GUIDE TO GETTING STARTED IN FOUR STROKE ENDURANCE KART RACING & FOUR STROKE SPRINT KART RACING

Subaru KX21 Sports Karting Engine

By Greg Cox

CONTENTS

WARNING

Motor Sport Activities are inherently dangerous recreational activities and there is significant risk of injury, disability or death.

If you do not wish to be exposed to such risks, then you should not participate in Motor Sport Activities.

This document is not written by or endorsed by the Subaru Karting Association of NSW from hereon in referred to as, “SKA”.

References to the rules and regulations are current at the time of writing but subject to change at any time. In every instance, if there’s a differentiation between the rules or regulations and this document, the rules and regulations take precedence.

This document contains opinions of the author, those such opinions are based on the authors experience and research, however, those such opinions may differ from those of others and may in fact, may be incorrect.

The first lesson you should learn in motorsport is, your competitors may not be completely truthful with you and may try to deceive you at every opportunity. You should never just believe something that you are told or anything you read without confirming its validity first. This document is no exception.

The reader should, in every instance, form their own opinion and seek further advice on any information that they consider to be incorrect.

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The suppliers referenced in this document are not expressly endorsed by the author or the SKA. The said suppliers are mentioned due to their ongoing support of the category by stocking and supplying components required by the category.

INTRODUCTION

This document has been written by Greg Cox with the support of Dieci Racing and many members of the Subaru Karting Association of NSW to provide information that may assist those looking to get involved in 4 stroke endurance racing and or 4 stroke sprint kart racing with a detailed source of reference material to help them get setup and started in 4 stroke Karting.

The engine referred to in this particular revision is the Subaru KX21 Sports Karting Engine as this is the current engine being used by SKA NSW for all events.

SAFETY WARNINGS

At all times, when working on your kart, take the appropriate steps to protect yourself and others from injury. Wear personal protective equipment (PPE) at all times.

The information below is a guide to help you, if you need help in determining what the appropriate PPE is for a particular task, seek professional advice.

Safety glasses should be worn at all times when using hand or power tools and when using chemicals or compressed air.

Gloves should be worn at all times when working on a kart.

Safety boots should be worn at all times when working on a kart.

Hearing protection should be worn at all times when running the kart engine, when using power tools and when using compressed air.

Respiratory protection should be worn at all times when working on the karts brakes, when using compressed air and when using chemicals.

Have a charged fire extinguisher of the type that is appropriate for extinguishing fuel and oil fires.

Always work in a well-lit and well ventilated area and keep the area clean, tidy and free of trip hazards.

CONTACTS

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COMPONENT SUPPLIERS

Stones Kart Sport

1 Longview Road, Mulgoa, NSW

Phone - (02) 4773 8578

Web – www.stoneskartsport.com.au

Homebush Karts

Unit 56/11-21 Underwood Road, Homebush, NSW

Phone – (02) 9764 5565

Web – www.karts.com.au

Aussiespeed

Adelaide, South Australia

Phone - 0403 22 11 05

Web - www.aussiespeed.com.au

THE SUBARU KX21 FOUR STROKE ENGINE

The first option for sourcing the engine is to check with the Subaru Karting Association of NSW (SKANSW). SKANSW may have some second hand engines available and will almost certainly have some new engines available

All engines supplied by SKANSW will be pre-tagged with the appropriate security tags.

If SKANSW doesn't have any engines available, you can source a pre-tagged engine from the Aussiespeed

The images below show the type and location of the engine security tags. If you are buying an engine from someone other than the suppliers listed above and it is not correctly tagged, please be aware that the engine will need to be stripped, inspected and tagged before it can be used in competition. This may cost you several hundred dollars.


0017612


0017546

THE CONTROL EXHAUST SYSTEM

The exhaust system is available for purchase directly from the Subaru Karting Association of NSW

The control exhaust for Subaru KX21DU engines consist of the three following components:

1. Aussiespeed Subaru KX21 Header Pipe (Painted Finish) Part Number AS0284P
2. Aussiespeed Muffler Coupler Adapter (6 Bolt 100mm diameter X 75mm overall length) Part Number AS0434
3. SKANSW Inc. Stainless Steel Muffler Part Number SKA-FF-001

THE CLUTCH

There are two brands/models of clutches approved for use

1. Maxtorque SS with 219 pitch sprocket

2. Noram GE with 219 pitch sprocket

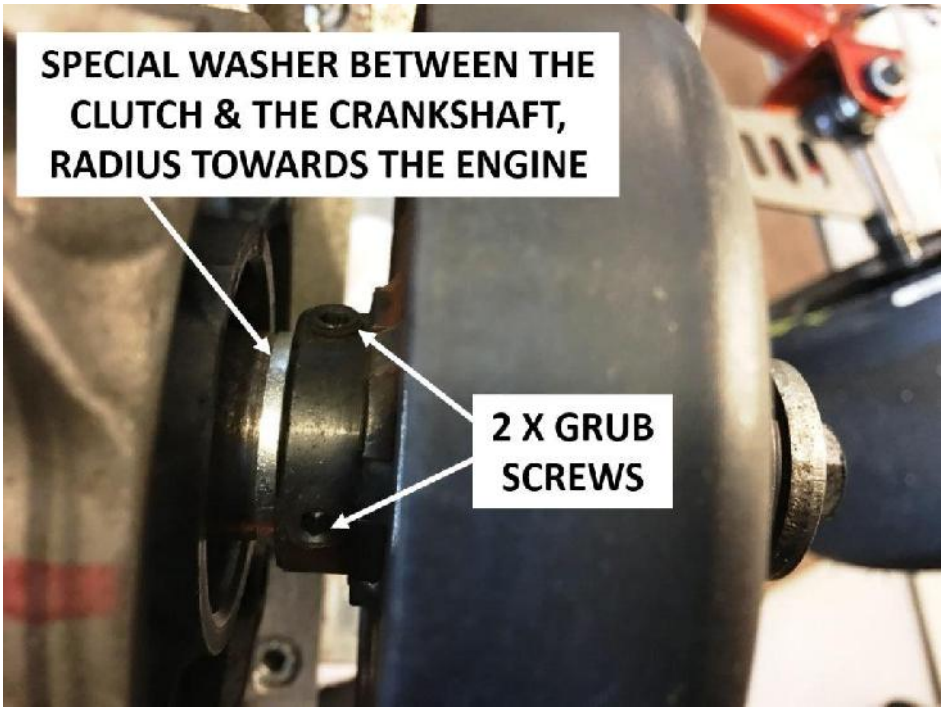
The majority of competitors are using the Maxtorque clutch for endurance racing, there are a limited number of teams using the Noram clutch for endurance racing as some teams have experienced advanced chain wear with the Noram clutch.

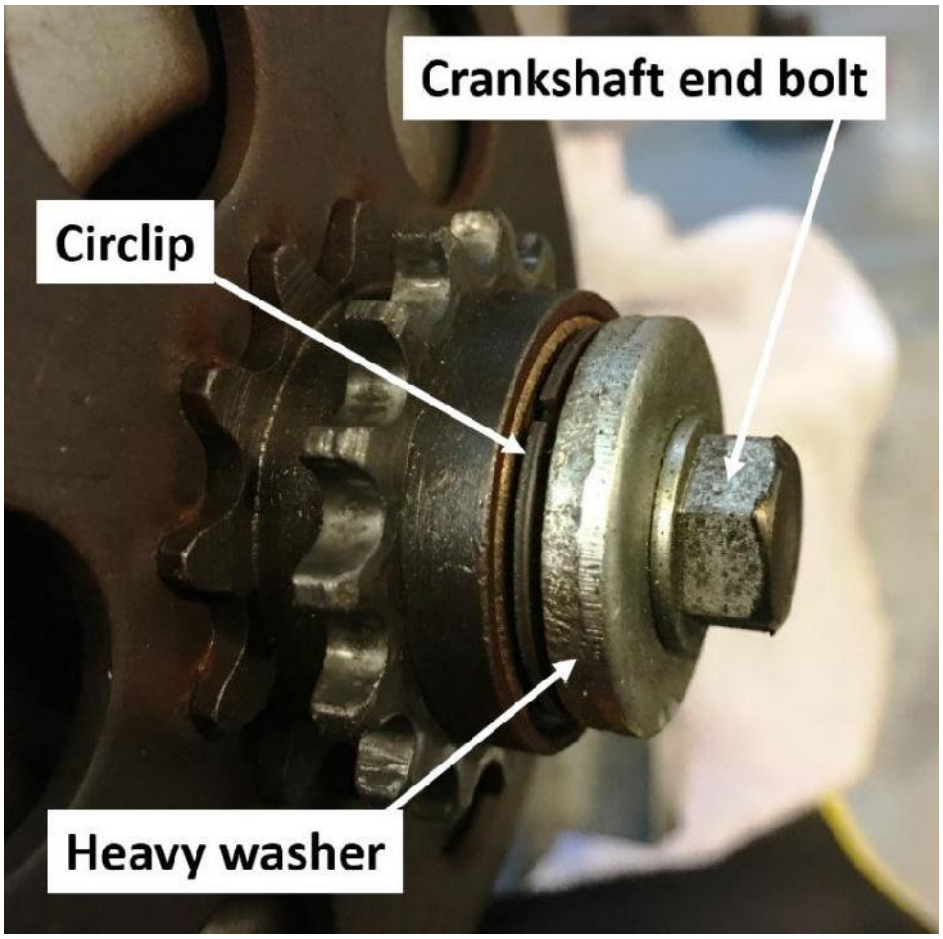
Clutches can be purchased from a number of sources.

