

CLUB CARS - THE HARD WAY

Engine peripherals

The failure of engine peripherals is the most common cause of DNF's in Club Car racing. Here is a few ways of improving reliability.

Alternators. A standard alternator is geared so that it will charge as you dawdle around town at 2000 rpm engine speed. When you put a road car alternator in a race car being revved to 6000 rpm +, the alternator is being spun at revs much higher than it was designed for, and consequently doesn't live long. Gear the alternator down, by installing a larger pulley (typically 4" minimum) on the alternator, or on a rotary, a smaller crank pulley. Loc-Tite or safety wire the mounting bolts, they have a tendency to work loose. Install a volt gauge which you check at the end of each session. It should read between 14 and 16 volts at anything over 4000 RPM. Any reading outside this range indicates a problem. Watch for regular alternator failures due to vibration - it could indicate a problem with the crank damper, particularly on a four cylinder. A broken crankshaft can be a dead giveaway.

Battery: Put your battery on trickle charge the night before a race meeting. A battery will discharge sitting around for a month at a time, particularly if it is not in perfect condition. Battery isolation switches are now mandatory, and are a good idea anyway. They make working on the electrical system much safer, and are more convenient than manually disconnecting the battery. They are also a good safety feature in the event of an accident. Install the switch so that the driver can reach it when strapped in.

Distributor leads : Check regularly for resistance. Suppression leads should be between 1500 & 3000 ohms for suppression leads, less for race leads. If you run electronic injection, use suppression leads, and don't route the wires for the crank angle sensor around the distributor or near the leads. The voltage can interfere with the signal. If leads tend to work loose on the distributor cap, cabletie them around the terminals. Don't cable tie leads together, they will cross fire - keep them separated.

Ignition: Run a separate switch to the ignition coil, not through your 25 year old ignition switch.

Throttle cable - This would be the all time most common failure on a Club Car. It is also the most preventable. Solder or crimp cable ends, and check regularly for fraying. Don't use clamp on type fittings. If you need to replace an inner, boat shops carry a suitable cable with a 200kg + breaking strain.

Fuel system : Under high cornering loads, fuel pickups can suck air, at best causing engine hesitation, at worst leaning out and detonating the engine. The cure is to fit a surge tank, either gravity or auxiliary pump fed. Carrying around a full tank of fuel is the unsatisfactory and arguably dangerous alternative. If the surge tank is gravity fed, make sure the top of the surge tank is below the bottom of the main tank, and fed with at least a 1/2 inch line, and preferably two. No, the surge tank does not have to be tall and skinny. If you have a return line, run it into the surge tank, with an overflow back to the main tank.. About one litre is big enough. The pickups should be at the rear and bottom of both tanks, so when you are running dry, the pickups will get fed under acceleration as you exit a corner. If you race a Datsun 1600 with an original fuel tank, buy yourself a new fuel cap. Your 25 year old one *will* spew fuel around left handers, and is a sitter for a black flag, as well as being uneconomical, and dangerous. Route the fuel lines where they won't absorb heat & get vapour lock. A sight gauge is a good idea, because relying on an old fuel gauge is a good way to run out of fuel in a race. Use a fuel injection filter in an injected car, and a carby filter in a carby car, not vice versa. Carby filters in injected cars explode and injection filters designed for high fuel pressure restrict the fuel flow unnecessarily in carby cars. In a carby car, use a good solid metal or glass filter. The cheap plastic ones have been known to crack, and some of them don't like avgas.

Oil system : Safety wire oil filter on using a large hose clamp around the oil filter, particularly if you have a Gemini twin cam. Fit a baffled sump, almost all standard road car sumps will surge on a race track, and the pickup will suck air, which can be potentially disastrous. Don't overfill the sump, the crank will cavitate the oil, resulting in low oil pressure and lost horsepower. Fit a big red oil pressure warning light somewhere easy to see, with a sender which comes on at 35 PSI. Standard road car senders come on at 5psi, just in time to tell you your engine is history. Standard or mild engines piston engines probably won't need an oil cooler, rotaries will. Any race spec engine will. Mount the oil cooler in airflow, buy the

biggest one possible, don't mount it hard up against a solid surface, and don't mount it outside the coachwork (illegal). You cannot cut holes in the bodywork to duct air, and you cannot remove headlights. In front of the radiator works well on later model cars, behind headlights or behind front spoilers on early model cars with less room in the engine bay. You can cut holes, for example in the radiator support panel, to route oil lines. If your sump protrudes below the crossmember, fit a sump guard, it will give you some confidence when kerb hopping.

