and how much power will be required for all your toys? It's easier to convert than to try and second guess your requirements for the future.

Is converting difficult? Not as difficult as working with a Power converter and the change is easily reversible. Just use the following simple steps.

1. Disconnect the ground (positive) cable from the Battery.

2. Disconnect the other cable from the battery (negative) that goes to the starter solenoid.

3. Rotate the Battery 180 degrees.

4. On the ignition coil, reverse the connections so that the positive (+) or (CB) is connected to the wiring harness and the negative (-) or (SW) is connected to the distributor.

5. Behind the dash panel, unscrew the knurled nut holding the retaining bracket for the ammeter. Pull the ammeter out of the dash slowly. Slide the push-on connectors off and reconnect them in the reverse of how the were originally connected. Reinstall the ammeter.

6. Connect the battery cable from the starter solenoid to the positive terminal of the battery. Since this is the positive lead you may want to replace the black cable with a red cable.

7. Reconnect the ground cable to the negative terminal of the battery. Since this is the negative lead you may want to replace the red cable with a black cable.

8. STOP — IMPORTANT. The next two steps cover polarizing the Generator. It insures that when you start the car, the Generator output is not opposing the polarity of the new reversed battery.

9. Disconnect the SMALLER lead from the wiring harness to the field winding connection of the generator (small spade lug).

10. Obtain a piece of insulated wire that is long enough to reach from the positive battery terminal to the field winding connector of the generator (step 9). Take one end of the other cable and connect it to the Positive end of the Battery (you don't want sparks near the battery that could cause an explosion). Momentarily touch the other end of the cable to the field winding connector of the generator together several times (careful you don't short it to the chassis or engine metal). Unless it's bright out, you should see a small spark each time you do it.

11. Disconnect the jumper wire and reconnect the small wire to the field winding connector on the generator.

12. Start your car and check to make sure the ammeter is reading in the plus (+) side.

Congratulations, you now have a negative ground car and you can now install all the neat little toys you want (except sonic boomers). Some of you may ask, "What about the starter motor and other gauges?"

Electrically, the starter is a series wound motor. Series wound motors always turn in the same direction regardless of polarity of the DC power source. Of the gauges, only the Temperature gauge on TR4s and the fuel gauge in the TR2, 3 & 4 are electrical. They actually rely on an internal heating element to heat a bimetallic strip that then provides the motion that moves the respective gauge's needle. As such, the gauges' internal heating element is also insensitive to polarity. If you think about that for a moment, you will realize that is why those gauges take a few seconds to return to their off position when you kill the ignition switch (the elements need to cool down).

Editor's Note: This article was originally written by Dave Burnell in Dec. 1985 *Triumph Standard*. Bill Sohl, VTR President, provided some additional information in an article that appeared in a later issue of the *English Channel*. Upon trying the conversion, I found some problems which I have edited into this article as well a some notes on battery cable color standards.

Replacement Distributor

There is a limited call for a replacement (better) distributor for the TR. The original Lucas distributor works well when maintained correctly but these days, can be worn to the extent that they adversely affect the engines operation. This was the case with mine and a new distributor was not an option at the time. Also I wanted to go to an electronic distributor and do away with any points or condenser problems. It was also a consideration that I wanted to see if I could.

After much research at my local Pick and Pay wreckers I came up with two options. The first was the 81 Nissan Pulsar and the second was the 81 Honda Civic. Both models fit in that period where they had electronic ignition but not fuel injected; hence the ignition is not managed by the engine CPU and contains both mechanical and vacuum advance/retard mechanisms.

I first went for the Nissan as all the components are enclosed within the distributor. With the Honda unit, a small module is mounted on the bulkhead. The problem I found was that almost all the Nissans had their electronic internals removed. That told me there must be a problem so I went for the Honda option (they were all complete). The spigot part of the Honda and Nissan housing is the same diameter as the Lucas. Also the main drive shaft on both the Honda and Nissan units were the same diameter as the Lucas. Together with the fact that they both spin in the same direction as the Lucas, it makes for an easy conversion.

When I purchased my Honda distributor, I also took the external module and a section of the wiring loom so that I could work out how it should be wired. There are other modules available such as Bosch that will work.

Stripping.

- Remove the two distributor cap retaining screws and the distributor cap.
- Remove the rotor button by pulling.
- With a suitable punch, drive out the pin that retains the drive gear and remove the gear. Ensure there are no burs on the shaft.
- Remove the two screws retaining the internals. Lift out the base plate. This may be awkward due to the lower magnet but can be lifted out.
- Remove the two screws that retain the vacuum mechanism and remove it.
- Carefully remove the shaft and internals by pushing then through the housing. Ensure that the two spacers that go under the internals retaining screws are not lost.
- Prise out the soft plug in the end of the shaft and remove the retaining screw.
- Remove one end of the two fly weight springs and remove the upper shaft together with the magnet and coil. No further dismantling of this section is required.
- Remove the two fly weights. Carefully clean all parts.

Modification.

- Cut 0.250" from the gear end of the main drive shaft. An abrasive disc is best for this as it is a hardened shaft. Dress the end of the shaft on a grinder to give a small chamfer.
- Drill a 1/8" hole in the fly weight base plate as per diagram.
- Fit the new timing advance stop to the plate from the bottom and line it up as per diagram 2. With a suitable hammer, peen the small end to fix the new stop in position.

BR

It Failed to Proceed, the Coil?

Jump in, turn the key, push the button, engine cranks but will not start. Sound familiar? Well it happens to us all at some time or other and as in this case, at the most inopportune time. My wife, Gwen, and I had packed the TR for the TT to Lightning Ridge and were ready to go.

I started the trusty TR and backed it out of the garage and turned it off. Closed the garage door and Gwen set the house alarm and shut the front door. We jumped in all full of enthusiasm for the upcoming tour with our TR friends. I turned the key, pushed the starter button and after a few splutters the engine died not to start again.

Panic......we were due to meet rest of the tour (13 other TRs) in fifteen minutes. There are basically four things required to make an engine go. Fuel, spark, air, and compression. Compression cannot be achieved without air and as the engine sounded OK during cranking, I immediately discounted air and compression as a likely cause of my dilemma. That left fuel and spark.

In my mind I discounted the carburetors, as it was highly unlikely that two fine pieces of equipment such as SU carburetors would fail at the same time. It is possible but not likely. The easiest next step was to check to ensure we had fuel and that it was getting to the carbies. Yes there was fuel in the tank and removal of one of the float bowls confirmed that when the ignition was turned on, we had fuel flow and no water.

My car is fitted with an electric fuel pump. That only left spark. I pulled number one plug lead, attached it to a spare spark plug, earthed the plug and had Gwen crank the engine. Yep, there was spark. Not the best spark but spark.

Now I was getting a little confused. All four things required for ignition were there, spark, fuel, air, and compression.

Now it is at this time the mind starts to think of all the improbable things that could be wrong. Up until this time I had, I thought, maintained a strictly logical trouble shooting approach. Distributor I thought.

My car is fitted with an electronic distributor from a Honda Civic, maybe it was faulty. I did not have the info or tools to check it so I would change it. I found the original Lucas distributor and after stripping and checking it I fitted it to the engine.

During all this I received three calls from Register members after both second hand parts and technical information. It was during one of these calls that I fitted the distributor 180° out of sync and had to redo it. Distributor refitted and the electrics jury-rigged to separate the wiring required for the Honda distributor, it was time to try it again.

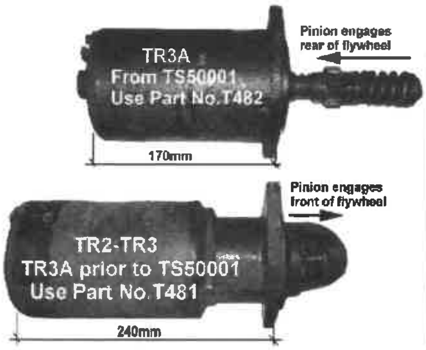
No luck, and it was luck I was relying on, not good trouble shooting practice.

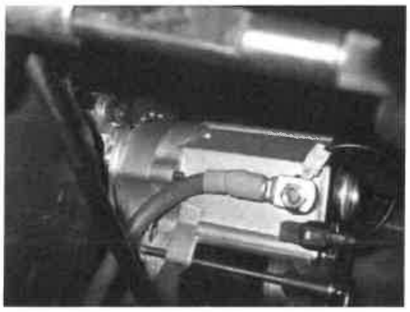
The only item left was the coil. Now in all my years of motoring, over 49 years of it, I have never experienced a coil failure. Good trouble shooting practice tells us to take a logical approach and to try the simplest things first. It would only have taken a couple of minutes to try another coil. Had I been able to try a new coil I would have but I did not have a spare and after all, the coil gave a spark.

So at this point I had put aside the logical approach and gone for the distributor. I dashed up to the nearest Repco and purchased a new coil. This coil was temporarily connected and varoom. The engine immediately started. I fitted the coil correctly, tied up the temporary wiring I had done, closed the lid, cleaned up, locked up, and departed some two hours late.

We met up with the rest of the tour about fifty klicks short of our first night's stay. Needless to say they all felt for me and at least half of them were carrying a spare coil. The car performed well on the tour and on returning home I checked out the failed coil. The primary coil resistance was within specs so I temporarily fitted it to my TR and it started, ran for about three seconds and stopped. It would not start again. I have no idea what the problem with the coil is but this little exercise confirms the need for good and logical trouble shooting practices. BR

Hi-Torque Starter Guide
WHICH STARTER FITS YOUR TR





Hopefully, this basic information will end the confusion that has been occurring in relation to early and late TR starters, flywheel ring gears and modern High Torque starters. Being a little long in the tooth, some of our cars have had starters, flywheels and engines swapped; hence, you should confirm what you have before ordering. Reference to these photographs should clarify the situation.
Before replacing your starter, first check the body length to verify the starter version fitted.
240mm Body = Early starter. 170mm Body = Late starter.
After removal of the starter, inspect the exposed portion of the flywheel ring gear. Presence of bolt heads retaining the ring gear confirms a late type flywheel (and late starter). Lack of bolts (shrunk on ring gear) confirms the early starter.
The early (large) starter, often referred to as the bullet or bomb shaped starter was fitted to TR2, TR3 and early TR3A (prior to TS50001). This starter is easily identified by the 240mm body length.
These starters utilize a bonded rubber drive coupling which can fail resulting in the starter rotating without cranking the engine.
Being so large, it is generally necessary to remove the exhaust to get it out of the engine bay. When the starter is operated and starts rotating, the starter pinion moves forward axially to engage "THE FRONT" of the flywheel ring gear, slowly wearing away the front of the ring gear teeth.
IMPORTANT.
The high torque starter also engages with the front of the ring gear, hence, if the front halves of your ring gear teeth are worn away; do not expect the High Torque starter to operate correctly. The original late 3A (smaller) starter utilizes a pinion in the starter Bendix drive which is pulled into the rear of the flywheel ring gear.
The fact that the pinion in both the early and late original starters is slowly rotating when engaging with the ring gear explains the wear on ring gear teeth.

The good news for TR3A owners with the late starter and a worn out ring gear is that the late type High Torque starter engages with the previously unused front side of the ring gear, eliminating the need to replace a worn ring gear.
Like all modern starters, the high torque starter pinion is pulled into mesh with a lever while both starter and engine are stationary, greatly reducing the possibility of future wear to the flywheel ring gear.

Reasons for problems with high torque starters:
- Incorrect starter fitted.
- Failure to use Loctite on starter adaptor plate bolts. *SEE BELOW.*
- Last year the Register received five starters with incorrect pinions. All of these now recalled. Cost us less than Toyota!

FITTING THE HIGH TORQUE STARTER

These universal starters are designed to fit a number of vehicles.
It is usually necessary to remove the ¼" diameter Allen head bolts and rotate the starter adaptor plate to find a position where the starter body does not foul the TR engine block while providing access to the head of the starter motor retaining bolt.
The normal position is with the starter solenoid facing out and downwards.
This provides easy access to the main starter terminal.
The solenoid should be clear of the exhaust.
IMPORTANT.
The ¼" adaptor bolts carry full starting torque. They must be tight.
You must use Loctite retaining compound when refitting these ¼" Allen bolts.
Don't blame the starter for badly fitted adaptor bolts!
HOW TO WIRE IT UP
Simply use a small wire to bridge the small solenoid terminal to the large terminal on the side of the starter and connect your existing large starter cable to the same large terminal on the side of the starter. (See photo above)

Allan Bare

The importance of being well connected

I believe it would be fair to say that the majority of electrical faults in a motor vehicle stem from a bad connection of one sort or another, whether it is a corroded or loose terminal or a worn generator brush, the result is still a bad connection.