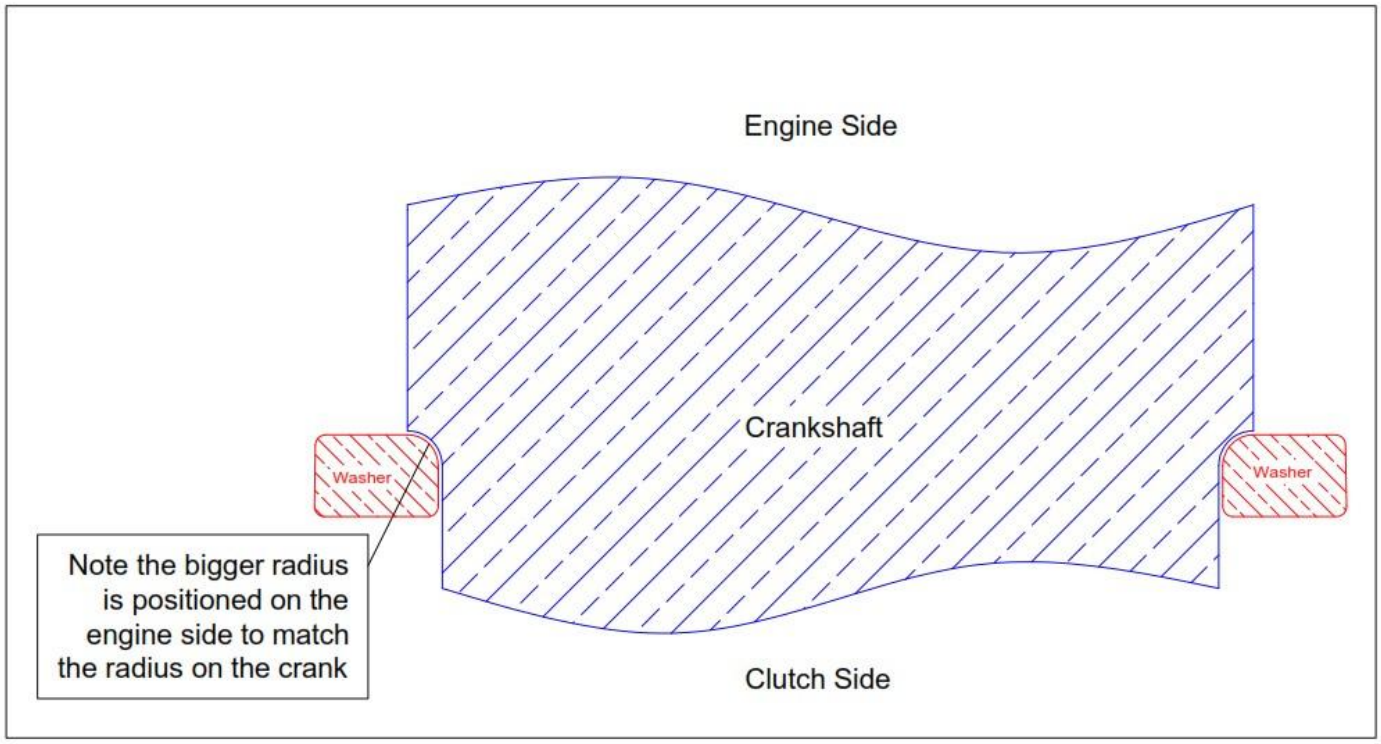
The SKANSW does have clutches available for purchase, stock may be limited at times. If SKANSW is out of stock, you can pick up a Maxtorque clutch at any Arrow kart dealer including Stones Kart Sport & Aussiespeed

CLUTCH MOUNTING

The clutch is mounted to the 3/4" crankshaft using a 3/16” x 1/2" long keyway, two grub screws (supplied with the clutch), a special washer that sits between the clutch and the inner crankshaft radius and then another heavy washer and bolt on the end of the crankshaft. The special washer, crank end washer and bolt are all available from Aussiespeed







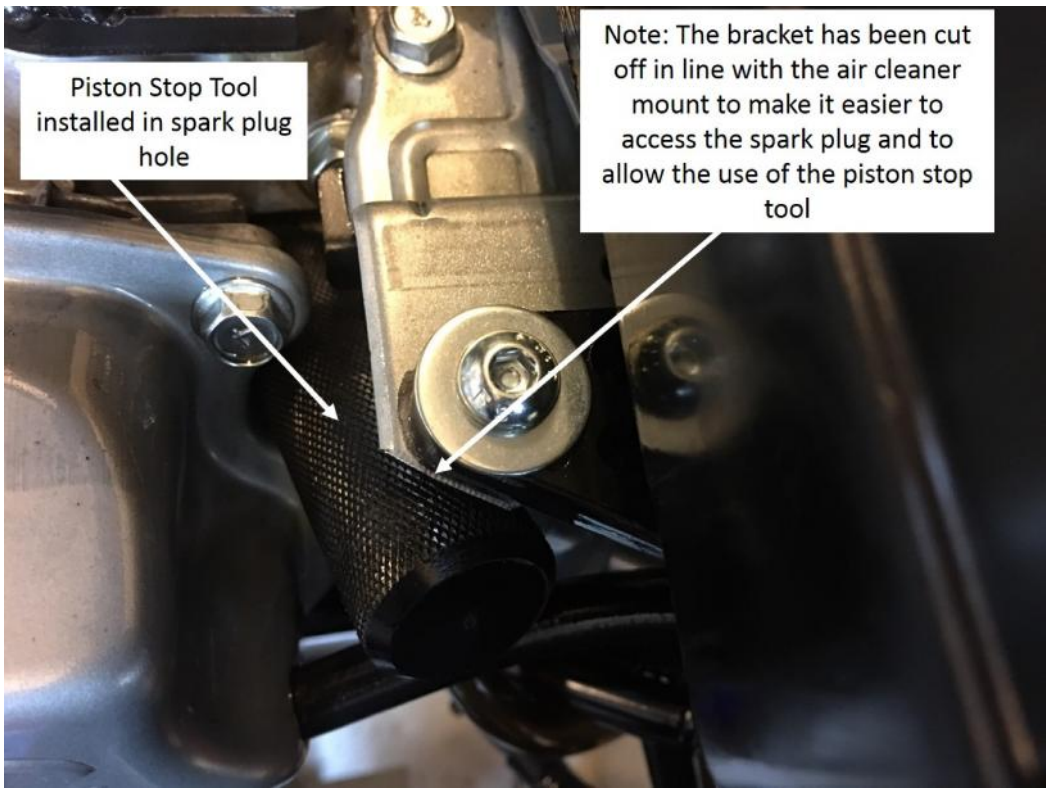
The grub screws and the bolt in the end of the crankshaft should be installed using thread locking compound to prevent them vibrating loose.

You may discover that the grub screws come loose during an event, this is not a concern, as long as you have the washer on the inside, the heavy washer on the outside and the bolt in the end of the crankshaft.