Cooling system : There are a number of things which can be done to improve your cooling system, without changing the radiator. Removing the thermostat is not one of them. A correctly working thermostat will slow the water speed through the radiator, giving it time to cool, as well as holding the cool water against the block longer for better heat transfer. Gear down the water pump, and put in a restrictor, if you feel you must remove the thermostat. Seal between the radiator and the support panel. Air will always follow the path of least resistance, and if there is a gap around the radiator, it will flow through the gap instead of the radiator. A front spoiler will create a low pressure area behind itself and the radiator, often improving airflow and therefore cooling. Watch the water pump speed, particularly on a 6 cylinder Holden. Some pumps can over rev and cavitate. Adjust the pulley size if necessary. Change your radiator hoses and fan belts every two years. If you have a mega horsepower engine, be aware that if the cold air intake draws from in front of the radiator, it can partially starve the radiator. A higher pressure radiator cap will raise the boiling point of the coolant, as will the addition of antifreeze/boil. These products also act as a corrosion inhibitor, which is not a bad idea, remembering that heat accelerates corrosion. The radiator cap should be the highest point of the cooling system, to prevent air locks. The overflow pipe should go into a catch bottle, so when the engine cools, the overflow is drawn back into the radiator. This saves you topping the thing up after every race, as well as keeping vital bits of your electrical system (eg distributor) dry.

Starter motors: How many times do you see cars being push started on the dummy grid? Solenoids on race car starter motors are prone to heat soaking and jamming, so insulate yours. Nissan FJ20 reduction gear starters are nice, and can be used on Datsun L series motors as well. Loc-Tite or safety wire the mounting bolts. Don't run your starter through the ignition switch, particularly on an old car, as you usually get a voltage drop. Use a marine starter button with suitable amperage cable direct off the battery, and on the engine side of the battery isolation switch..

Exhaust: Chains are the preferred method of attaching a race car exhaust. Don't mount the muffler too low or you will rip it off on a kerb or getting it off the trailer. Attach the entire system so that if one chain fails, the other(s) can support it. A dragging exhaust equals a guaranteed black flag. Unless your engine is solid mounted, allow the exhaust system some movement or you are asking for a set of busted extractors.

Clutch: A solid centre button clutch is preferable, even on a standard or "wrecker" motor. It represents cheap drive train reliability. Don't even *think* about using a sprung centre fabric clutch on a race spec motor. Drill a small hole in the bell housing so you can monitor clutch wear. Use drill bits to estimate the thickness of the remaining friction material, and stick to the manufacturers recommended minimum thickness. If you have a cable operated clutch, check the cable regularly for fraying. If you have a hydraulic clutch, monitor the fluid level. If it drops *at all*, check behind the dust boots on the back of the master and slave cylinders to see where it is leaking, and rectify. Properly maintained hydraulic cylinders rarely "blow" without warning, they will usually start with a small leak, and if not fixed, they will then blow, usually when you are on your way to the dummy grid for the first race.

Exterior engine checks: A regular leak down test or compression test is a good way of monitoring ring wear and valve condition, and if done regularly, will give you an idea of how often the motor needs to be rebuilt. It can also help prevent nasty surprises the next time you go to load the car on the trailer. Keep an eye on your engine mount condition, and if cracks appear, replace them. If left unattended, the mounts will one day break clean through, most likely at the start of a race. Check around the welsh plugs for any sign of leaks, and replace them whenever the motor is apart.

Strategies for improving your lap times.

Practice makes perfect. A very experienced former professional racer once said to me, "the problem with you blokes (referring collectively to amateur racers), is that you are ready to go racing at about four

o'clock Sunday afternoon." He was referring to the general lack of testing and practice undertaken by Club Car racers. Unfortunately, we don't all have mega dollar budgets, so we have to be careful about how we spend what budget we have. Racing and practice miles is about the most economical way to improve your lap times when you are starting out. New racers often find that they get quicker as the day progresses, setting a better lap time in their final race than in qualifying. This is because of the experience and the increased confidence on the circuit. Practice the day before will help you to set a quicker time in qualifying. A quicker qualifying time will improve your position in the race. It doesn't take much - I've seen days where four tenths of a second could move you six spots up the grid.