Electrical connections are seldom checked until a problem arises, and even then the connection at fault can be quite elusive.

Bad connections are the result of insufficient area of electrical contact between conductors and need not be the proverbial 'loose connection', an apparently firm connection can be faulty due to an oxide interface between the conductors which need only be microns thick. this type of problem is often found between mating surfaces of washers, spade connections and rivets and is quite insidious as the conductive capacity of the connection is progressively reduced over a period of time, often without any external evidence. most electroplated surfaces can only offer protection for a limited time.

From a safety point of view, the most important connection in the car is the one between battery and engine, as this is often made via the body and/or chassis using an earth strap between engine and body.

If the battery-body connection is good and engine-body connection poor then, during start up, very high electrical currents may be induced in components not designed to carry them; such components as temperature gauge capillary tube, oil gauge tube, choke cable, fuel line, tachometer cable.
The current induced can easily be high enough to bring the component(s) to red heat with possible disastrous results.

Here is a list of some 'connection' problems to look for in older cars.

- Missing/broken earth strap between engine and body, bad earth strap connection.
- Inadequate capacity of engine-body earth strap.
- Inadequate capacity of battery cable-body connection.
- Interface corrosion between battery post and clamp.
- Interface corrosion between battery cable wires and clamp (can apply to unitary assembly as well as separate clamp- cable assembly).
- Poor starter motor performance due to paint applied to interface ends of starter motor body and/or interface surfaces of end plate – bearing carrier.
- Generator problem as above.
- Poor/intermittent generator performance due to poor conductivity at mounts.
- Oxidised points of voltage regulator and cutout due to long period of disuse.
- Any terminal washer, nut, bullet or spade connector with a dull/oxidised finish.
- Interface corrosion in riveted connections (relays, switches, generator terminals) – can usually be corrected by cleaning top of rivet/adjacent metal and soldering over.
- Poor/nil earth connection between fuel gauge case and body (dashboard).
- Poor/nil earth connection between fuel tank sender and body.
- Intermittent connection between fuel tank sender float support arm and sender body.
- Lack of secure earth connection between tail light bases and body – a common earth return wire connecting all bases is recommended.
- Interface corrosion of headlight earth return connections.
- Lack of secure earth connection between instruments and dashboard (body).

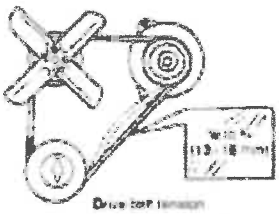
DR

Lucas

GENERATOR REPLACEMENT INSTRUCTIONS

WARNING *Many generator equipped British vehicles were positive ground. In these cases the negative battery terminal is the hot one. Many such cars have a label adjacent to the battery. Positive earth means positive ground. Negative earth means negative ground. As long as polarizing procedure is followed, then the generator will be correct for car. Incorrect connections or failure to polarize the generator as per these instructions will damage both the generator and regulator and may damage the wiring harness. Read the following instructions before proceeding with the installation.*

1. Disconnect battery ground. Remove old generator.
2. Carefully remove fan and pulley from old generator. Look for signs of wear on both pulley and belt. Belt should not bottom in groove. Fan should be undamaged — no bends. Install pulley and fan on new generator using new nut, key and spring washer supplied.
3. Install generator on vehicle — leave mounting lugs slightly loose until belt adjustment is complete.
4. Adjust fan belt — ½ to ¾" play is correct. If too loose, belt will slip — if too tight, it will cause bearing failure.
5. Reconnect battery ground.

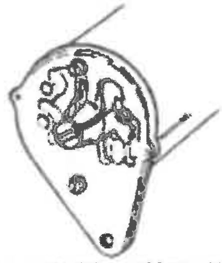


Drive belt tension

6. Before connecting generator wires, polarize the generator by taking a suitable length of 14 gauge or similar wire from the HOT terminal of the battery and flashing it several times against the field (smaller terminal) of the generator. If battery inaccessible, see 8.

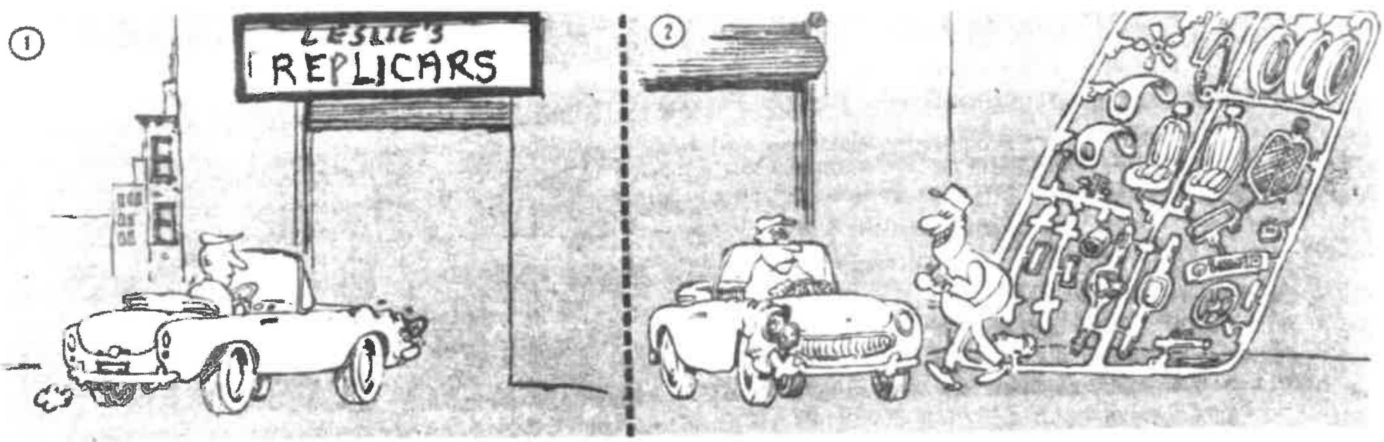
Lucas Automotive
Troy, MI 48098

7. Connect generator — large terminal is main output or "D" lead, small terminal is field or "F" lead. If battery is connected when generator wires are being installed, then a spark at the "D" or "F" lead indicates that the regulator lead indicates that the regulator is defective and should be replaced. Lubrication — the drive end bearing is prelubricated and requires no attention in service. The commutator end has a porous bronze bush and requires a few drops of engine oil every 6,000 miles.



   Suppressor condensers when used should only be connected between the large "D" lead and ground at the generator — never on the small "F" lead.
8. If Battery is inaccessible, the generator may be polarized as follows. First connect generator, see para. 7 above, then momentarily jump B or A terminal on which the wires are still in place, the method shown in 6 being preferable when the battery is under the hood.
9. Testing generator
   a. Disconnect both wires from generator.
   b. Connect voltmeter between large "D" terminal and ground. Start engine. A reading of 1.5 - 2.0 volts should be obtained at 1500 - 2000 engine rpm. Stop engine.
   c. Connect ammeter between "F" and "D". Voltmeter still between "D" and ground. Slowly increase engine speed. When voltmeter reads 12V ammeter should read 2 amps.
   d. Maximum safe output — reconnect "F" and "D" leads to harness with ammeter in "D" lead. Run engine. Switch on vehicle headlamps, max. safe output 25 amps (G4011) or 22 amps (G4012). If output exceeds this, check regulator. Stop engine. Ammeter should show momentary discharge of 10 amps max then return to zero. If higher or does not return to zero, check regulator.

Lucas



GENTLEMEN START YOUR ENGINES.

I have own my TR for some fourteen years. On the way through restoration things were checked and repaired/replaced as needs be. Starter motors tend to be under stressed; they burst into life for a few seconds and then go back to sleep for hours unlike generators that are always busy.

It was always slow to start but it did start. Then it started to jam as my Mini did back in the 60's so grab the spanner that you keep at hand, up bonnet, quick twist and away you go. This became more prevalent so I gave it to a friend (Dr Lucas) whose hobby is fixing Lucas which appears a lot in his car collection.

When I picked it up I asked what was wrong with it. The reply was "Everything". Apparently it shouldn't have worked. Everything was original though worn out. He rebuilt it but suggested that I get another and he would overhaul that as a spare which is what he did.

It stopped jamming but was still slow to start so to help matters I started it under the bonnet which caused me to know that it was turning at about 20 RPM. It was cold morning in Beechworth that caused me to realise that things needed to change so upon return home I had the starter changed over. Nothing changed. I was speaking to the mechanic who happened to mention, "Oh by the way that new starter had the wrong pinion on it so I swapped them over". I started to consider that comment.

I read that the old bomb starter for the early TR's has a shrunk on 91 tooth ring gear with a 9 tooth pinion. The long nose starter for the later TR's has a bolt on 90 tooth ring gear with a 10 tooth pinion. So I dived under the car, pulled the starter forward and counted carefully three times and kept on coming up with 11. Out with the starter, swapped the pinion over and for the first time in fourteen years it burst into life!

For those who are interested in such things the starter should be stamped M418G 25550A (pinion no 291806). My starter was stamped M418G 25533D (pinion number 255194). The first set of numbers applies to a vast number of vehicles. All the long nose starters have it. M=motor, 418=4 1/8" diameter case, G= diecast commutator end bracket or frame.

25533D applies to Rover 75/90, Land Rovers ,Morris Commercials and Daimlers from the mid 50's to the early 60's.

25550A applies to Morgan +4, Vanguards and TR3a in the late 50's to early sixties.

What was the difference between the two? Actually the only difference was in the pinion and sleeve. One part number.

Of course there is an extensive list of applications for starter numbers. They vary in not only things like number of teeth on the pinion but also in direction of rotation which really causes starting problems.

Terry Hicks

12 / 2015

Cooling

COOLING THE SIDESCREEN TR
A series of articles by Brian Richards

Without doubt I would say that the most common concern TR owners have regarding the performance of their cars is that of engine cooling, or rather the lack of it. This has led to this outpouring but it should be emphasised that it is composed with the operating conditions found in Australia in mind. Cold climates cause other problems that we fortunately do not experience.
The TR's engine cooling system is quite a basic one without the intricacies of the modern systems.

Before we look at the system itself, we should get some understanding why we need it at all. After all, if we could retain all the heat energy released during combustion the engine would be much more efficient than it is. The problem is that the materials available to be used in the construction of the engine would not stand the heat. Materials are available and engines have been built that do not use any coolant at all.... I know..... We have all had one of them at some stage but these were designed to run without coolant. The cost of these is prohibitive and life expectancy low but more importantly they are diesel.

When combustion takes place, the heat generated is quite high. High enough to destroy pistons valves etc. very quickly. The temperature of all these components must be controlled. Internal components such as pistons, rings, etc. are cooled primarily by the engine oil and contact with the components that are fluid cooled (block and head). The temperature of the fuel air mixture in the combustion chamber is also a very important factor in the engines operation. It must be kept at a temperature that will not allow it to self-ignite before the spark is introduced or explode once the spark is introduced. If this happens we get the 'pinging' sound we hear (pre-ignition and detonation).

The mixture is heated by a combination of,

- Heat generated by the compression of the mixture.
- Heat soak from the cylinder head, pistons, cylinder, etc.
- Heat generated by the combustion itself.

It can be seen then, that the engines coolant temperature not only effects the physical components of the engine but also the combustion process and hence performance. Whilst the prime source of heat is the combustion process, heat is also generated by the friction of the moving parts in the engine. The oil primarily carries this heat caused by friction away.

So we have the heat generated by both combustion and friction to control. Of the heat generated by combustion approximately 1/3 is lost out the exhaust, 1/3 lost through the cooling system, and 1/3 is converted to power (HP). Of this last 1/3 some is then lost to friction in the form of heat. It is important to note that if you increase the HP output of the engine you also increase the load on the cooling system and exhaust by the same amount. This increase will of course only be felt when you use the additional power. Our concern here is with the 1/3 lost to the coolant system. This system not only consists of the one, as we commonly know it, (radiator pump, etc.) but also the surfaces of the engine exposed to the air stream (block, sump, cylinder head, rocker cover, etc.) and an oil cooler if fitted.

Let's look at what we term the cooling system. On the TR this is as stated previously, a fairly basic one. It consist of,

- Radiator the means by which the heat is transferred from the coolant to the air stream.
- Radiator Cap Maintains the required pressure in the coolant system.
- Coolant. The medium used to transfer heat from various parts of the engine to the radiator.
- Water pump. The devise used to circulate the coolant around the system.
- Thermostat. Controls the temperature at which the coolant is directed to the radiator.
- Drive belt. Transfers power from the crankshaft to the water pump and generator.