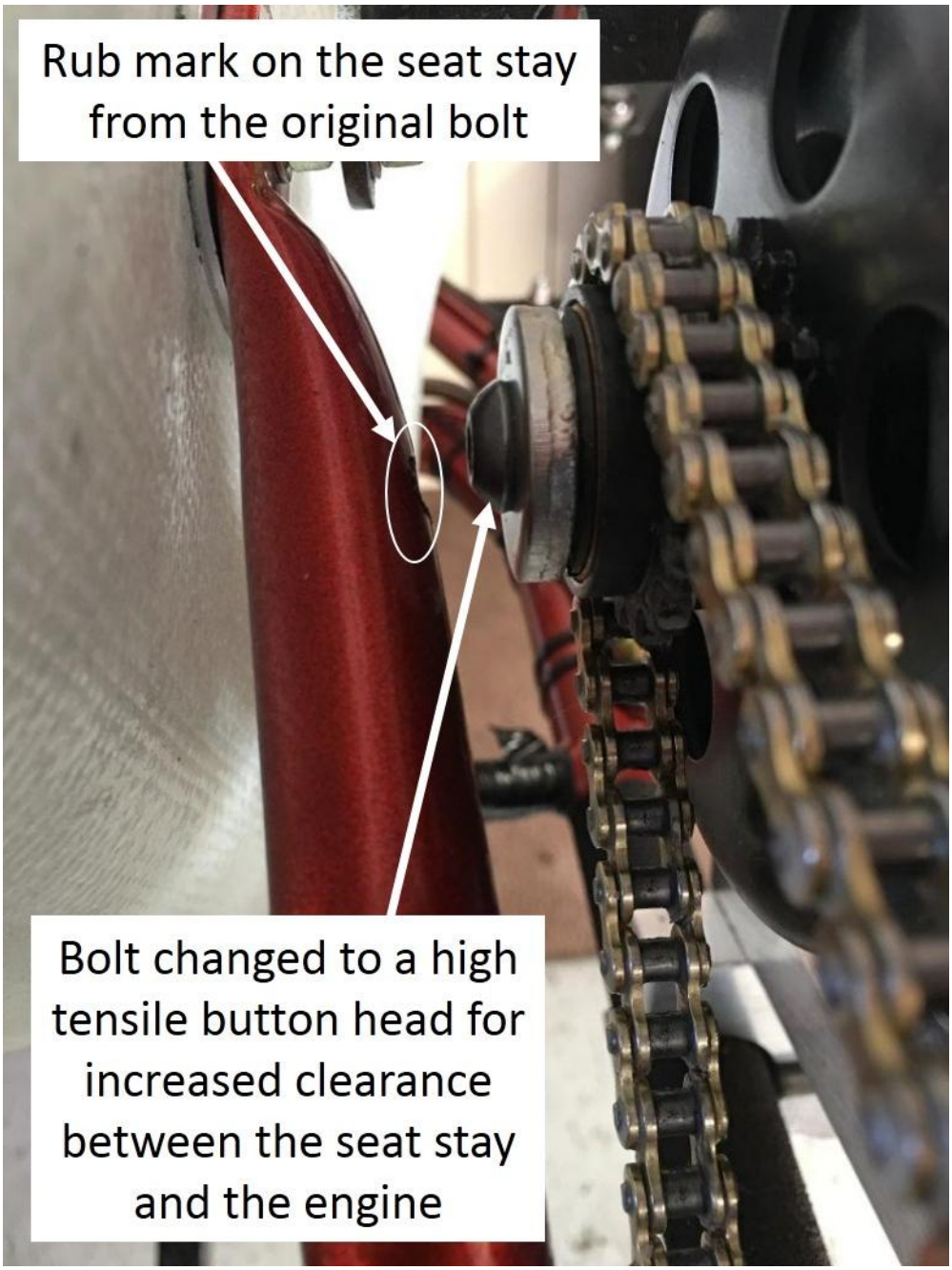
The keyway for the crankshaft is 3/16” square, you can purchase a length of key-steel from any industrial supplier or bearing supply company and cut your own 1/2" lengths.

You will need to stop the crankshaft from turning so you can loosen or tighten the crankshaft end bolt. The easiest way to do this is to use a Piston Stop Tool. These piston stop tools are available from most kart shops. The spark plug is removed and the tool is screwed into the spark plug hole, make sure, the piston is not at top dead centre (TDC) when screwing the piston stop tool in. Once the tool is crewed in, rotate the crankshaft very slowly until you feel the piston contact the tool.

Cut the air cleaner mounting bracket off flush with the air cleaner mounting tab to allow easy access to the spark plug and to provide clearance for the piston stop tool.



On some chassis, you may find it difficult to get enough clearance between the crankshaft end bolt and the seat stay. If this is an issue for you, you can purchase a 5/16” UNF x 1” long high tensile button head cap screw to replace the original hex bolt. These bolts are commonly available at any fastener supplier.

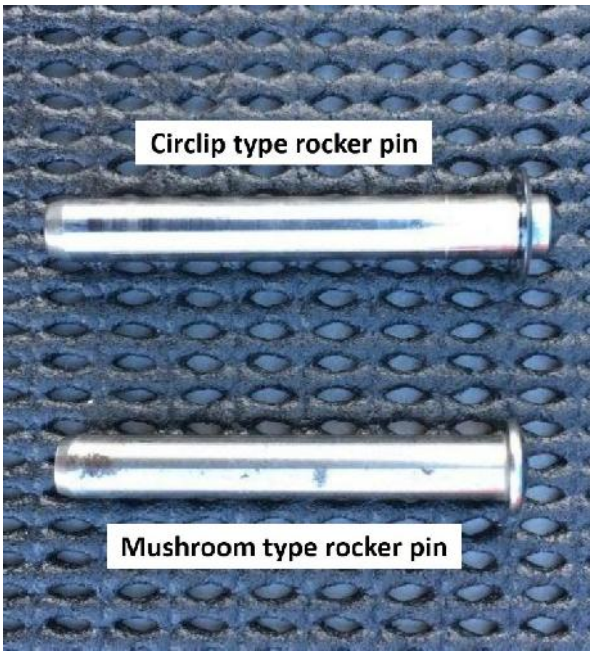


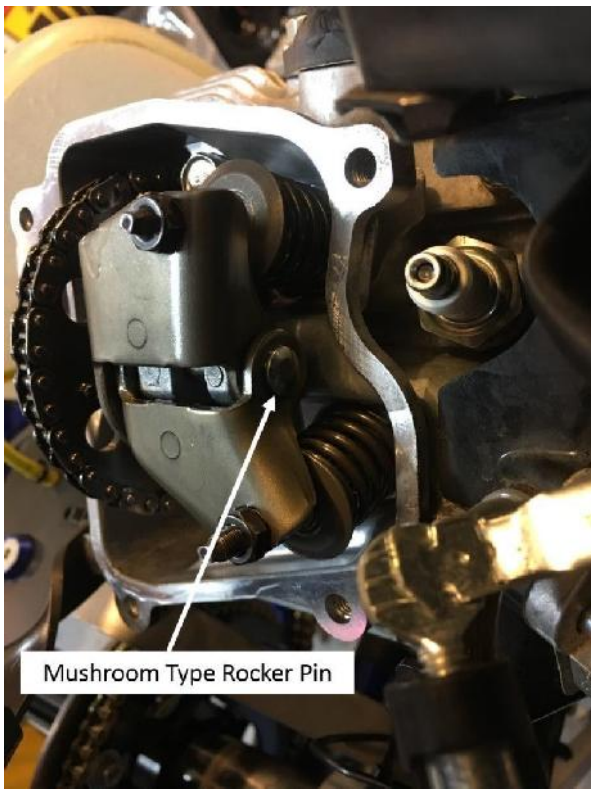
ROCKER PINS

The Subaru KX21 engine comes standard with circlip type rocker pin. If the circlip falls off, the pin can jam the cam sprocket and damage the engine.

There is a more robust, “mushroom” type of rocker pin that is available and approved for use. It is recommended that you change your rocker pin to the mushroom type for endurance racing.