Be prepared. State of mind is critical to going fast. The bloke mentioned in the previous paragraph once said (he has a lot of good sayings) "if the car isn't ready Friday night, it will never be ready".

If I had to point to a single thing which made me faster when I was starting my racing career, it would be this piece of advice.

If you are still working on the car at 2.00 am Sunday morning, you obviously will not get much sleep, which is not helpful to being fast. Neither is rushing around trying to get the car ready five minutes before qualifying. If you are thinking about the car, you are not thinking about being quick. And believe it or not, being consistently quick is all about thinking, and has nothing to do with "big balls". You need to be well rested, relaxed and able to concentrate on the task at hand in order to be at your fastest.

So make sure the car is prepared well in advance of the meeting. And don't decide to make some radical change to the car on the Wednesday before a race meeting. Big changes should be tested well before a race.

Car setup. Good handling is more important than good horsepower. Just ask John Boston. He races a Datsun 1200, with a 1500 cc engine, and has qualified on the front row of plenty of Trophy races. It doesn't have a lot of grunt, but it handles and stops very well, so John has the confidence to drive the wheels off it every time he goes out.

People much better qualified than me have written very comprehensive books on the subject of handling, so I won't go into too much detail. I suggest you buy one and read it. Fred Puhn's "How to make your Car Handle" is a good starter. Carroll Smith's "Tune to Win" is a bit more meaty and mostly relates to open wheelers, but is still valuable. I will just mention a few specifics which relate to Club Cars, which you may not pick up from the text books.

Your car should have somewhere between 2.5 and 4.5 degrees of negative camber on the front. Our control tyres, Yokohama A008r's, overheat and blister the outside edge of the front tyres, particularly on heavier cars, if there is insufficient negative camber. Negative camber compensates for the body roll generated by our cars, as a result of relatively high centre of gravity and relatively soft spring rates. You will read in the text books that negative camber detracts from traction when braking. This is true, but it is better that the alternative, which is lots of destroyed tyres, and lower corner speeds. Also, a relatively high profile tyre (ie our 60 series) is less sensitive to camber change than a lower profile tyre. Ask experienced drivers with the same car as yours about their suspension setup. A tyre pyrometer (measures tyre temperature) can give you a guide to the correct camber and tyre pressure, but it is not the be all and end all. I use mine mostly for home brewing. Remember, the stopwatch tells no lies.

When you lower the ride height of your car, bear in mind that you can go too far. Make sure you have sufficient suspension travel left, typically 50 mm to 75mm minimum, and that the car isn't riding on the bump stops. A car either riding around on the bump stops or hitting them regularly will result in terrible handling. Remove the bump stops or cut them down if necessary. Bear in mind that drastic lowering of the ride height can also effect the suspension geometry, particularly roll centre height and dive/squat. You may find the car is faster in spite of a slightly higher ride height, due to more travel and better geometry. Lets look at an example close to home, my Datsun 1600. Lowering a Datto to what looks like a racing ride height but making no other changes will result in a car that understeers going into a corner and oversteers coming out. It will also squat more, which is not good on a Datto, because squat results in excessive negative camber and toe out on the rear. It will also bottom the suspension at both ends. These problems are made worse by using 14" or 15" wheels, because you have to lower the car further to achieve the required ride height. There are ways of fixing all these problems, but they involve considerable work. The quick fix is to run a higher ride height.

Spend some time playing with your tyre pressures. It is cheap and easy, and the right tyre pressures on the day can make a surprising difference to your lap times. Some of the things to bear in mind are:

- Tyres heat up with use, and as the air inside heats up it expands, increasing the pressure. It is the hot pressure that is important to you. Get a feel for how much pressure your tyres put on between cold and hot.
- The humidity of the air in the tyre will affect the amount of pressure the tyre puts on. The more humid the air, the more pressure is put on.
- The tyre heats up mostly as a result of sidewall flex. The lower the cold pressure, the more the sidewall will flex, and the faster the tyre will heat up.