- Temperature gauge. Provides the operator with limited information on how the cooling system is functioning.
- Hoses & pipes. Directs the coolant from the engine to the radiator and back again.
- Internal passages. Directs coolant flow around the various hot parts of the engine.
- Cooling air passages. Directs the airflow through the radiator and then away from the engine bay.
- Fan. Provides airflow through the radiator when the vehicle is stationary or at low speed.

First the system must be full i.e. No air, only coolant (note coolant not water). More sophisticated systems use a fully de-aerating set up that continually bleeds any air trapped in the system and increases the coolant pressure in the head and block. The TR's system does not so it is important to ensure that it is correctly filled and the level maintained.

When the engine temperature is below the thermostats operating temperature the water pump causes the coolant to circulate through the engine and out to the thermostat housing. As the thermostat has not yet opened the coolant is directed down the bypass hose back to the water pump inlet. No coolant passes to the radiator.

As the coolant outlet temp increases it passes by both the temp gauge sensor and the thermostat sensor (a wax bulb). Once the coolant temp at the thermostat reaches its operation range, the wax expands and opens the thermostat against the tension of a spring. Coolant is then allowed to flow into the radiator top tank, down the various tubes into the bottom tank where it is collected then directed back to the water pump through the lower radiator hoses and pipe.

If the coolant temp continues to increase, the thermostat opens further allowing even more coolant to flow through the radiator. As the coolant outlet temp from the engine drops, the thermostat will start to close and restrict coolant flow to the radiator. In this way the thermostat attempts to control the engines coolant temperature.

All sounds easy so why all the problems. The reasons are many and varied. First let's assume that it is a standard system and look at the various components.

Radiator.

The radiator works as follows, the coolant enters the top tank and is distributed across the top of the core and then travels down the individual tubes to the bottom tank. Here it is collected and directed to the lower radiator outlet. As the coolant passes through the tubes, heat is transferred to them and then to the airflow. The amount of heat transferred is directly proportional to dT (where 'd'=Delta) or the difference between the hot surface and the cooler surface. So as the ambient temp rises, dT would decrease and the heat transfer would also decrease. Also if the coolant temp increased, dT would increase and heat transfer would increase.

When the TR was designed, the most common coolant in use in Australia was straight water. This allowed corrosion to occur in the system and together with dirt from various sources (dirty water, casting sand, Dutzt from the air drawn in when the engine cools, etc.) would form a slurry in the various passages in the block and head. A thin coating of rust would form on all the wet surfaces and acts as an insulator. If the engine experienced an overheat (boiled) it would agitate this slurry and circulate it through the system.

The usual end result is that it would tend to be filtered out by the radiator and either block or restrict some of the tubes. This is the reason that once an overheat is experienced in an older engine, it would continue to experience them, even if the original cause was fixed, until the radiator was cleaned.

Putting a flushing compound through an older engine can also have the same effect, even if it is correctly flushed.

The only way to effectively clean a radiator is to remove it and have the bottom tank removed and the individual tubes cleaned.

Standard cores also have a hole for the crank handle. This effectively reduces the core by up to 20% (depending on how the hole is incorporated).

As a matter of interest, the coolant temperature drop across the radiator is only about 10 ° F(7 ° C).

Coolant.

The original coolant was water but today we use a coolant consisting of ethylene glycol (EG), corrosion inhibitors, and water. The ratio of the ethylene glycol to water recommended for the TR is 1/3 to 2/3 water.

The need for corrosion inhibitors is self-evident, ever removed your thermostat housing or what was left of it, but why the ethylene glycol. The EG acts as an anti-freeze, an anti-boil, and as a wetting agent. Its anti-boil characteristics are of most importance in Australia with the wetting characteristics a close second.

If we looked at the individual areas around the coolant system, especially around the cylinder head, you will find areas whose temp is well above that felt at the thermostat (and temp gauge). The temp at the thermostat is only the average of the outlet temp. Some areas will rise above the boiling point of water. This localised boiling can cause cracking or distortion of engine components

To prevent the coolant from boiling, the system is kept under pressure, which raises the boiling point to about 225 ° F(107 ° C), but in today's environment this is not really enough. The addition of 33% anti boil raises the boiling point to about 235 ° F(112 ° C).

Another phenomenon is after boil, where heat stored in the various components soaks into the coolant when the engine is shut down. You sometimes can hear this if you only use water and/or your radiator cap is defective. This is normally experienced if the engine is shut down immediately after some hard driving and as such it is always a good idea to let the engine temperatures stabilise before turning off the cooling system by shutting down the engine.

Good engine coolant can reduce the instances of this.

Water Pump

This is a very simple and common type of pump known as a centrifugal pump. It utilises centrifugal force to move the coolant from the centre of the pump's impeller to its outer rim. This creates a low pressure at the water pump inlet compared with the outlet and causes the coolant to flow through the system.

Very little goes wrong with the pump unless there is some mechanical failure. The most common problem is a leaking seal. This is the seal that stops the coolant from leaking out around the water pump shaft. Seals simply wear out but leaks often occur because of foreign matter circulating the system or failure of the water pump bearings that allows the shaft to run out of alignment.

Water pump seal leaks do not always show when the engine is running. While running the spinning impeller creates a low pressure area at its centre (close to the shaft) and this can cause air to be drawn in and circulate the system. This can lead to air pockets and localised overheating that does not show on the gauge.

Another failure that can occur is the impeller spinning on the shaft.

The impellor spinning on the shaft is the only one that can cause an overheat problem and it will cause the problem under all conditions.

Water pump bearing failure is normally caused by an incorrectly tensioned drive belt. The 'Bush Mechanic' wrote an excellent article on the in issue No 8 (Jun/Jul 03) of Sidescreen.

The pump must be removed to repair any water pump failure but is generally the last place you would look for the cause of an overheat.

Thermostat

The thermostat is basically a temperature sensitive valve. It is fitted between the outlet on the cylinder head and the radiator. It has a wax bulb that expands as the temperature rises. This in turn forces the valve open against the tension of a spring. The original thermostat had a shroud or skirt around the operating valve. As the thermostat opens this shroud would move to cover the bypass line and so restrict the amount of coolant that would bypass the radiator. It can be seen then that the thermostat continually modulates the amount of coolant that would flow down both the radiator and bypass line. This two coolant flows would then mix at the water pump inlet.

The temperature at which the thermostat starts to open is around 158 ° F(70 ° C) and is fully open at around 195 ° F(90 ° C). The manual gives directions on how to check thermostats and is fairly straightforward. Never place a thermostat straight in boiling water. It can cause it to fail.

As previously explained the original thermostat is actually two valves in one, with the shroud closing off the bypass line as the thermostat opens. These thermostats are not readily available and modern units are normally fitted. They do fit OK but do not have the shroud and as such do not perform the important function of closing off the bypass line. This allows coolant to continually bypass the radiator, even when the engine is approaching overheat.

In our generally warm climate we can overcome this problem by inserting a restriction in the bypass line.

This restriction is simply a plug with a ¼" bleed hole drilled through. Never simply block off the return line. Coolant must be allowed to circulate the system with the thermostat close to prevent any localised hot spots. Also the heated coolant needs to circulate around the temp gauge and thermostat so they can perform their function.

Remember, when driving the temperature will fluctuate between about 168 ° F(75 ° C) and 195 ° F(90 ° C) (the thermostat is not fully open till 195 ° F).

Thermostats are relatively inexpensive and easy to change. If in doubt, change it. Modern thermostats are a lot more reliable than the early ones.

Drive Belt.

A lot has been written about this much abused component and I recommend that you read the very good article by the bush mechanic…or at least read the manual on how to adjust it.

It is often over tightened in a vain attempt to overcome an overheat problem yet is very rarely the cause and can cause the water pump and/or the generator bearings to fail.

Temperature Gauge

This is the only indication the operator has as to what is happening in the coolant system and it does not tell you much. All it indicates is the average temperature of the coolant exiting the engine. The unit fitted to the TR is fairly reliable but should you be chasing temperature problems then it is strongly recommended that the gauge be checked first. Ensure you have a problem before you go chasing it. This may not be easy if the unit has not been removed from the thermostat housing for some time. The quickest and easiest method is to use a contact temperature gauge on the thermostat housing and compare the results or use an infra-red one if you have access to it.

A little known fact is that the temperature gauge will not work if the sensor is not immersed in water. So we can have an engine with no coolant and cooking but the gauge may show a low temp.

Hoses and Pipe

These are used to transport the coolant to and from the radiator and act as a bypass line. They are very seldom the cause of a temperature problem and tend to either work or fail. It is a good practice to change the hoses every 4 or 5 years so as to avoid failure on the road. They do deteriorate over time.

Passages within the Engine

There is nothing you can do here except keep them clean. Some commercial engines actually incorporate a bypass coolant filter in the system. Use a good quality coolant that incorporates a corrosion inhibitive package and this will help keep it clean.

Radiator Cap

A very important part of the system, inexpensive yet often overlooked and abused. The cap incorporates two valves. The main valve is the system pressure valve and works by way of a spring-loaded rubber seal that sits on a seat which is part of the radiator filler neck. The original cap was rated at 4PSI and is classed as a long neck type. I.e. the top of the filler neck is about ¼" further from the seat than the more common short neck type. If you hold a long and short neck cap together you can easily see the difference. The long neck one is the longer of the two.

The second valve is a non-return valve. As the coolant temp increases it expands by up to 12% of its original volume. This excess coolant escapes past the pressure valve in the cap and out the overflow pipe. As the engine cools and the coolant shrinks the pressure in the system falls below the outside air pressure and air enters the system via the overflow pipe and through the non-return valve. This is why the system always appears low when you remove the cap.

Whilst the original cap was set at 4PST it is common and desirable to use a 7PSI cap these days. Caps do not give a lot of problems and can be easily checked at most workshops.

Unless the engine has been built to withstand the higher pressures it is not recommended that caps of a higher pressure be used.

Caps can be the cause of cooling system problems if they do not control the pressure in the system. Remember the reason why we put the system under pressure is to raise the boiling point of the coolant to prevent localised overheating, the ones that do not show on the gauge.

A common problem is that people do not understand how the cap works nor that it is a long neck type and fit a standard short neck unit because that is all that is commonly available. This results in the incorrect pressure being held on the system. In an emergency a short neck unit can be used but should be replaced as soon as practicable and do not run the engine under high loads or high ambient.

They are small, inexpensive and can easily be carried as a spare.

Fan

The fan is there to provide airflow through the radiator when the forward speed of the car cannot provide the flow required and is mounted direct to the crankshaft.

At about 30 MPH the air flow resulting from the forward motion surpasses that provided by the fan. If you only ever drove on the open road you could throw the fan away, as do most race cars.

Around town is where the fan is vital but the original fan is marginal at best and inadequate in today's operating environment. Even when new, TR's overheated.

You need everything working at its optimum and there is very little you can do to improve the situation. The fan is the weak link in the cooling system.

If you are experiencing a problem on the open road then the fan is not the problem but is most likely the one if the problem only occurs around town.

Cooling Air Ways

The radiator works by transferring heat from the coolant to the airflow through the core. The greater dT, the more efficient it is. As the air travels past the first row of tubes it starts to heat up and therefore the dT is lower when it reaches the second row of tubes and so on. The aim therefore is to provide adequate cool airflow through the core so that the dT remains high.

To provide airflow you need a pressure differential, i.e. a higher pressure in front of the radiator than behind it, the greater the difference the better. In the TR2 and TR3 the air inlet passage is well controlled by the airway formed by the front apron ensuring that all air that enters the grill passes through the radiator. The only hindrance is the tortured path the air must travel to exit the engine compartment, not much you can do here but it does tend to restrict the flow.

With the TR3A a cardboard baffle is used to direct the airflow inside the front apron. Unfortunately this component of the cooling system is often damaged or left out during repairs. This baffle must be installed to ensure the system will work satisfactory… not negotiable.

With the baffle removed the following occurs. Whilst the vehicle is stationary or at low speed the fan has to provides the required airflow. The air from the fan travels rearward and hits the engine, some of this air will recirculate back through the fan thus reducing the possible flow through the radiator but this is normal. Without the baffle some air will also recirculate around the sides of the radiator and back through it. This recirculated and preheated air reduces D T and the radiator efficiency.

At speed, all of the air entering the grill is directed through the radiator. The flow will depend on the restriction and pressure in front of the radiator as well as the pressure behind it. The engine and all the other bits and pieces in the engine bay that are either original or retro-fitted, restricts the airflow exiting the engine bay. This acts to increase the pressure behind the radiator above what it would be if there was no engine at all.

No problem because the system was designed for that effect. If we remove the baffle then things change. Now we have reduced the restriction in the front of the radiator by allowing most of the air entering the grill to pass around the radiator. The restriction behind the radiator has not changed so the pressure behind the radiator builds up as the increased volume of air attempts to exit the engine bay. The combine effect of this is to greatly reduce the actual flow through the radiator.