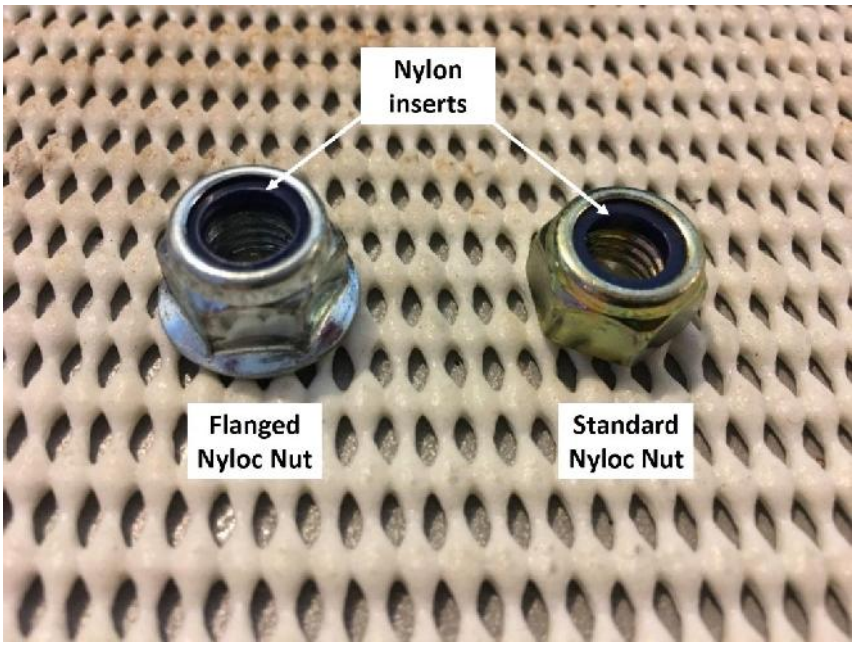
The mushroom type rocker pin is available from the club and from Aussiespeed





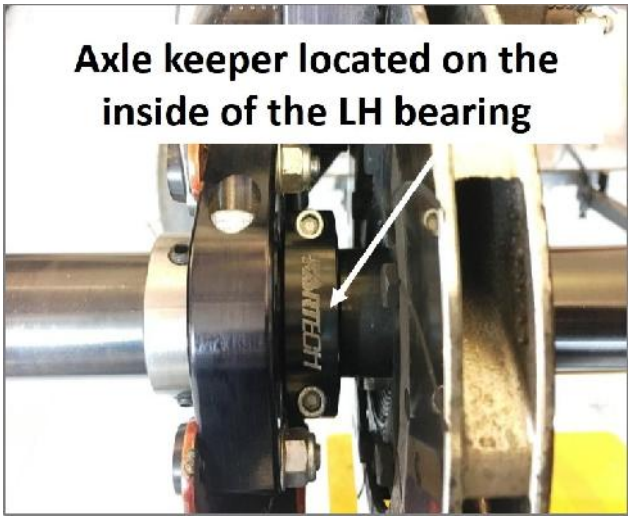
THREAD LOCKING COMPOUND

The use of thread locking compound is highly recommended on any bolt that is not held in place by a nut with a nylon insert (Nyloc nut).



AXLE KEEPERS

Axle keepers are used to prevent the rear axle from moving in the event of the axle bearing grub screws coming loose. Axle keepers are available from most kart shops and are highly recommended for endurance racing.



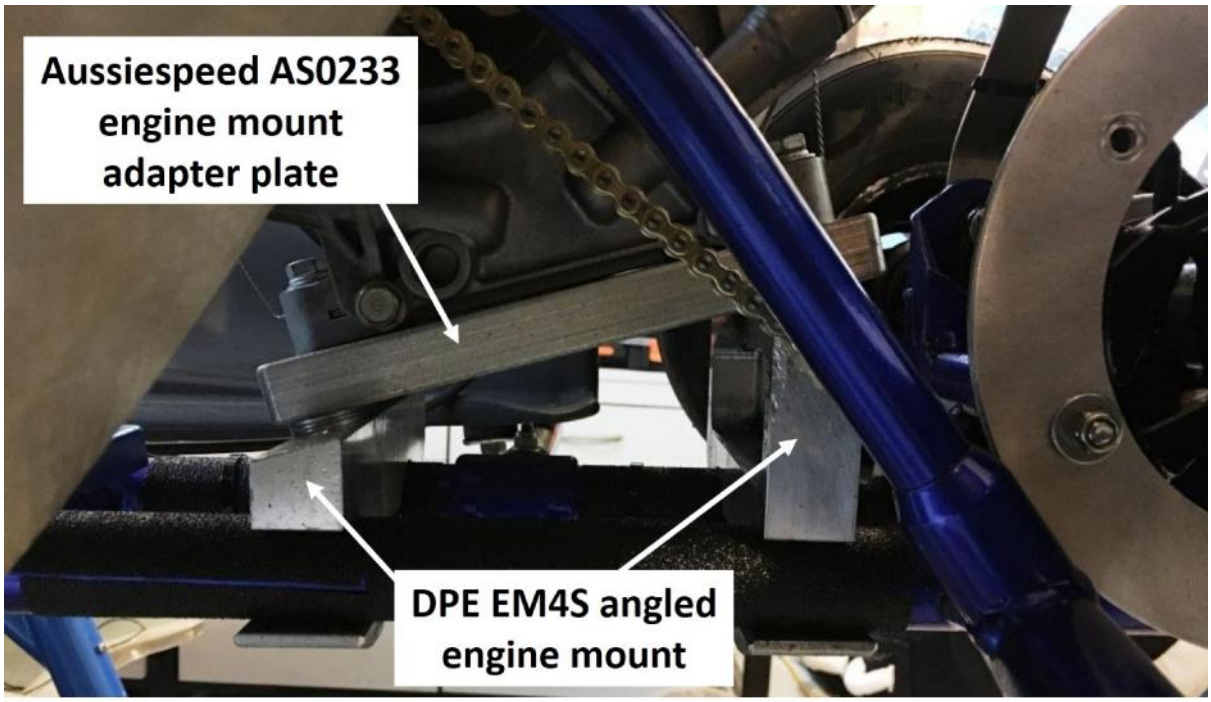
NOSE CONE CLAMPS

On most modern karts, the nose cone is clamped between the chassis and the front bar using two nose cone clamps. These clamps are an over centre type clamp and they can be loosened or knocked off by a reasonable impact. It is recommended that a cable tie be used to prevent this occurring, refer to the image below.

ENGINE MOUNTING

There is generally two methods of mounting the Subaru KX21 engine on the chassis

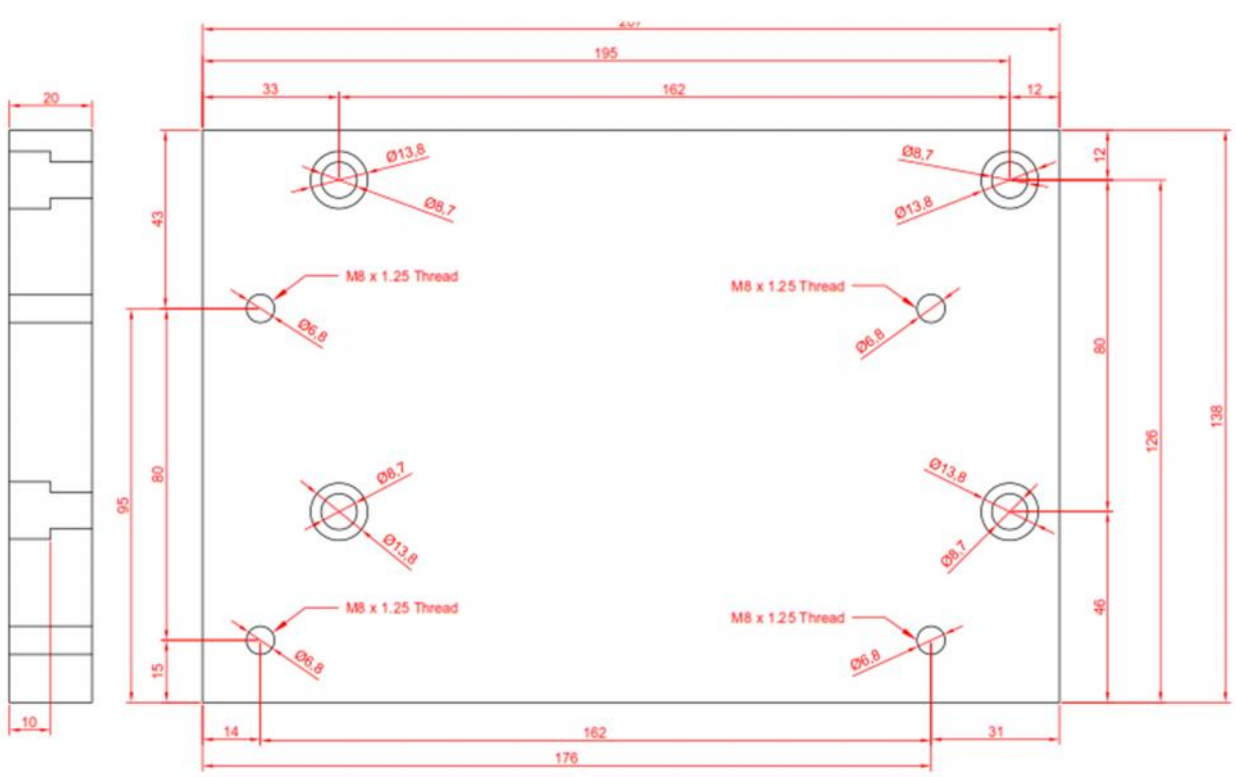
1. Drew Price Engineering (DPE) angled four stroke engine mount
2. Conventional flat engine mount.