On the subject of brakes, it's a case of fit the best ones you can afford. A mistake often made by inexperienced people building a Club Car is under braking their car. Brakes that might be fine for two laps in a supersprint could fade away in a 10 lap race. Have a look at what is fitted to the cars which are developed to the level to which you aspire, talk to the drivers, and copy what seems to work. There is no point spending \$3,000 on AP Racing brakes if your car is a daily driver which you race occasionally. And if you want your RX3 to be running for the Open Championship next year, you might as well spend the money now and throw your single piston fronts and drum rears in the bin. The front of the car will do approximately 80% of the braking in dry conditions, so this is where you should spend your money. Some of the more common front brake calipers are Landcruiser, RX7 series 4 & 5, Volvo and Nissan 300ZX, all of which are four spots. The single piston fronts which work well are calipers from heavy cars such as late model Commodore or Falcon, and only when fitted to much lighter cars than those for which they were originally designed.

If your car is a purpose built racer, I suggest you install a mechanism for adjusting the brake bias. A pressure limiting valve in the rear brake line, such as those from Tilton or AP, are the most common method. Twin master cylinders and a balance bar are in theory superior, but most of the really fast Club Cars seem to use a pressure limiting valve.

I recommend using an asbestos based pad, such as Black Flash, when you are starting out. If you ask around, you will find that a lot of the more experienced competitors will prefer a carbon metallic (such as Hawk) or carbon kevlar pad (Cool Carbon). These pads have a coefficient of friction which is up to 50% higher than an asbestos pad, and they have a very wide operating temperature range, which means they bite like hell even when they are stone cold. They also have a lot less feel than "regular" compound pads, meaning that it is really easy to lock front wheels. This is not good, because when you are starting out, you will be trying to develop your brake modulation (mental ABS) skills, and this lack of feel will make the job much harder. Locked front wheels equals flat spotted front tyres, which can get very expensive very quickly. A flat spotted tyre cannot be fixed, and the only thing it can be used for is a very ordinary looking coffee table in your lounge room. So unless you like giving Mr Yokohama lots of your money, stay away from carbon pads for your first season.

Going fast in the wet.

There are two simple ways to be successful in a wet race:

- Make sure you can see where you are going.
- Stay on the track.

These comments may sound trite, but so many people get caught out in the wet, and you can take advantage of this. If you can't see the track, you won't be quick. The biggest problem is fogging the windscreen. There are several things you can do to combat this. Make sure your heater/demister is in good working order. If you want to get really serious, fit an electric demister to your windscreen. You can also smear Fog-X or a similar anti fog product on all internal glass. If you have none of the above, race with all your windows wound down. This keeps the cabin temperature down and will minimise fogging, but you will get pretty wet. If your windscreen wipers are not much chop, Rain-X is great.

People will invariably spin off in the wet, and if you stay on the track you will beat them. All that is required of you is to make fairly careful use of your brain and your right foot. The off track areas (ie grass and mud) are so much more slippery in the wet, you won't believe it until you try it. The most common outcome when someone leaves the track in the wet is that they keep sliding until they are stopped, usually by part of the scenery. Keep your eyes open for water running across the track or in puddles. The car can aquaplane when driven through such water, and if your car is aquaplaning, the only thing you can do is

tighten your harness, and make sure your thumbs are not hooked around the steering wheel. Be aware of cars spinning out in front of you, and be prepared to avoid them. Look out for mud dragged onto the track by a car which has been off, and if you go off yourself and get going again, take the next couple of corners easy, as you will have mud in the tread of your tyres.

In terms of car setup, you need to go soft in the wet. Drop a couple of pounds tyre pressure, bearing in mind that the water on the track will keep the tyre cool, so it won't put on as much pressure during the race. A008s are a pretty good tyre in the wet, if they have plenty of tread. The more tread you have, the faster you will be. A brand new set of tyres is ideal, and will give you a distinct advantage over someone with half worn tyres. If you have adjustable shocks, back them off a few clicks. Disconnect your sway bars, or if they are adjustable, set them on the softest setting. If you have adjustable brake bias, wind it a bit towards the rear.

What to do on race day

Scrutineering: Be early, and be ready to race. All cars are scrutineered for safety and for compliance with technical regulations before they are allowed on the track. Present your car as you will race it, not with bits missing, or extra bits added eg jack and spare wheels in the boot. It is not unusual to see these items make it to scrutineering. What is unusual (but I've seen it) is these items making it through qualifying.

A clean, well turned out car will attract less attention in scrutineering than a scruffy one, and less attention is what you want. If a car doesn't present very well, a scrutineer will naturally wonder what else is wrong with it, and take a closer look.