It can be seen therefore that removal of the baffle can effect both low and high-speed engine cooling

If you are going to regularly drive your TR today then there are some improvements that you can make. What was acceptable in the1950's becomes very suspect in the 2000's. The ambient temperatures in the cities are higher today and not just because of global warming but because of the greater expanses of concrete, bitumen, and tall buildings.

The average speed in traffic is lower and we spend more time stationary at the traffic lights. On the open road, we are able to maintain higher average speeds for much longer. Today when I drive out of town, I jump on the freeway and sit on 75MPH for some hour's straight and in ambient up to105 ° F (40 ° C). As a result much more stress is placed on all vehicle components today.

Radiator Apart from keeping it clean and not fitting a crank handle hole when re-coring, there is not much you can do here. Modern radiators and/or larger radiators can be fitted but unless you are competing with your car, it is not really necessary and as such not covered here.

Coolant As discussed before, a good quality coolant should be used with a 33% mix of anti-freeze/anti-boil and a good corrosion inhibitor package. Remember to change the coolant as per the manufacturer's recommendations, that is assuming you can keep it in the engine for that long.

Water Pump Again not much you can do here. I know of one TR3 owner that is fitting one of the new electric water pump kits. This seems to be the ideal but beyond what is normally required or would be undertaken by most TR owners.

Thermostat The problems with the commonly available thermostats has been covered so apart from looking at fitting a restriction in the bypass line, not much can be done here. Do not be tempted to run without it. It is important that the engine is able to reach its optimum temperature.

Temp Gauge The unit fitted is fine.

Hoses & Pipe Units fitted are fine.

Engine Passages Just make sure the system is kept clean.

Radiator Cap The function of the cap is to maintain the desired pressure in the cooling system. In doing so it dumps excess coolant. Modern systems catch this excess and return it to the radiator when the engine cools down. Fitment of a similar system to your TR is a relatively simple and worthwhile project. There are two methods, both being used to day and each with their advantages and disadvantages.

Remote Top Tank. In this system we fit a remote coolant reservoir and connect it to the radiator. This Reservoir runs under the same pressure as the cooling system. A suitable Reservoir (e.g. Mini Minor) is mounted (normally on the RH inner guard) level with the top tank. The overflow pipe on the radiator filler neck is then connected to the inlet pipe on the remote tank. A blanking cap is fitted to the radiator in lieu of the standard cap and a conventional radiator cap fitted to the remote tank. Remember that the whole system will be under pressure so be sure to use suitable hose and clamps.

What we have done is simply add coolant volume and move the radiator cap from the radiator to the remote reservoir. In operation the radiator is filled and the remote reservoir is only partially filled. This provides space for the excess coolant to be stored so that it can return to the radiator when the engine cools.

Advantages:

- The radiator is always full.
- No coolant loss.
- A modern short neck cap can be used.

Disadvantages:

- All components are under pressure and as such ads potential problems.
- Engine must still be cool to check fluid level (no change)

Coolant Recovery Tank. With this system we still add a remote tank but it is not under pressure. A suitable reservoir (e.g. Mid 80's Mazda323) is fitted under the bonnet (e.g. RH side front apron cross brace). The overflow from the radiator is connected to the inlet of the remote reservoir.

The standard radiator cap is replaced with one suitable for a recovery system. These caps are the same as the standard ones except they have a seal at the top to prevent any fluid loss around the cap and directs all excess coolant out the overflow pipe.

The recovery tanks are normally translucent and marked with Min/Max levels. As the coolant heats and expands, the excess coolant dumped by the radiator cap is captured by the Reservoir. The cooling engine then draws this fluid back in from the Reservoir.

Advantages:

- The radiator is always full.
- Fluid level is easily checked. No cap to remove.
- As it is not pressurised, any failure of the add-on system will not disable the car.

Disadvantages:

- Difficulty in obtaining a suitable long neck radiator cap.

Another worthwhile mod is to have the original radiator filler neck changed for modern short neck filler if the radiator is ever removed. This allows the readily available caps to be used. This is relatively inexpensive, and overcomes the only real disadvantage of the coolant recovery system.

Cooling airway The TR2/3 is OK as is the TR3A providing the baffle is fitted correctly.

Fan As this is the weak link in the system, it has the greatest potential for improvement. There are two approaches, upgrade the fan itself or remove it and fit an electric one.

Upgrade. The original 4 blade fan can be changed for a more efficient one but if this is contemplated then it must be remembered that it is a crank mounted unit. I.e. bolted direct to the crank, albeit through an adaptor. The problem with crank mounted fans, and one you may have experienced, is one of blade failure. Torsional vibrations are transmitted from the crank to the fan and lead to cracking and failure.

To reduce this in the TR, the fan is isolated from the crank with rubber bushes. This also tends to allow the fan to act as a basic harmonic balancer. Any fan replacement must also incorporate some form of torsional isolation. A suitable fan is one from the early Triumph 2000 sedan. It is a 6 blade steel and aluminium unit that mounts the same as the TR and is directly interchangeable. This fan works well but there are others. Just remember those torsionals.

Electric. Here again we have two approaches. Fit the fan in front or behind the radiator?

Front. This is the simplest method and allows a wide variety of fans to be used. A suitable fan is mounted in front of the radiator and connected to the cars electrical system.

Advantages:

- Easy to fit.
- Large selection of fans.
- Original fan can be left in place.

Disadvantages

- Restricts airflow to the radiator at speed.
- Visual pollution on a TR2

A fully shrouded fan is the most efficient but offers even more restriction at speed.

Rear. This involves fitting a fan at the rear of the radiator. Mounting is more difficult due to the restricted space available and this restricts the number of fans that can be used. A fully shrouded unit is best as it prevents any air recirculation.

Advantages

- Very little restriction to air flow at speed
- Fully shrouded fans can be used.
- Out of sight on a TR2

Disadvantages

- Original fan must be removed.
- Fewer fans available.
- Harder to fit.

Overall, although it's a little harder, the rear-mounted option is best. Both work well in town but the rear is much better at speed.

Electric Fan Controllers.

A switch could simply activate the fan but it is desirable to automatically control the fan so that it does not run unless required. Again there are options. The common type of controller is one where a probe is inserted in the coolant flow via the top radiator hose. This is connected to an adjustable temperature switch by a capillary tube. This in turn activates a relay to supply power to the fan. This is a clumsy looking system and easily damaged.

An alternative system is a fully electronic unit that utilises a small contact probe that simply pushes into the radiator fins below the inlet hose. This is connected to a small electronic module that incorporates both the temperature-controlled switch and the relay.

Regardless of the system used, the cut in temp should be about 8 ° F (5 ° C) above the thermostat opening temperature.

Oil Coolers.

Not a mandatory item but one that provides distinct advantages to people who do what TR's do best, cruise at speed on the open road. The engine oil plays a crucial role in cooling various components within the engine. Normally the oil is cooled by airflow over the block, sump, head, rocker cover, etc. as well as contact with the fluid cooled surfaces. The engine oil will run hotter than the coolant.

Back when the TR was king (still is) this was adequate unless you were undertaking competition. Today, we can all jump in our car and cruise at speed for some time without slowing. The standard TR was not designed for that. We can upgrade the coolant system but what of the oil. To perform all its functions as designed, the oil should run within a specified temperature range. Operation of the engine gets the oil up to temperature but we need some means of controlling the upper limit. This is where an oil cooler can help.

There are a number of adaptors available to direct the oil, after the filter, to an oil cooler before entering the main oil gallery. A good one is available that forms part of an adaptor that converts the lube filter to a spin on type and incorporates an oil thermostat. This thermostat is set at 176 ° F(80 ° C).

If utilising an oil cooler then it is strongly recommended that a thermostat be incorporated in the system. This controls the temperature of the oil much the same as the cooling system thermostat. It is important that, like the coolant, the oil is allowed to reach its optimum temperature.

I hope these three articles have been of some interest and benefit and if you have any questions or can add to this then I would be most happy to hear from you.

Addendum

Since this article was written, there have been some new products come available or known to the writer. Two are listed below.

Water Pump.

There is now available an uprated water pump. I have no experience or knowledge of its benefits.

A recent release from Moss Europe (Triumph World Apr/May 2005) quotes "The uprated water pump for example, comes with a 6 bladed impeller that should virtually double the flow of coolant through the system."

A word of caution about high flow water pumps. A doubling of the pumps potential flow will not give a doubling of engine cooling. There may be a gain but as in most systems, all components are interrelated. Increasing the flow through the radiator means that the coolant spends less time in the radiator and hence less heat will be transferred to each litre. Also the increase in flow will cause a greater pressure drop across the thermostat, radiator, and coolant passages giving a drop in the potential flow. There will be an overall increase in heat transfer due to a higher flow but how much is dependent the systems capacity to utilise this potential flow.

It is important to remember that the original TR impellor did not change through to and including the TR6. It is also the same as the Triumph 2000 and 2500. These engines all have a higher output than the TR2, 3,3A.

It is not being suggested that an uprated water pump is not worthwhile, just temper your expectations if that is the only change you make.

Radiator.

There is available, what is called a CT Core. This core is new technology and visually different to the standard core. It is also probably the biggest single improvement available for the TR cooling system.

Each cooling fin in the standard core is one piece and runs horizontally across the cooling tubes, locking them together. In the CT core, they run in a zig zag pattern vertically between the tubes. Radiator repairers have advised me that this change means that the cores life will be shortened, from 30 to 35 years to 20 to 25 years. Not a problem as I see it.

The big plus is the claimed 25% increase in efficiency. Unlike the uprated water pump, the gain is available regardless of the rest of the system. Any coolant pumped through the radiator will be subject to this gain. If the only mod made to the system (both air and coolant) is the addition of a CT core, then the net gain will be that of the radiator. A claimed 25% over the current heat transfer.

A CT core would allow the maximum benefit to be gained from an uprated water pump.

The CT core gets a big recommendation and should be seriously considered when having your TR radiator repaired or re-cored. The down side is that it is about 20% more expensive than the standard core. No gain without pain.

Well, I'm in another quandary (other projects will have to wait – heater replacement, valve noise, distributor springs, Seems the old thing is overheating. Read on:
While I was putting in one of those new Moss Motors skirted thermostats, I took the opportunity to "calibrate" the temp gauge. The needle half way is 70C (158F), three-quarters is 90C (194F) and just below the red zone is 98C (208F). The last point was with the pan of water boiling. The Moss Motors sleeved thermostat started opening at 75C (167F),
Both Haynes and Ball say the temp should not exceed 85C (185F)
OK, today with an ambient temp of 80F, we went on a 10 mile trip "round the block" - country roads, zero traffic and I'm getting 90C. Yesterday, coming home from work, again an ambient of 80F, with moderate traffic, stopping at traffic lights and such, it actually went into the red zone until I could get to the open road. Needless to say I was very worried about doing some horrendous damage.
The question is: is this sort of normal for a TR3? , no matter how much coolant I put in, whenever I check the level after a run, it has always dropped to 1/4" from the bottom of the "long neck". Let me tell you what I've done so far:
Replaced and properly tensioned the fan belt (Remember that!)
New coolant.
New radiator cap.
New Castrol 20-50W.
New sleeved Moss thermostat.
Checked ignition timing.
Plugs - they look wonderful, with a nice tan brown colour.
Installed two 12 oz. overflow reservoirs for radiator (
The PO says the radiator was checked out.
There's zero sign of oil in the water and vice versa.
The cardboard deflector for the radiator is in place and looks in good shape.
Rad hoses feel good.

According to the booklet I should be looking at getting an oil cooler. I'm assuming the front apron has to come off for that installation. That seems major - anything easy I've missed?

Try enriching the mixture to the engine. It may run less than optimally, but it'll run cooler.

One common problem worth checking is the radiator cap. Yep, the one you just replaced. On the 3's and early 4's, the radiator cap is longer than the typical cap (1" deep vs 3/4" deep). If you get a new cap at Auto Zone, they'll sell you the short one. With the short one, even though the cap feels like it's going on right, it's not seated on the inside flange. The result is the same as running without any cap at all.

I was thinking about getting one of those thermostats too. They are 165 degree, if I remember correctly.

The benefit to the skirt is that it restricts the bypass as the main valve opens. It ought to result in lower engine temps than your previous one.

So, either there is less flow through the radiator, or the engine is putting out more heat, or the radiator is radiating less. Or the sender is sending the wrong signals. They are the only options.
An oil cooler is not the answer

TH=here must be something else going on to cause inadequate cooling. Maybe the radiator needs a good cleaning internally (maybe professionally).