The majority of the teams will use the angled mount as it provides greater clearance between the engine and the rear tyres, this allows the rear wheels to be brought in closer together when required. The part number for the angled mount is EM4S. This engine mount is available from most kart shops that carry Arrow parts including Stones Kart Sport and Homebush Karts.

You will need an adapter plate go between the engine mount and the engine. There are two options here, make your own or purchase a pre-fabricated adapter such as the Aussiespeed AS0233 adapter plate. If you choose to make your own, you would need 20mm thick machine grade aluminium, the hole spacing is 80mm x 162mm centre to centre. The threads for the mounting of the engine are 5/16-UNC however, you can use 8 x 1.25 if you prefer metric. The hole spacing for the DPE EM4S is also 80mm x 162mm centre to centre and the holes in the plate should be drilled to between 8.5mm and 8.75mm. M8 cap screws are commonly used to hold the adapter plate to the engine mount so, the adapter plate will need to be counter bored to allow the head of the cap screw to sit just below the surface of the adapter plate. Generally this plate is used to offset the engine rearwards and further out towards the right hand side of the kart.

Below is an image of the drawing we use to manufacture our own adapter plate.



Caution: This drawing is to be used as a guide only, this layout may not be suitable for your chassis/engine mount combination, and it is your responsibility to confirm all dimensions are suitable for your application before proceeding.

If you are using the DPE EM4S engine mount and the Aussiespeed AS0233 adapter plate, there are four sets of mounting holes on the AS0233 that you can use to mount the plate to the engine mounts. The outer two sets are spaced at 162mm which is the correct spacing for the EM4S engine mounts. If you are using the inner sets or a combination of the inner and out sets of holes, you will need some spacers between one of the engine mounts and the AS0233 adapter plate to get the angle of the adapter plate correct.

Some teams are using flat engine mounts and the same adapter plate as above, however, in most cases the engine needs to be spaced up higher to clear the rear tyres, so the plate may need to be 25mm or 30mm thick.

CHAINS

There are two types of chains being used for endurance racing

1. Conventional unsealed pin type

2. O-ring type

The conventional pin type of chain is more popular in Subaru endurance racing than the o-ring type chain.

The O-ring type chain provides for better retention of the lubricant and will therefore, generally last longer, however, O-ring chains do absorb more power from the engine than a conventional chain and they are considerably more expensive.

We use the CZ brand of conventional chain. It provides excellent life and is about 50% of the cost of an O-ring chain. A correctly cleaned and lubricated CZ chain will last for several endurance events before it needs to be replaced.

The common sizes used are 106 to 112 link chains, these sizes will be suitable for most chassis and most ratios.

CHAIN AND CLUTCH SPROCKET MAINTENANCE

Never use petrol or brake cleaner on your chain, your sprocket or your clutch drum.

Remove your chain from the kart and clean it using WD40 and a soft brush and then blow them off with compressed air. We use a shoe brush that we purchased from Bunnings.

Remove the clutch drum from the engine then remove the sprocket from the clutch drum. Clean the sprocket using the same method as you did for the chain.

For the next step, we use a cheap rice cooker, purchased from BigW for under $20.

In the rice cooker we put 2cm of melted paraffin wax (use pure paraffin wax, not a soy blend) purchased off eBay or a local candle supply company. We then add 2cm of Paraffin

Oil or 30 weight engine oil. If using a 30 weight engine oil, avoid using friction modified oils that contain Teflon or Silicon as they will damage your clutch. We take our old engine oil, filter it through a paper paint filter and use it for chain lube and in the oil/wax bath. Paraffin oil can be purchased from Bunnings.

When the oil/paraffin mixer cools in the rice cooker it will be firm, wont spill and the rice cooker lid will help keep it clean.

Place your chain and sprocket in the rice cooker and turn it on

Once the wax has melted, you need to leave the chain and sprocket in the hot mixture for at least 30 minutes, this will cause the air to escape and allow the oil or paraffin to penetrate into the pins and into the sintered bush of the sprocket. We always leave it for about an hour.

Caution: Do not let the mixture boil

The rice cooker that I use has a function that automatically changes for “Heat” to “Warm” and then keeps the mixture at the correct temperature.

After a minimum of 30 minutes, remove the chain and sprocket and allow them to cool. When the paraffin wax cools, it will seal the oil in the pins of the chain and in the sprocket bush, keeping the lubrication where you need it.

You don't need to remove the chain from the kart if you don't want to. Just loosen the engine mounts, remove the chain from the sprockets and hang it on the rear axle to clean it. Sit the kart and the rice cooker on the ground and rotate the chain every 30 minutes until the whole chain has been through the paraffin oil mixture.

Remember, when your lubricating the chain at the track, the lube is not going to penetrate into the pins, so, don’t overdo it. Too much lube will result in oil being drawn into the clutch, contaminating the friction surfaces and damaging your clutch.

Consider using a paste type lubricant such as Motul Chain Paste, your kart will be cleaner and you may not need to lubricate the chain during the event at all.

The Noram clutch sprocket is not able to be removed from the clutch drum and really doesn’t need to be. The Noram clutch has a needle roller bearing which can be lubricated by conventional methods.

Clean the drum and bearing with a petroleum based cleaner, blow the drum and bearing off with compressed air, then relubricate the bearing with a small amount of bearing grease, don’t use too much grease, it will find its way onto the friction surfaces and damage the clutch.

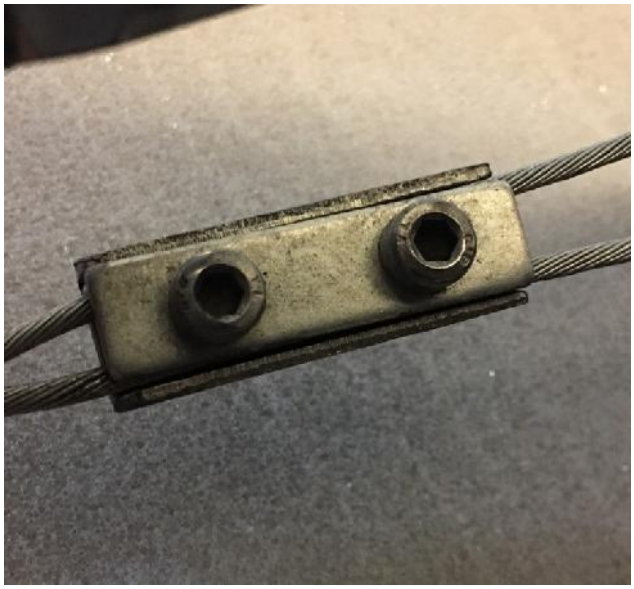
Finally, before fitting the drum back onto the clutch, spray some brake cleaner onto a clean, lint free cloth and wipe the inside of the clutch drum. Take care not to get any brake cleaner in the bearing.

SAFETY CABLES

Safety or safety retention cables are used to prevent certain components separating from the kart if they come loose.