Speaking of attention from scrutineers, a word about arguing with them. That word is "DON'T". I have seen heaps of arguments between scrutineers and drivers, and I haven't seen a driver win one yet. And remember, the scrutineers will probably know the regulations better than you. The procedure to follow is this: If you get pulled up by the scrutineer for something, immediately say, in a polite tone, "would you like me to fix it now, or can I fix it for next time?" If the item isn't too serious, chances he will say "fix it for next time" and won't even log you for it. If he says "fix it", don't waste you time arguing, the time is better spent fixing it. You can make all the excuses you like, but he probably knows the rules a lot better than you do. One of the oldest excuses is "but it's been like this all year." This never works - it just means that the scrutineers who had previously scrutineered the car hadn't done the job properly. A classic is number patches. They are supposed to be either black or white, and a contrasting colour to the surrounding coachwork, so a black or white pin stripe box is not acceptable. A certain high profile CCRR official went for a 18 months before getting pinged for this one!

Trap for young players..... After scrutineering, go and collect your permit to practice/race from the office. If you show up for qualifying without it, you won't be allowed on the track. A last minute rush to get it is not the sort of distraction you need immediately before qualifying.

Qualifying. In Club Car racing, you will see some competitors lining up to get on the dummy grid before the session even starts. They are doing this for a good reason. They want to get on the track first. Club Car grids are so big that traffic in qualifying is a problem for drivers trying to find the last couple of tenths of a second, so they get out on the track first so they can get a couple of clear laps. If a couple of tenths isn't going to make much difference to you, don't try to get on the front of the dummy grid.

Qualifying is qualifying, not racing. Don't try to dice with anyone in qualifying, chances are you will just piss them off, and you will both go slower as a result. If you get caught up with someone, back off and find a gap. Keep an eye in your mirrors for drivers in a fast lap. Be aware that individual drivers can vary their speed considerably - they may do a couple of slow laps, then a quick one, etc for a variety of reasons. When you see a faster car coming up behind you, point to the side that you want the car to pass you on. Just giving the other driver clear road is not sufficient, he/she needs to know you have seen him/her coming. When you are on your quick lap, approach any car which has not "pointed" for you with caution. Don't assume that the driver has seen you, or the waving blue flags. When passing a slower car, don't cut it off, or push it into the marbles, dirt, etc. Remember, it is your responsibility to pass cleanly, and not the other driver's obligation to get off the track when you are coming through. When you are on your cool down lap, stay off the racing line, there may be other drivers still trying to do a quickie.

Racing. When you are gridding up, look around you to see if someone is out of place. I had a problem in qualifying at Amaroo last year, and started at the rear of a 30 car grid, when I had no excuses for being outside the top three. After the race, I was hauled up before the Clerk of the Course - someone had lodged a complaint that I "had given him a fright" on the way through, although no contact occurred. If this turkey had bothered to have a look around him before the race started, he wouldn't have got such a fright. When the light turns green and racing starts, don't weave all over the track approaching the first corner. This is a good way to get some unnecessary panel damage, by collecting someone from the row behind you who got a better start than you did.

If you are midfield or further back, be aware of the length of the race and the likelihood of being lapped. It won't happen in a five lapper at Oran South, but in a 15 lap race two thirds of the field could get lapped. If you are about to be lapped, don't hold up the other driver or try to dice with him. Let him through, pointing to the side you want him to pass on. If you are about to lap someone, or in particular more than one car, be aware that they may be involved in their own dice, and may not see you coming. The fact that you are lapping them does not entitle you to stuff up their racing by running one or both of them off the road on your way through.

If you are dicing with another competitor, you pass only on your merits. If you don't have the ability to get past cleanly, you do not "give them a tap" to let them know you mean business, and you do not punt them out of the way. This will get you a chat with the Clerk of the Course, possibly a fine, and will certainly endanger the life of the other driver. Remember the saying "motor racing is dangerous" - don't do anything to make it worse.

A few items you should have for your car, garage and toolbox, and where to get them. Also a few things you shouldn't have.

In the garage:

Do yourself a big favour, and buy a decent **trolley jack** ie a professional quality one, not a \$80 K-Mart one. During your motor racing career, you will jack your car up hundreds of times. A decent jack should cost you around \$140 to \$200 and jacks the car up higher and faster than a K-Mart jack, making the process a lot easier and more pleasant. Get it from any discount tool shop.

A **mechanic's creeper** is also a big time saver - you can move under the car quicker and easier than if you are on your back, as well as saying cleaner. Also, the creeper makes a great skateboard for when the Robson kids come to visit.