How did you calibrate the temp gauge? Dip the sender in hot water while still hooked to the car? A grounding wire attached to the sender itself?

I will probably get flamed for this statement, but after owning 3 TRs, my experience has been that all British cars overhear at some time. I had the same scary experience that you did; where my TR3 overheated so badly once or twice that I was afraid of permanent engine damage. (There wasn't any as far as I could tell!)

There have been many cooling tricks discussed in the past. Some people put in a 4-bladed fan (from a TR4?) instead of the 3-blade TR3 fan. Some people use "water wetter", sold by the big 3. My solution was to add an electric fan and adjustable thermostat. Who cares about authenticity -- my car is a great driver but will never be concourse quality! The fan is mounted to the front of the radiator as a pusher, and the original fan was left in place. The thermostat was adjusted so that the electric fan never comes on unless the water temperature exceeds the centre position, 185 degrees F. It only turns on in hot weather, or in heavy traffic.

this totally solved the problem. It's as if the meter needle is painted on -- it goes to 185 and just stays there.

Now, the thermostat and the bypass. For some reason this seems to be a highly emotive issue, and has been the subject of much discussion in our TR magazine. I found the article from the engineer I mentioned last night, which seems to me to paint a rational picture. It's a bit long, but I think it's worthwhile. He says:

"Last newsletter carried an article that recommended the blocking of the radiator bypass system when a skirted thermostat is not available and a non-skirted type has been fitted.

I most definitely do NOT recommend that this action be taken, for the following reasons.

While the radiator bypass serves no useful function when the engine is at normal operating temperature and the thermostat is open; it serves a vital role when the thermostat is closed.

When a cold engine is started the thermostat is closed and coolant is prevented from circulating through the radiator. However, under the influence of the water pump coolant does circulate through the block and the head via the bypass hose, ensuring an EVEN distribution of the generated heat throughout the engine.

As the coolant must pass the thermostat on its way to the bypass outlet the thermostat heats up at the same speed as the coolant so when the temperature reaches the specified temperature for the thermostat, the thermostat begins to open, admitting a small amount of cold coolant from the radiator at first, which has the initial effect of lowering the temperature of the coolant in the engine and slowing the rate at which the thermostat opens; this is important to prevent a sudden surge of cold coolant into a hot block and head.

When the coolant temperature in the whole system has stabilised the thermostat will continue to vary as necessary to maintain the correct operating temperature for the engine.

If the thermostat is closed and the bypass blocked, coolant cannot circulate and coolant heating is localised to areas adjacent to the top of the cylinder bores; coolant does not pass by the thermostat and heat only reaches it by conduction.

In this situation several things can happen and none of them are good for the engine.

Since heat cannot be quickly conducted away from the cylinders, hot spots develop. These can be hot enough to cause local boiling of the coolant. The steam generated forces coolant back through the water pump to the bottom radiator tank and then up and out through the radiator cap and overflow pipe.

The steam forces the water out of the head and then reaches the still closed thermostat which opens immediately, allowing the steam to pass into the cold coolant of the upper hose where it condenses immediately.

The heated coolant which was forced into the lower radiator tank returns to the block and head and passes straight through the now wide open thermostat to the top radiator tank. The very hot coolant is immediately followed by the remaining cold coolant from the radiator with consequent rapid cooling of the head and block - an excellent recipe for cracking both of these.

Another scenario is that the coolant does not boil, but coolant that is hot enough eventually reaches the thermostat and it begins to open. Coolant begins to flow under the influence of the water pump and, because the rest of the coolant in the head is much hotter than that which first reached the thermostat, the unevenly heated block and head are quickly cooled by the cold water from the radiator, with a similar recipe for disaster as before.

If you are one of the growing number of TR owners unable to find an original type thermostat, I can recommend the following procedure.

Use an off-the-shelf unskirted thermostat with a heat rating as near as possible to the recommended rating of 70 degrees C. Do not use a thermostat with a rating over 80 C.

It is permissible to reduce the bypass access to a minimum of about 3/8 of an inch. The important thing is to maintain at least some flow during warmup. It should be pointed out that the skirt on the original type thermostat did not seal off the bypass, but rather just directed coolant flow more towards the top hose outlet. "

NARROW FAN BELT CONVERSION

an Aussie Method

This is a co-operative attempt by two TR Register members (John Buck & Rick Fletcher) to solve the problem of converting the existing wide B section belt on the TR to a modern narrow 11mm belt. We know that you can buy this gear off the shelf but it is very expensive and we wanted to see if we could do it on the cheap. Like all such conversions, it takes away from the originality to some extent so is not recommended for the purist. However if you do want to use a readily obtainable narrow belt and change a few other things, then this may interest you.

*By the way - this article is written in good faith but neither of us are motor engineers so be careful - we are simply revealing what **we** have done. [I have had the conversion on my car for over 5 years and done over 50 thousand kilometres including some at racing speeds and all the modifications behaved perfectly - Rick Fletcher 2004]*

Things that you need to GET, SCROUNGE or have MACHINED are highlighted in **BOLD**

THERMO FAN

The first thing that is a big change is the existing crankshaft mounted fan. We don't use it. In fact my car ("Bluey") has been running since 1970, over 30 years, without the fan and without a harmonic balancer (the motor is balanced). Use a thermo fan mounted behind the radiator. Bluey used to have a Kenelow fan which had several "losses of smoke" and two re-winds. I eventually accepted the advice preferred by many and purchased a cheap **thermo fan** off a wrecked *Japanese* car and fitted that.

The one I used has 4 short stubby blades and 2 flanges or brackets extending one from each side of the motor body. **2 U-bolt clamps**, each holding a **vertical strip of metal** were attached to the tubular spacer between the suspension towers. This made suitable mountings for the fan.

CRANKSHAFT

The crankshaft requires a narrow pulley. John is now an Australasian expert on every available form of harmonic balancer which may remotely come near to fitting a TR! Many of you have also helped by contributing suggestions and telling us what you have used. We chose to use a common variety Holden (GM) harmonic balancer which is CHEAP (particularly if you can get an old one to trade-in) and can be obtained from Auto One type shops. The one to use fits the Red, Blue or Black motors and is an **HB17A Harmonic Balancer**

Of course nothing is simple - a previous Prime Minister had something to say about that. The front of the crankshaft on the TR is 28.6mm in diameter. The Holden H/B is 28.5mm in diam and was meant to be pressed on. We don't want to do that so you will need to remove the offending 0.1mm (4 thou) from inside the balancer. Get a machine shop to **polish it out** for you.

The key way is a perfect fit for the TR so some things work out OK. The **correct seal** to use is an imperial size which is available at bearing suppliers. It is:

2.5" x 1.75" x 0.375"

(mine came from Metropolitan InDutztrial Supplies - Penrith 02 4731 2005)

Before you take the original pulley off, set the motor to Top Dead Centre (pistons at top of stroke - distributor rotor pointing to #1 plug - both valves closed on #1). The keyway on the crankshaft should be facing down. Remove the pulley and then the timing cover and Woodruff key. The original seal needs to be removed but not replaced with the one listed above just yet.

A **spacer** is needed behind the Holden balancer as its nose is too short. The spacer needs to be:

28.6mm Inside Diameter x 8mm thick x 45mm OD (OD is approx - not critical)

This would be a simple job for a machine shop. It is important that the two faces are exactly parallel.

There is a shouldered stud just above the crankshaft which supports the timing cover near the seal. Temporarily remove it. It will (just) foul the Holden H/B when fitted so grind a few millimetres off the top and thin-down a nut to suit. Refit the stud, slide the 8mm spacer on the crankshaft (it can stay there) refit the Woodruff key and try the balancer in place - it should just clear the stud. Set the timing cover (no seal) back in place and you will note that the triangular TDC marker collides with the harmonic balancer - bend it up and crank it back out so that it clears the balancer. Temporarily refit the original pulley and adjust the motor so that it is again at TDC. Carefully remove the old pulley and refit the balancer which can now be marked for TDC - I filed a tiny nick at the edge and filled it with white marking pen.

Remove the balancer and timing cover. Check that the cover is "true" particularly where it mates against the engine front plate. This would be a good time to check the timing chain and almost certainly to **replace the tensioner.** The seal can be carefully fitted with a smear of gasket cement around the mating surfaces (I use "Permatex Blue silicon gasket maker"). Coat the seal lips with oil so that they will not be damaged during assembly. Prepare all the bolts and studs for reassembly - watch a couple at the top which go straight into the block - use a small smear of Permatex Blue on the threads when you assemble them to prevent oil leaks.

I made a thick paper **gasket** (0.8mm) for the cover simply to get the seal running further along the nose of the balancer - if you do that then fit a couple of fibre washers to the shouldered stud. Use a thin smear of Permatex Blue to both sides of the gasket. It is important to initially LOOSE fit the timing cover to the engine plate relying on the dowels and machine screws to roughly locate it - don't forget to fit the thinned nut to the shouldered stud. The exact location is guided by very carefully sliding the balancer through the seal which then accurately "centres" the cover. Tighten the bolts progressively and not too much (14 -16 ft.lb)

The balancer is in place and now only needs to be bolted-up. I used a **crankshaft bolt** obtained from a Vanguard in a wrecking yard. You could try Noel at Sportscar Spares - Girraween - 02 9631 9279. He certainly has the **tab washers** which need to be fitted behind the bolt. I used an additional plain washer behind the head of the Vanguard bolt as it did not seat correctly against the tab washer. Bend 2 of the tabs against the faces of the bolt. Bottom end finished!

WATER PUMP
Note: see box below ** for another simpler alternative

The **pulley** we used was from a wrecker. It is from a Toyota Corolla 3K motor produced from 1968 into the '80s. The extreme Outside Diameter of the pulley is approx 125mm and the pulley is approx 70mm deep if sat on a flat surface and measured to the front face. The pulley runs on a 24mm diam hub and the 4 mounting holes (7mm) are equi-spaced on 40mm PCD. Should cost about $5 to $10.

This pulley requires a **hub** to be machined according to the dimensions shown in the accompanying drawings.[See **Drawing**] Use 4 x 1/4" UNF **high tensile machine screws** 3/8" long to attach the pulley to the hub.

If you are inordinately lucky, you will be able to remove the old pulley, clean the shaft and key and be able to replace the new hub and pulley with no fuss. The manual says to use a small 3 leg puller - ones I do usually require dynamite or nuclear energy to release them! Hopefully you won't have damaged the seal but if you do, at least from here on it is a piece of cake to remove the pump as it now possible to remove the pulley by the simple expedient of undoing 4 screws. Take the opportunity to replace the bolt holding the water pump to the block with a stud. Don't use overly thick nuts to hold the pump on as the new pulley runs very close to the nuts. A thin smear of Permatex Blue or Red (higher temp) is all that is required to seal the mating surface.

John Pike's report on his variation to the conversion

As mentioned in the last magazine, I was converting Thud's electrical system to be looked after by an alternator, as per the instructions devised by Rick Fletcher and John Buck. I can now report that the conversion is complete, and the fact that Thud conveyed the Pikes to and from the Concours without losing any of the smoke in the electrical department would indicate that the conversion was a success.

To recap, the afore-mentioned Messrs. Fletcher and Buck had spent a considerable amount of time and effort in designing a suitable alternator modification to the TR, including the use of a narrow fan belt to replace the more difficult to obtain (and change by the side of the road) standard belt. The story of their exploits appeared in the magazine of April 1999, and I was interested in finding out whether a less than mechanically gifted person could successfully undertake the conversion.

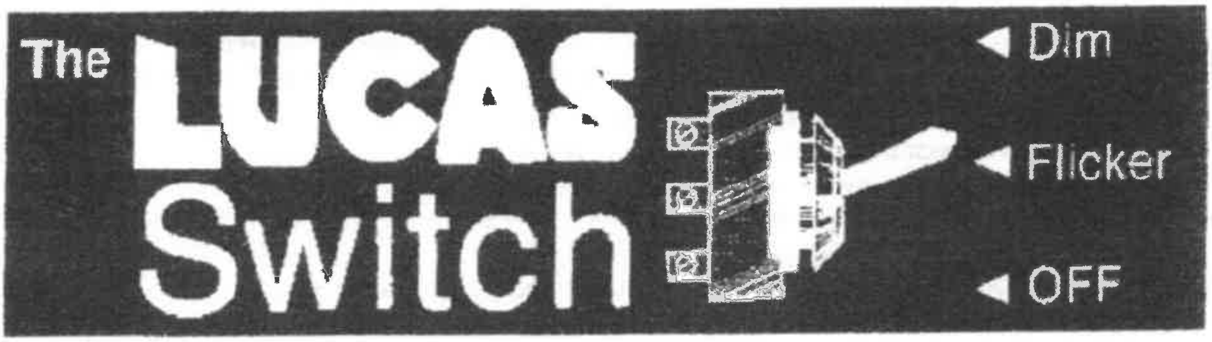
The job essentially consists of three separate elements - changing the harmonic balancer on the end of the crankshaft, replacing the water pump pulley, and consigning the generator to the Prince of Darkness spare parts bin.