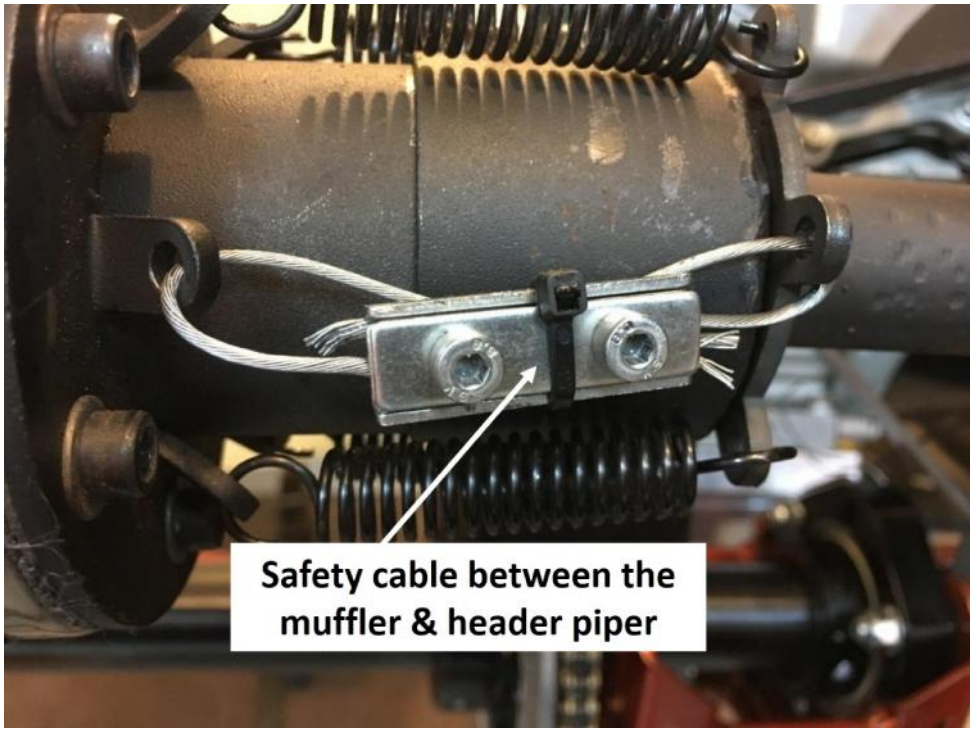
The cable that is used is the inner throttle cable which can be purchased from any kart shop, some shops will even have a complete kit which includes the cable and the clamps.

There are a couple of different types of clamps that we use, some images are included below showing the two main types.



The items that should have safety cables fitted are as follows:

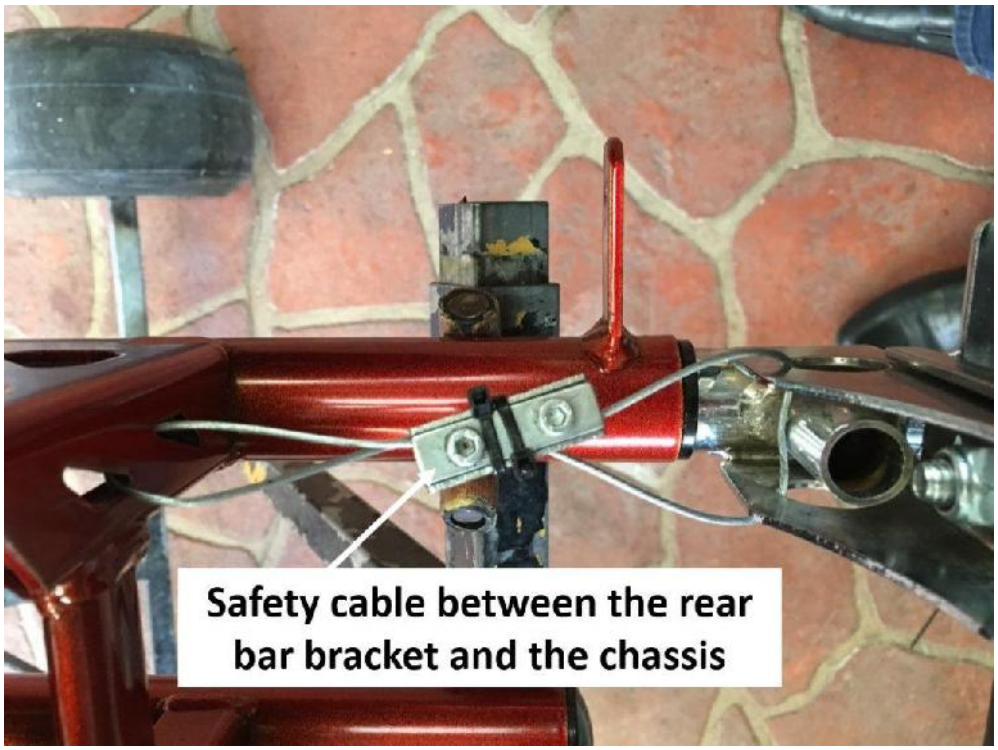
- Muffler to header pipe



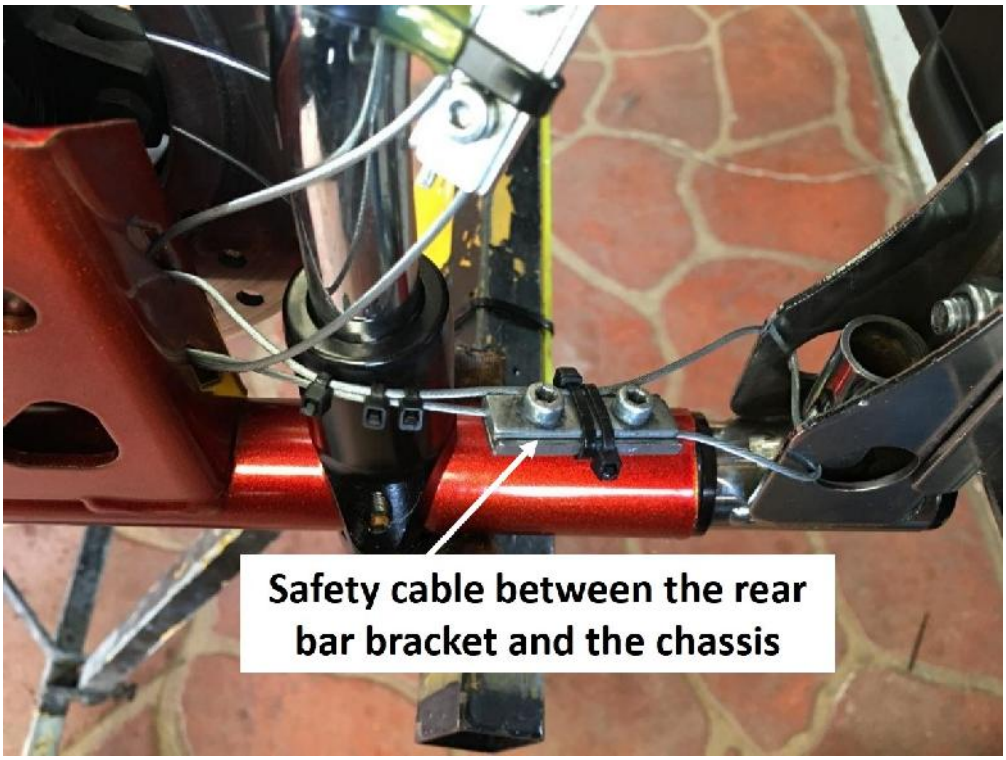
- Muffler to chassis

- Muffler to mount
  In the image below, the cable is passing through the middle of the spring