Speaking of being clean, set up a **parts cleaner** in your garage. It is much more pleasant working with clean parts than dirty ones. My parts cleaner cost \$10, and is comprised of a siphon system using some windscreen washer tubing, a 4 litre can of kero suspended above an old sink, and a long handled pot scrubbing brush. The sink drains into another can, and when the top can is empty, I refill it with the bottom one. (I know all professional mechanics are laughing pretty hard as they read this, but you can all get stuffed - it works, and it doesn't cost much) If you want to get really fancy, rather than siphon, use an old electric fuel pump, a big foam filter and a 12 volt transformer, to replace the top can.

In the toolbox:

Permatex RTV is a silicone based sealant, and can be used for just about anything, from fixing quite large holes in sumps to a surrogate exhaust manifold gasket. Get it from almost any car parts shops, and carry at least two tubes. Costs about \$7- \$8 per tube. Don't do the lids up too tight, they seem to have a habit of breaking in half. About the only sealing job it won't do is where it is exposed to fuel, so don't use it on an intake manifold, or any fuel fittings. There are two other products in this range, which quote a higher temperature tolerances. They are Permatex Blue (\$13/tube) and Permatex Ultra Copper (\$18/tube). Given that the cheaper RTV works great as an exhaust manifold gasket, the only application I have found for the higher priced **Ultra Copper** is for sealing between the exhaust manifold and the turbine housing on a turbo charged engine. Blue and Ultra Copper are also "sensor safe" ie they don't affect oxygen sensors, if you use one.

I have always wanted to own a pair of **safety wire pliers**, but had baulked at the \$70 - \$80 price. Safety wire pliers are used for doing a neat job of safety wiring sump, gearbox and diff plugs, and any bolts which have a habit of coming loose. I now own a pair, which I got from Aviall (a supplier to the aviation industry) in Bankstown for \$42.

Great for a rainy day of racing, **Rain-X** is applied to the outside of the windscreen, and beats potatoes hands down. It stops the rain from adhering to the windscreen by breaking down the surface tension of the water droplets. This means you can race in the rain without using your wipers, which is great if you have a Datsun 1600, as the wipers are hopeless.

Fog-X is applied to the inside of all windows, and stops them fogging on a wet day. This sure beats the Scuba diver's idea of spitting on them.

I'm not sure you should keep them in your toolbox, but **gumboots** are great for wet race days, too. There is always water all over the place when it rains, and water is very bad for your race boots. If the soles are glued on, the glue is water based for fire resistance, so it dissolves when it gets wet.

Don't bother trying to use an ordinary 10 mm spanner on brake pipe fittings, it will only lead to tears. Get yourself a proper **brake fitting spanner**.

On the car:

Having just completely replumbed my car, I have a few tips to pass onto anyone contemplating the same exercise. Configure your **plumbing** for straight hose ends where possible. Hose fittings with bends are usually more than twice the price of straights. The Speedflex range of press fit hose fittings from Earls are not too outrageously priced, and the hose (non braided, from other hose suppliers such as Enzed and Pirtek) is cheaper too. Watching the Bathurst coverage, I noticed HRT had their fuel system done with this stuff. I wonder what Alan Jones uses? ENZED and Pirtek also have steel & brass hose fittings, not as light and pretty as Earls, but they work just as well. Fuel injection quality hose (250 psi), compatible with the Speedflex fittings, can be had from some of the hose outlets, as can hose suitable for oil coolers. I purchased Aeroquip hose from Hi Impulse Equipment in Bankstown for about \$10/metre for 3/8 id for my fuel system. 5/16 suits most naturally aspirated engines and costs a little less. It is much easier and quicker to plumb with flexible hose than with copper, aluminium or steel pipe. Be very careful using copper pipe. Vibration can cause it to work harden and crack. It is not recommended, but if you must use it, support it at regular intervals with "P" clips or a similar rigid mounting method.

Don't paint your **engine bay** black or a dark colour. It is much easier to see what your are doing in an engine bay which is a light colour, as it reflects more light.

For anyone contemplating making a **fuel rail** for an injected car, don't bother. Motec in Melbourne carry a special aluminium fuel rail extrusion. It isn't particularly cheap on a per metre basis, but you more than make up for the extra cost in labour savings. The extrusion is specially shaped so that all you have to do is drill holes to plug the injectors into, tap the ends for hose fittings, and hey presto, one fuel rail ready to bolt on.