My experience revealed that there were a couple of divergences from the instructions, which I'll cover here.

Step one was to change the harmonic balancer. As the apron and radiator were already off the car this was not a difficult process. Mind you, the thing that made it even easier was that Graham Brohan happened to be visiting, and was instantly pressed into service. We followed the instructions, with one exception, relating to a stud just above the crankshaft, which supports the timing cover near the seal. Rather than remove this stud and grind a few millimetres off it, we left it in place and massaged it with a cut-off disc attachment on a Dremel. I have to say that the Dremel is a fabulous bit of kit, enabling one to do some very precise work that would be almost impossible with more conventional type tools. It took no more than a minute or so to cut a 3mm slice off the stud, without disturbing its seal, and about the same time to cut a similar amount off the appropriate nut, after mounting it in a vice.

Next item on the agenda was the water pump, and here the Fletcher/Buck instructions were not required at all. Following advice from Bob Seaman, a Triumph 2500 pump and pulley were used. [*Rick Fletcher - the mounting holes are not a direct replacement as they are on a different PCD - Pitch Circle Diameter, but in the correct radial position. However the impeller diameter is correct and the pulley is designed to take a thin belt so the previously described machined pulley hub IS NOT REQUIRED. What is required is for the holes in the flange to be slotted towards the outside of the flange as per John's following description. There are cheaper alternatives to the Dremel but in each case the fibre-glass miniature cut-off wheels are the best to use, albeit more expensive.*] Slotting the attachment bolt holes was a piece of cake, courtesy of the Dremel again, and after applying a light smear of Permatex red the new pump snuggled easily and neatly into place. [*Note: be careful to ensure that the impellor is centred and not fouling the pump casting when relocating it as the slotted holes don't provide an exact alignment. It should rotate without touching the casting.*]

Finally, we came to the alternator itself. This was fitted without drama, but caution is required when tightening the attachment nuts. The instructions said to tighten the first nut so that the alternator is quite stiff to move. I found that doing this tended to distort the mounting bracket on the block, so my approach was to tighten the nut until the bracket was about to bend, then fit the second, locking, nut. The original instructions also indicated that the adjusting arm needs a bit of a tweak, and sits behind the top lug of the alternator. In discussing this with Rick, it turned out that his adjusting arm was somewhat second hand, whereas the "proper" arm is virtually an exact fit and falls into place in front of the top lug.


The LUCAS Switch
Dim
Flicker
OFF

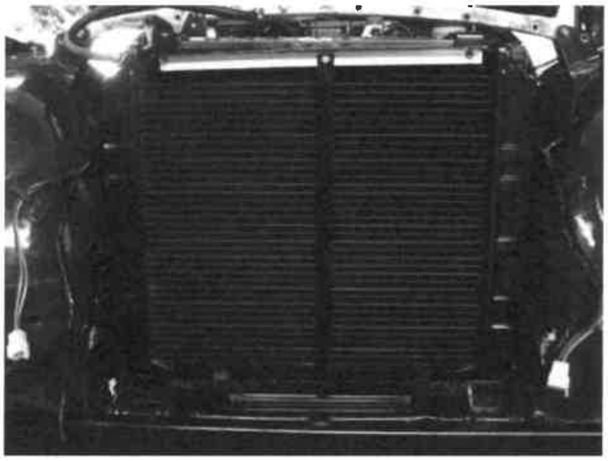
FITTING A VOLVO RADIATOR to a TR3A

By Brian Richards

This mod cannot be applied to a TR2/3 as you require the full width between the inner guards. Also it is not possible with the original steering box.

I decided to fit a new radiator after many problems with the original one with leaks and marginal performance on the track. It performed fine on the road but was stretched on a hot day on the track. Also I needed a new water pump as my $10.00 ex wreckers pump purchased three years ago, was leaking.

After much investigation I decided on a Volvo 240/244/740 cross flow unit. I was able to obtain a leaking unit from the wreckers free to use as a template.

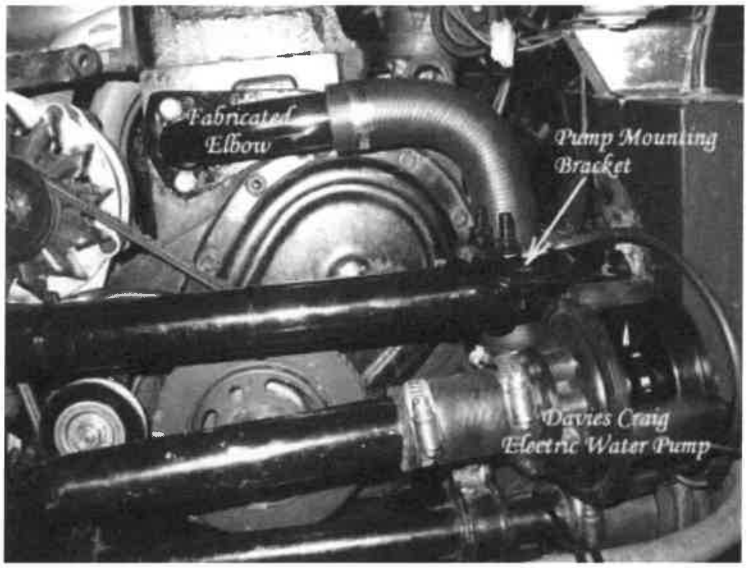


My car is fitted with rack and pinion steering so I could move the radiator forward. The Volvo radiator is almost the full width between the inner guards so it would foul the steering box if so fitted. When fitted, the bottom of the new radiator is level with the floor of the air inlet of the front apron. As such I was able to fit my oil cooler where the lower part of the old radiator would normally be. This is mounted to the rack and pinion mounting cross bars.

The water pump (Davies Craig Electric Water Pump) is attached under the cross brace on the LH side and connected to the radiator outlet utilising the original TR tube and bottom radiator hose. These are mounted horizontally.

I made up a simple frame for the bottom radiator support and utilised the Volvo lower rubber mounts. This frame was bolted to the original TR radiator mounting points. I fabricated a similar mount for the top and this is held in place by a central vertical brace from the lower frame and two rear braces similar to the original two used on the TR.

These pics give some more details about the location of the radiator compared to the original steering box mounts.

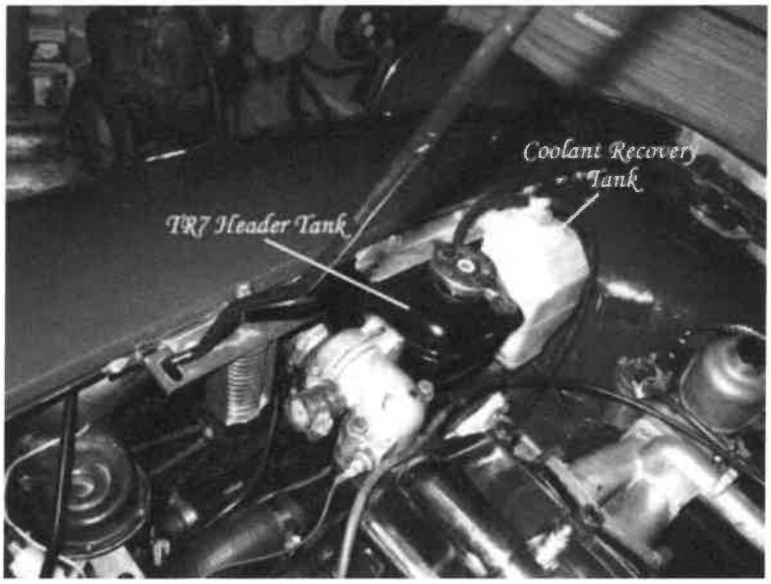


The block outlet is by way of a fabricated elbow (see picture) and half a top radiator hose from an 86 Laser. The other half is the same so I get a spare.

Thermostat was removed and an off the shelf hose (Magna I think) was used to connect the thermostat housing to the water pump.

As the radiator is a cross flow unit without an effective top tank, I fitted a TR7 remote tank to the front apron cross brace. Its outlet was connected to the fill line on the radiator and the vent line also connected.

I maintained my coolant recovery tank. There is no problem with filling the system and it only requires one small top up before it's full.

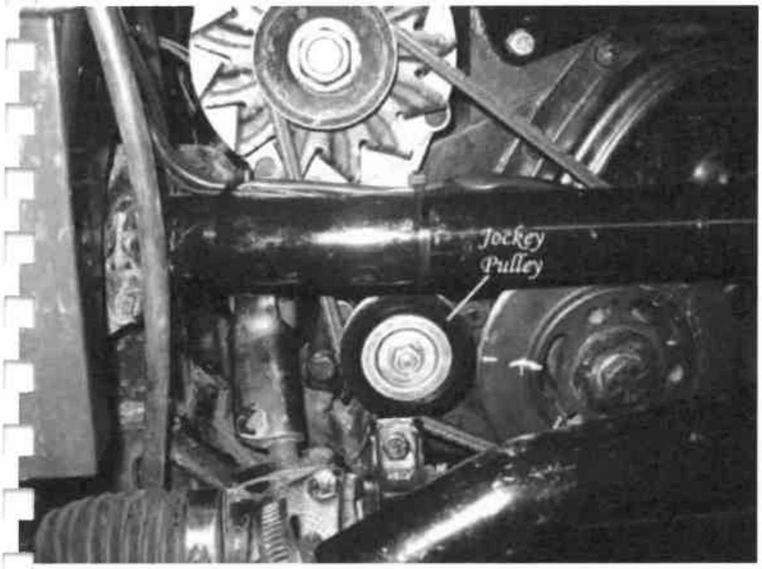


This photo still shows the original thermostat housing in place.

After I made all the required fittings I took my 'free' radiator to a repairer to see if it could be fixed. "No" - it was beyond repair. A new one was only $360.00. I could have got a brass one or an aluminium one. The repairer recommended the brass one which is what I ended up with.

I fitted a Davies Craig Electronic Controller to regulate the temp as the thermostat is removed. This works by controlling the voltage to the pump. Until the temp gets up to about 50C, there is not current to the pump. After that it starts to apply short pulses to get the coolant moving. As the temp increases a steady voltage is applied and so more coolant is circulated. If the temp drops the voltage is reduced. This can mean that you can actually be getting full coolant flow while the engine is idling or in traffic and conversely low flow at speed. The coolant flow is therefore regulated depending on engine requirements rather than engine speed.

The control unit is mounted in the cabin on the rear of the brake/clutch master cylinder housing.



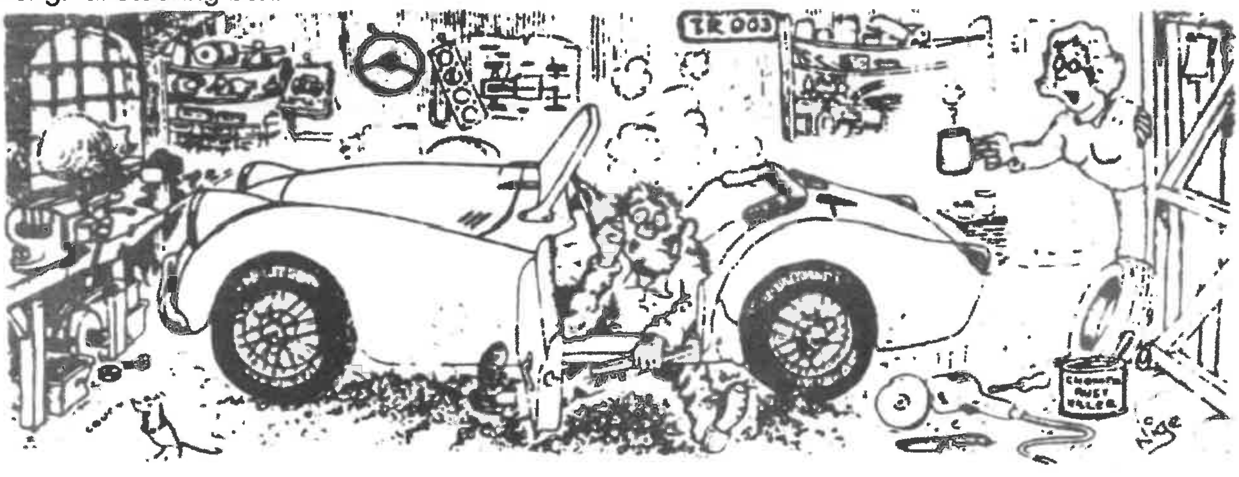
To allow for adjustment of the alternator belt (a thin one on mine) I mounted a small jockey pulley from an early Barina air con unit to the front engine plate slightly above and to the right (driver's side) of the crank pulley.