- Rear bar mount to chassis on the right hand side



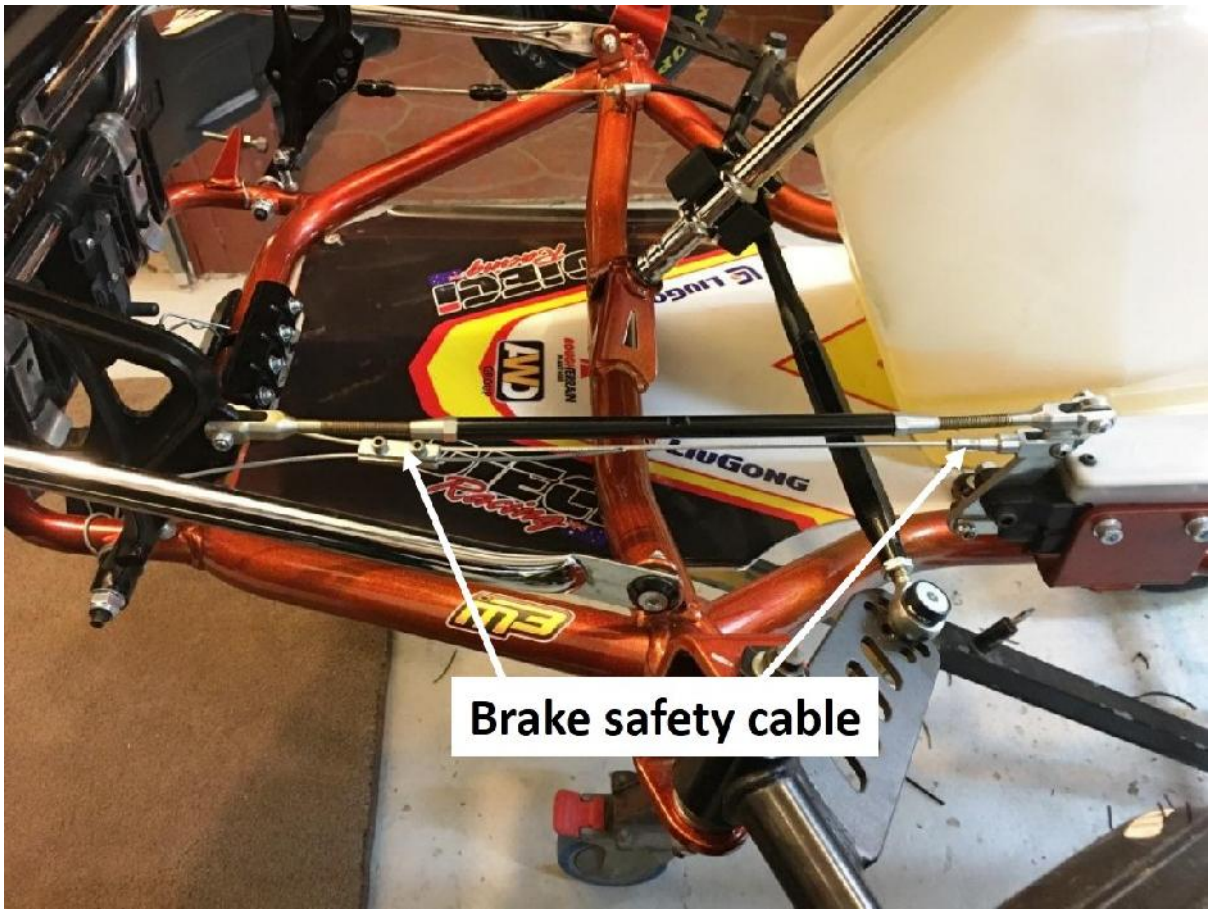
- Rear bar mount to chassis on the left hand side



The three extra cable ties on the safety cable above are to stop the cable from scratching the exhaust mount.

BRAKE SAFETY CABLE

The brakes must have a safety cable between the pedal and the master cylinder, however, throttle cable should not be used for this purpose. This cable needs to be stronger and should therefore be a proper brake safety cable, a brake inner cable or a clutch inner cable.



All safety cables must be checked regularly for broken strands, damaged cable should be replaced immediately.

LOCK WIRE ON ENGINE FILL AND DRAIN PLUGS

The Subaru KX21 engine has two drain plugs and two fill plugs, all four plugs must be lock wired to prevent them coming loose during an event.

Stainless steel lock wire can be purchased from most kart shops or industrial supply companies.

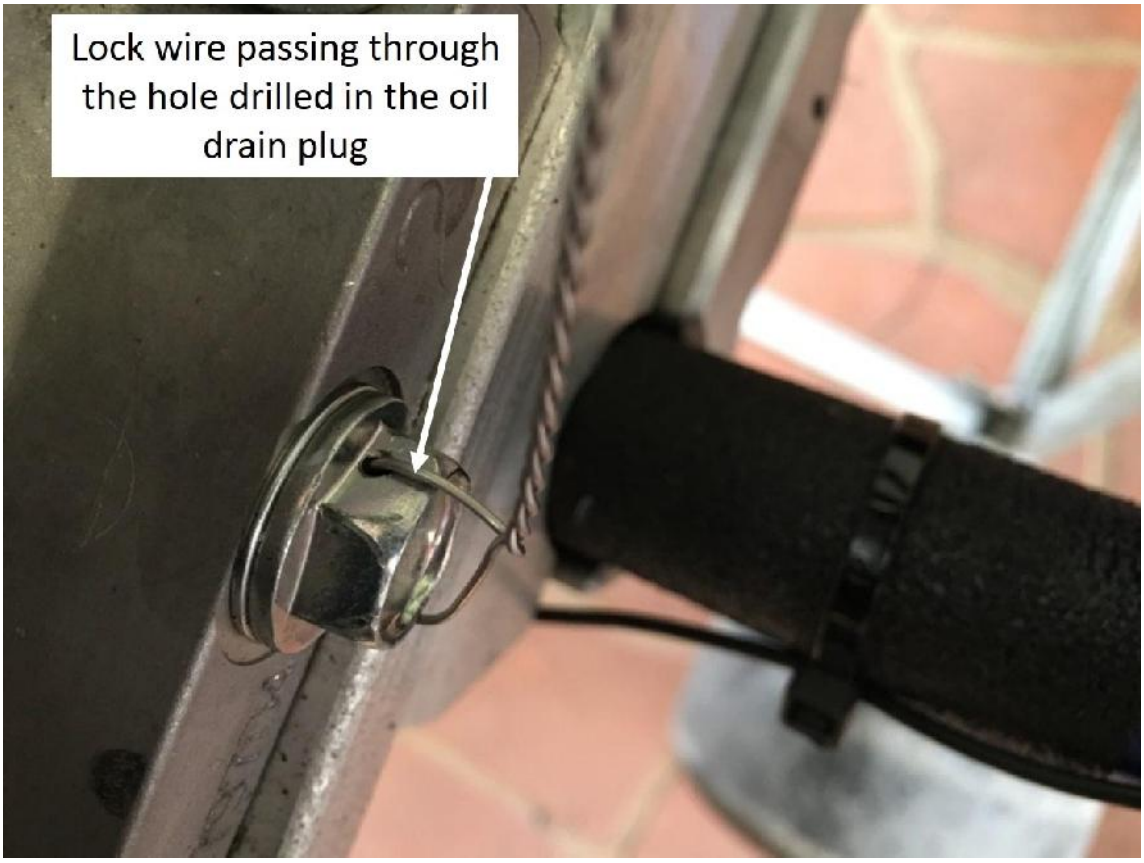
The task of lock wiring is greatly simplified by using lock wire pliers, available from most kart shops or tool suppliers.

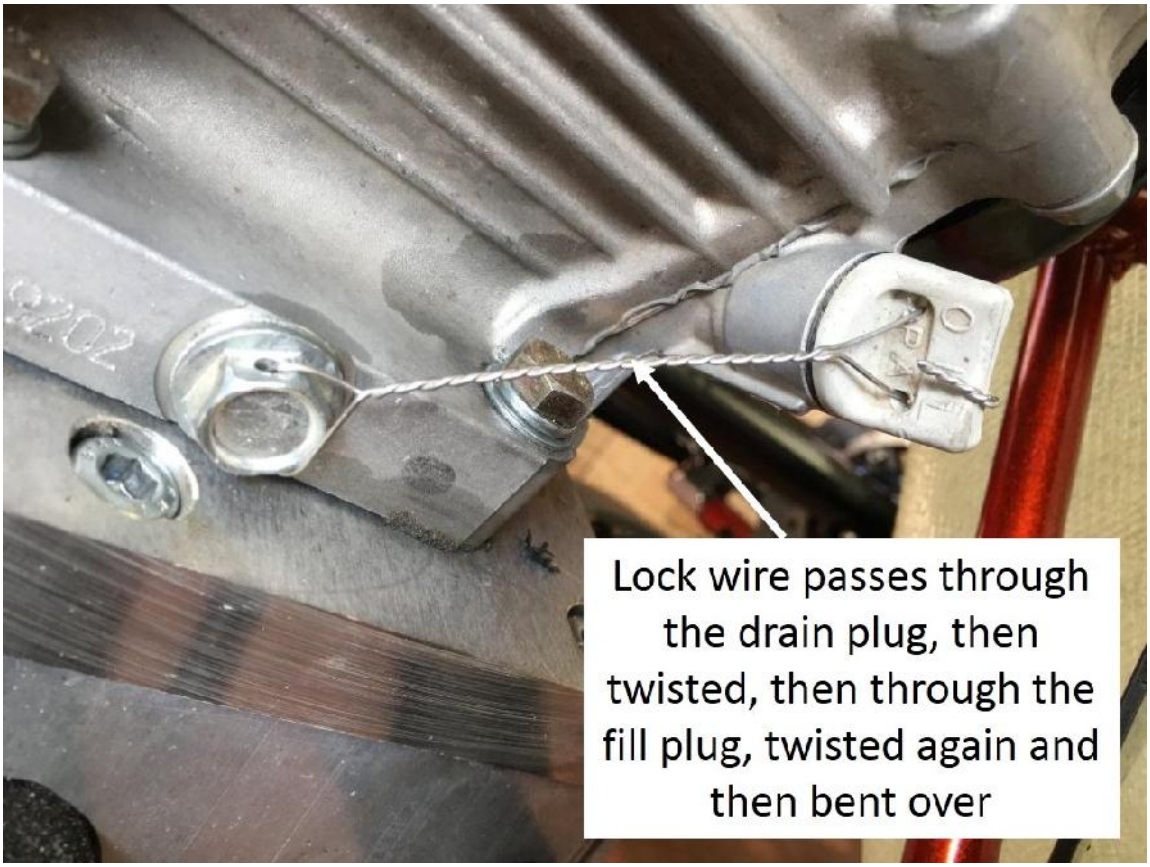
You will need to drill a hole in the head of each drain plug using a small drill, 2mm is a good size to use for this purpose.