Performance is great with temps steady at 81°C in hot traffic, expressway, and on track it does rise to about 90°C but this should drop according to Davies Craig after I make a small mod to the controller to increase its sensitivity.

In total this cost me in the order of $765.00 plus my time. ($360.00 Rad, $190.00 water pump, $155.00 Controller, $30.00 hoses, $ 30.00 misc). If you discount the cost of a new water pump and the required radiator repair, it was not too bad.

To carry out this mod there were no changes made to the car (holes, brackets, etc) and the original parts can be refitted at any time.

This mod cannot be applied to a TR2/3 as you require the full width between the inner guards. Also it is not possible with the original steering box.



HAVE YOU FINISHED TREATING THAT BIT OF RUST IN THE FLOOR, DEAR.......?

FIXING A VOLVO RADIATOR SENSOR PLUG LEAK

By Rick Fletcher

If you carry out the Volvo Radiator modification using a second-hand radiator with *plastic side tanks*, there is a chance that the temperature sender unit may leak. This is located in the top of the driver's side plastic tank as shown below.

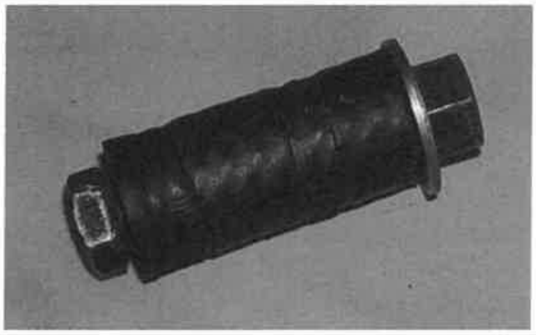
The sender unit, when not fitted, has a blanking plug to fill the hole. There is a rubber grommet which fits here to seal the blanking plug and it softens with age. The correct Volvo spare part for this no. 1378869 ("Rubber Bushing" - I paid only $2.75 for one of these from Manning Valley Motors at Taree).

Unfortunately, when it failed at Mungo Brush, I had no spare and needed to improvise. The repair below works fine for a temporary seal of the 3/4" hole.

The plastic blanking plug back in place.

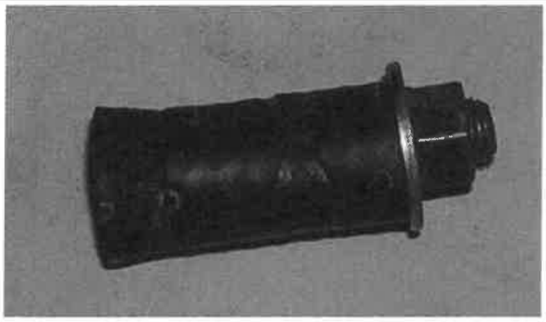
None of this is required if you use the brass tank radiator.

These bits came from my spare parts odds & ends that I carry. The hose is about 1/2" ID (might have been ex. brake booster?) and the bolt is 2" x 3/8".



This is it assembled. Push about 1/2" of the left hand end into the hole and tighten the nut on the engine compartment side. *(I did it back-to-front with the potential disaster of losing the nut inside the radiator when removing it)*

The head of the bolt pulls in to the tube ...



... gradually expanding it. You need to hold it such that the expanded bit fills the hole in the plastic tank.

There is no need to make it too tight, just so that it is firm. I used a LITTLE bit of silastic around the bolt head but I don't think it was necessary. The water pressure wedges the repair in tightly and it got me home from Taree to the Central Coast without losing a drop of water.

When you fit the correct rubber bushing, the plastic blanking plug is a "push" fit into it. Actually it is a *"b###" tight* fit. I ended up lubricating it with a tiny little bit of Teflon grease. There is NO taper or lip on the plug - yet it seals!

Too Cool, a TR

Too cool in winter and too hot in summer seems to be part of the birthright of a TR in Australia or any place outside the "Mother Country".

All the "other" cars we own run at a constant temperature (about 82°C) regardless of the conditions outside or what it is we demand of them, except the TR! This has bothered me from the start of our restoration, so there was special care taken to rebuild the radiator with a new late TR4 core and fit a thermo-fan with temperature controller and the T336 non original thermostat from the register.

The temperature gauge was restored by a reliable instrument technician so I thought we were onto a winner, until we ventured into slow traffic on a hot day or cruised across the Hay Plains in 35°C, when the temperature varied quite a bit as we went between cloud shadows?

This along with popular folk-law, convinced me that the TR does not have a large enough radiator so as we so often do, I went down the track of rectifying that problem by fitting a Volvo radiator and larger capacity thermo-fan.

Well the first trial came with a journey up the Washpool Ranges of the Gwydir Hwy on a 35°C day stuck behind a B-Double. The temperature kept climbing and climbing and we could not pull over or stop due to the narrow steep road and traffic behind us. This was not the result I was looking for or expecting from all the time, expense and effort of the radiator upgrade.

Since radiator capacity was not the answer, it was time for a rethink of how the system works.

Most if not all air conditioning systems which use water, have a constant output pump and then modulate the temperature in each location using balancing/ modulating control valves to compensate for area demand

The TR cooling system should work the same way so there must be a problem with the balance between flow and demand.

What are the needs of system?

- Car radiators usually only provide a 10°C drop in temperature, so the ambient temperature and the amount of air flowing through the radiator are going to be major considerations.

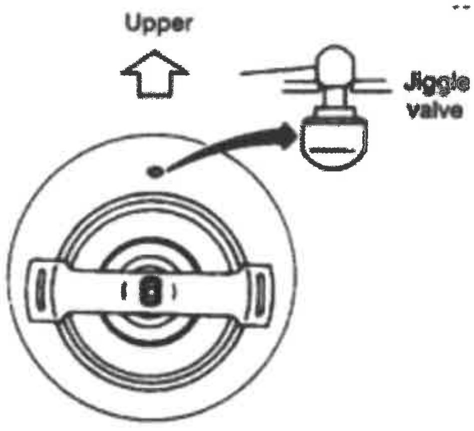
- The next variable is the demand or heat being generated by the engine, which can combined with high ambient temperatures and low airflow, be another major consideration.

- I concluded that the TR water pump produces a range of about 8 to 22GPM at 5 1/2 PSI, (1000-4000RPM) so the next step was to look at how all this came together to cope with the best and worst conditions.

- Radiator manufacturers recommend a maximum flow of 1.5 GPM in any one tube of the radiator which means that the TR radiator maxes out at 36 GPM from the flow point of view (no crank hole).

- The next thing to look at is the system resistance which is usually about 3PSI across the radiator and about 1 PSI for the pipes and hoses etc at maximum flow.

- Now it was time to look at the "Balancing valve"/ Thermostat. By definition a "**Thermostatic Radiator Valve** (TRV) is a self-regulating valve fitted to a system which controls the temperature by regulating the flow of hot water to a radiator."



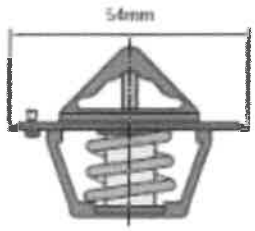
This unit also has an air-bleed jiggle pin already fitted, which reduces the amount of air that can be trapped in the system. Trapped air can cause corrosion of the housing and further reduces the capacity of the thermostat.

There are a number of available temperature ranges but after testing them all, I found that a 77°C unit was in balance with the pump at 82°C and only 25% open, which allows for more than enough increased flow when the demand increases.

TT2000 Series

High Flow version of TT1 series

Conventional type with jiggle pin



Temp.	Part No.	Temp.	Part No.
71°C	TT2000-160	77°C	TT2000-170
82°C	TT2000-180	88°C	TT2000-190
89°C	TT2000-192	91°C	TT2000-195

Temperature Conversion

Celcius °C		Fahrenheit °F	Celcius °C		Fahrenheit °F
60	-	140	84	-	182
71	-	160	85	-	185
74	-	165	86	-	187
75	-	167	88	-	190
77	-	170	89	-	192
79	-	174	91	-	195
80	-	176	92	-	198
82	-	180	95	-	203

TRIDON

Thermostat

- The thermostat is a temperature control valve assembly used in the vehicle cooling system. Located in a housing usually at the front of the vehicle engine; the thermostat allows circulation of coolant through the radiator once the predetermined engine temperature is achieved.
- There are various styles of thermostats available including conventional, by-pass, thermostat housing assemblies, High Flow and inserts used in conjunction with original housing.
- Thermostats bearing the High Flow logo are Tridon High Flow thermostats. Tridon's range of High Flow thermostats are designed to improve cooling system performance. The High Flow thermostat has a larger valve allowing up to 50% more coolant flow, eliminating the need to use a cooler temperature thermostat.
- Tridon High Flow Thermostats are designed to upgrade the vehicles standard thermostat.
- The thermostat must be compatible with the vehicle cooling system; the Tridon thermostat range has been carefully researched and engineered to suit each specific application.
- Please refer to the Tridon Part Finder for the correct thermostat for your application.

oom

TT2000-170	**Thermostat (High Flow)**	Thermostat (High Flow)	• Opening Temp: 77°C • Flange Dia: 54mm • Foot Dia: - • Height: - • Conventional style thermostat with jiggle pin. • High flow version of TT1 series.	

I tested my Register unit and found that it began opening at 72°C and was fully open at 81°C. The TR manual specifies an opening temp of 158°F (70°C) and fully open at 197°F (92°C) for the original shrouded unit.

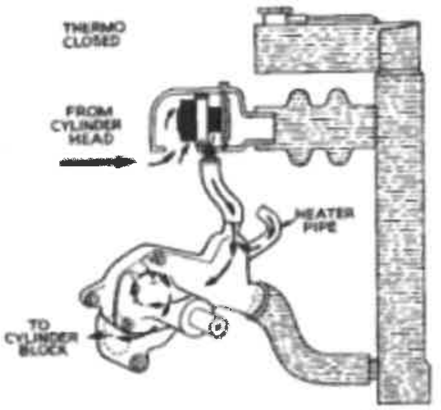


Fig 3 Circulation of Water before the Thermostat has opened.

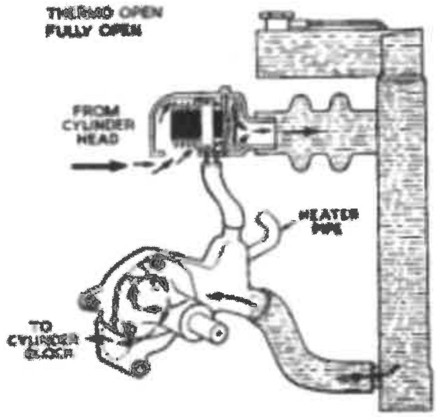


Fig. 4 Circulation when the Thermostat is open.

The Question is: Why is the opening temperature set so low and how does this concept perform in balancing the flow with demand?

Going one step further I looked at the capacity of the Thermostat and found that the flow area or flow coefficient of my unit was about 10 which means it was taking up to 65% of the available pump energy when it was fully open, which was all the time.

No wonder the car ran too cool most of the time and then too hot when the demand or the ambient temp went up.

What I needed was a thermostat which could flow up to the maximum pump output and be only partially open at normal running temperature. This would allow the thermostat to modulate and balance the flows to keep a constant temperature regardless of either the ambient temperature, the air flow rate through the radiator or the output of the engine.

This is in effect what happens when using a variable speed water pump controlled by a temperature controller.

The answer came in a TRIDON Model TT2000-170 high capacity Thermostat purchased from Supercheap® Autos for about $20.00. (These are available from most Automotive Parts Suppliers)

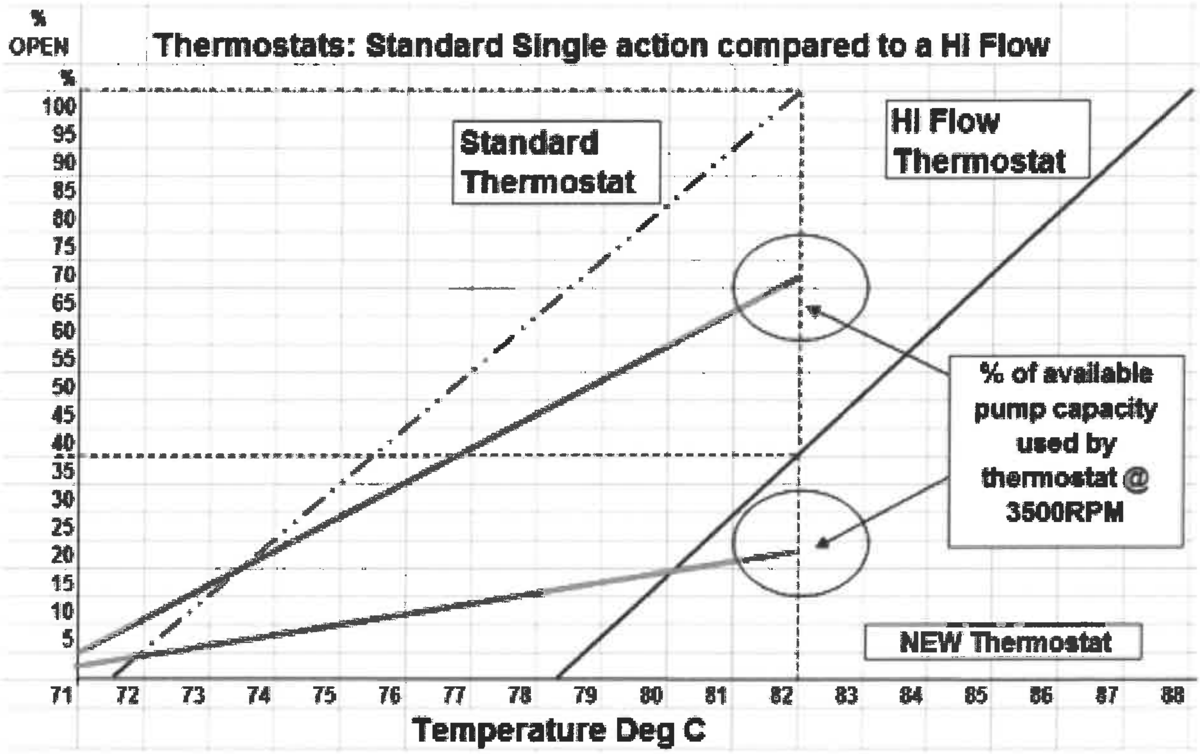
This unit has a fully open flow area 2.3 times the size and uses only a fraction of the available pump energy

According to my tests, this increased the capacity by more than 50%

Following is a diagrammatic representation of the 2 thermostats, showing approximately how much of the available pump energy each one absorbs.

I am of the opinion, that there is no need to upgrade the radiator without first confirming that all the available flow and cooling capacity has been used up for a standard TR engine

However, as the power output is increased by performance tuning, there will be additional demand put on the cooling capacity which might exceed the ability of the standard radiator in high ambient temperatures. There is also room for improvement in the water pump impeller design as the one we use will most likely be cavitating at high RPM and lack capacity at idle. High RPM pump performance is less of a problem as this will usually be associated with high airflows, however low speed output is much more of a concern.



The result of changing to this thermostat was dramatic. The gauge now sits firmly covering the "1" of 185°F even in 6°C early mornings and only moved to half cover the "8" after thrashing the car up the Bunya Mountain on a 29°C day (about 15minutes with hairpin bends and some 1[st] gear work). Extended idling in 35°C in Longreach gave about the same result.

I am now also of the opinion that the factory designed setup lacks the flexibility to achieve optimum performance in our climate.

The shrouded thermostats can not effectively modulate the flow as there is a conflict between shutting of the bypass and balancing the flow to the radiator, compounded by the very high head losses induced by this type of unit.

The T336 unshrouded thermostats even where correctly fitted are still too cold and too restrictive to be able to perform properly. These engines will only sometimes run at optimum temperature and probably run either too cold or too hot most of the time.

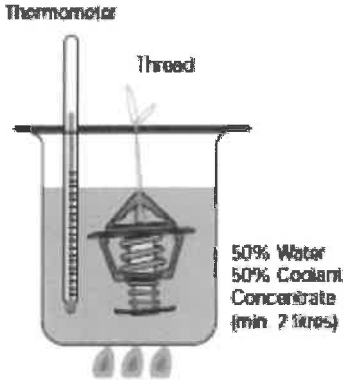
Having gone through all of this I happened upon Graham Campbell's article in "*TR Register – Technical Tips 2" section 2 – Cooling, p62*. He came to same conclusion by modifying and fitting the biggest thermostat he could squeeze in (from a Nissan Skyline/Ford). The effect was similar and he was completely satisfied however since the TT200-170 is cheap, fits straight in and is off the shelf it is a suitable solution for most of us.

So before you embark on an expensive modification to your TR cooling system, take a good look at what you have and how to get the most out of it. It might be as simple as a $20.00 trip to the shops and only take 10 minutes to fit.

Here are a few technical tips courtesy of Tridon®

Thermostat Testing Procedure

- Fill test container with 50% water and 50% coolant concentrate (minimum 2 litres).
- Open the thermostat and insert a fine thread under the valve seat.
- Suspend the thermostat by the thread in the container. The thermostat must be fully submerged and not touch any part of the container.
- Place a thermometer into the coolant so that the bulb is adjacent to the thermostat temperature sensing pill.
- Heat the liquid slowly from cold and agitate the test fluid for accurate results
- Observe the thermometer and note the temperature at once when the thermostat drops from the thread. This reading is the commencement to open temperature.



- The temperature should be increased and the thermostat observed to make sure it fully opens. The thermostat should be fully open at approximately 12°C (22°F) above the specified opening temperature. For example a thermostat with an opening temperature of 82°C should be fully open at 82°C+12°C = 94°C
- The distance of travel to achieve the fully open temperature is the centre orifice diameter divided by 4. For example, orifice DIA 24mm÷4 = 6mm. 6mm travel is the fully open extended position.
- Note: As there is a tolerance of 2.5°C plus or minus of the nominated rating, a thermostat should be replaced if it opens at a temperature more than 6°C (11°F) below or 3°C (5°F) above the specified opening temperature.
- Any testing needs to be done with the water heated at a slow, steady rate with the thermostat being placed into the water at room temperature. This allows the thermostat to heat up consistently and to normalise as the water is heating up. If the water is allowed to heat too quickly it can begin to boil before an accurate temperature is taken. At the same time, if there is too much bubbling in the water incorrect temperature readings may be taken. The thermostat will also take a little time to react to the temperature of the water.

When cool, carefully examine the thermostat valve to make certain it is properly seated. If it does not seat properly, it should be replaced.

Thermostats do not work intermittently - they either work or do not work.
Should a thermostat fail it can either fail in the open or closed position.

I hope this works as well for you as it does for us.

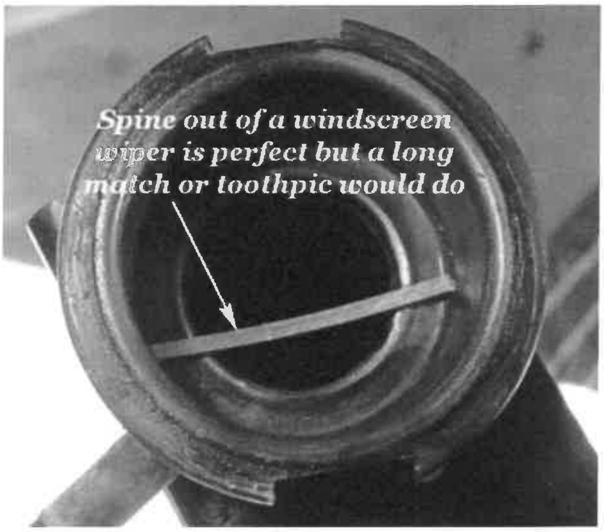
Cheers

Rob

Thermo Fans and Radiators do not always get along together.

The time to discover that the radiator is not holding coolant is obviously on the way to the Tasmanian ferry in transit to an Event like the Targa Historic Rallye, where there is a week end looming and no time to spare. One amazing feature of this sort of timing is the abundance of good fellowship at all hours of the day and night to render assistance.

The first strategy was to find some containers for filling up the radiator just before disembarking, which should allow us to get out of the traffic and properly investigate the severity of the problem. There is much frivolity and consumption of stimulants as the ship sails, so it was off to scour the bars and restaurants to see if they might have some containers available later on.



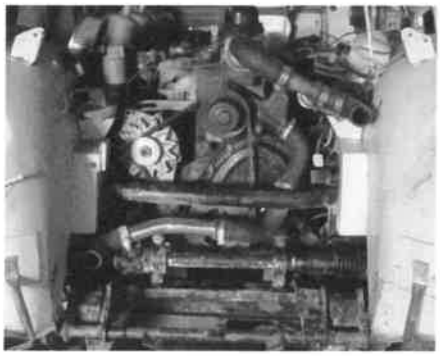
The second task was to find something to prevent the cooling system being pressurised by putting a suitable spacer under the cap when we start up in the morning.

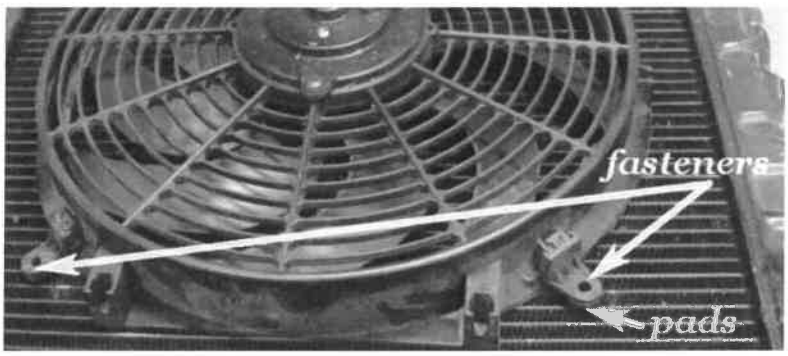
It is a handy thing to have in one's tool kit.

The early bird is supposed to get the worm, so the coffee bars and eateries were scoured and we were rewarded with 2 ex milk containers freshly rinsed and filled with clean water along with the comment that "these have been in high demand today for some strange reason!!"

It is amazing how quickly we were put in touch with mates of mates who within the hour had located a spare identical Volvo radiator we could have. Bearing in mind the task of removing the front of the TR and swapping the mounting brackets over on a week end somewhat complicated that option.
The assembled competitors in the Davenport car park were probably capable of rebuilding an entire car during morning tea so we were able to obtain and apply a liberal dose of STOPLEAK and expert opinion, after first flushing out the coolant remnants we determined that checking the level at regular intervals and hoping for the best would be the only option to begin with.

The Rallye which is associated with Targa Tasmania is one of the best TR expeditions we have done, it allows one to pretend to be in the Targa by running flat out on Closed roads prior to the Targa Cars, doing most of the stages on Open roads chasing a pace car, (Mustang) with a constant barrage of Wineries, Golf courses, dinners, lunches and all manner of things to amuse the ladies between the blokey stuff where they just have to hang on.





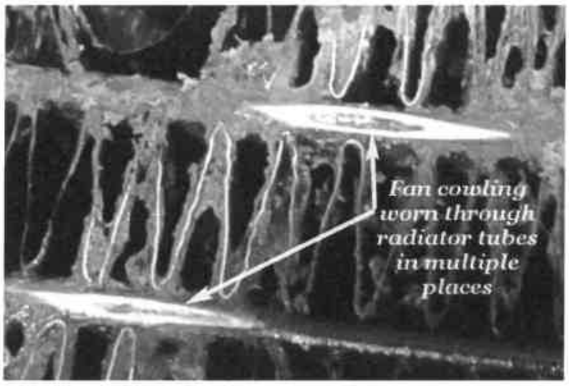
Daily checks on coolant levels and several more doses of Stopleak got us through the next 4000Kms and home, where the investigation started.

Most things that stop working or go wrong are related to short cuts, silly stuff or bad luck and this was not a case of bad luck.

When fitting the Thermo fan I used the kit supplied which has some rubber pads and plastic locking strips which are fed through the radiator and locked by griplock pads on the other side.
Well this is clearly not a good idea...

The plastic fasteners and the rubber pads are really not good enough and so as plastic is more abrasive than copper the slight movement eventually allows contact with both and the copper loses.

A good clean up and a few minutes with the soldering iron soon had everything fixed before doing a pressure test and looking for a proper solution to the cause of the problem. (aka short cuts!)



Mr Bunnings has a wondrous range of solutions for such situations, which include sticky backed weather 2.5mm wide strips which are easily adhered to the fan housing.

A search through the bolt box came up with some extra-long Allen headed bolts which were probably salvaged from a piece of furniture being thrown out! (everything has to be useful at sometime)

The total cost of overcoming this lapse in concentration with the original fitting was $6.50 plus several bottles of Stopleak.
It could have been worse and spoiled one of the best expeditions we have had.
Targa 2016??? Rob Bradford.