You will need to drill 2 holes in each fill plug, 3mm is a good size for the fill plugs.

The correct steps to follow when lock wiring are as follows:

1. Pass through the drain plug and then twist so that the twists stop just short of the fill plug.
2. Push one of the two ends of the lock wire through one hole in the fill plug and then the other end through the other hole in the fill plug.
3. Twist the two ends of the lock wire together so you have approximately 20mm of twisted wire above the fill plug.
4. Cut off the excess wire and fold the end of the twisted wire over so there are no sharp ends sticking out.


Lock wire passing through the hole drilled in the oil drain plug


Lock wire passes through the drain plug, then twisted, then through the fill plug, twisted again and then bent over

BALLAST CANISTER

The 2017 Karting Australia Manual references the methods for adding ballast to your kart.

Class Rules, Chapter 21 is the chapter that relates specifically to Endurance Karting.

Class Rules, Chapter 21, section 10 (b) of the 2017 Karting Australia Manual states the following:

b) Fixing of Ballast to the Kart

(i) Ballast may be added to the Kart but must be firmly attached with secure mechanical fixings.
(ii) Any ballast carried in the seat or seat insert must be restrained by a method deemed acceptable by the scrutineer.
(iii) It is the team's responsibility to supply ballast if required.
(iv) A team may be disqualified from the Event if any ballast becomes dislodged during practice, qualifying or the race.
(v) No diver's belts or other methods of ballast are to be carried by Drivers.
(vi) It is a serious offence to have any ballast in a Driver's clothing or on a Driver's person.

The ballast canister shown in the photos below allows us to quickly change the weight of the ballast when changing drivers. Remember, the ballast must be retained using at least an 8.0mm bolt of minimum grade of 8.8.

If you're not sure if your ballast canister will meet the requirements, please contact a club official prior to your first event so they can provide any assistance you require. It's much better to get any issues resolved before you get to scrutineering.

This ballast canister has been manufactured using a short length of 100mm x 3.0mm aluminium tube purchased from Edcon Steel and two 110mm long 40mm x 40mm x 5mm pieces of Aluminium angle. We got the local aluminium welder to weld them on the bottom of the canister at the correct spacing to suit the mount that we have on our chassis. We then cut off the excess angle and ground them to the same profile as the tube. We also cut the bottom of the angles off at about 45°

You may also notice that we have a piece of foam in the bottom of the canister. The foam is 25mm thick. This is to prevent the weight hammering the bottom of the canister and therefore hammering the chassis. The foam allows water to pass through and drain onto the ground. All the fasteners used are 8.0mm diameter and a minimum of Grade 8.8.

SPROCKET GUARD

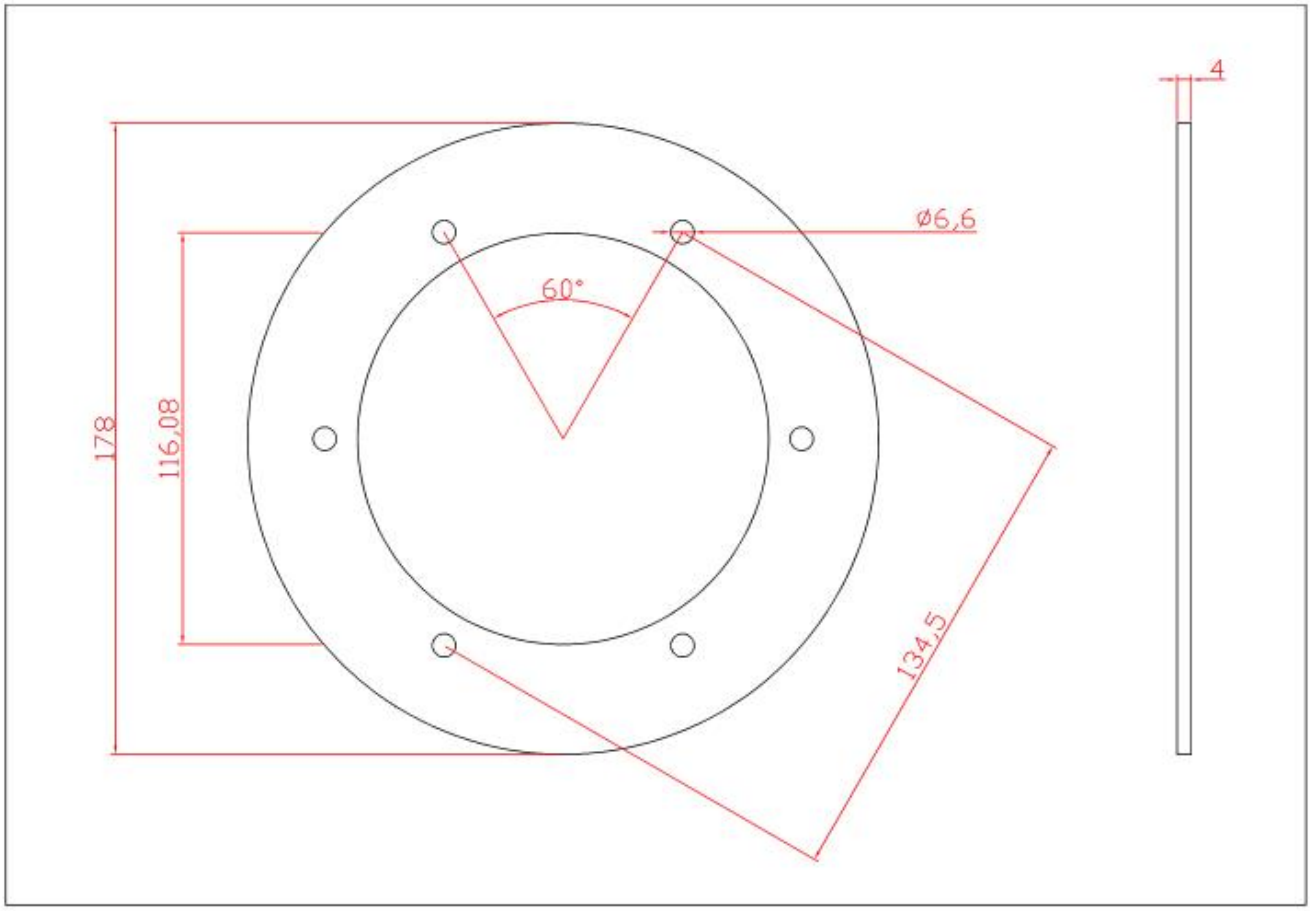
A sprocket guard can help prevent chain and sprocket damage when you run off the track or catch a ripple strip.

You can make your own sprocket guard using an old sprocket as a template for the mounting holes and large centre hole.

The sprocket guard should be large enough to protect the chain and sprocket, however, a maximum of 15mm may protrude above the chain.

The photo below shows an aluminium sprocket guard, rules state that the sprocket guard must be made of plastic, if you have an aluminium guard fitted, please check with the scrutineer and track operators at your event before using it.

Below is a drawing of the sprocket guard that we use.



You can download a DXF file via the link below if you would like to get one made.

https://www.dropbox.com/s/arnr41qiafi9dsb/Sprocket_Guard_178mm.dxf?dl=0

FUEL HOSE CONNECTIONS

All fuel hose connections should be retained using two small cable ties on each connection. This will help prevent the fuel hoses from being pulled off in an accident and will also help to prevent air being drawn in and fuel leaking out

FUEL PUMP MOUNTING

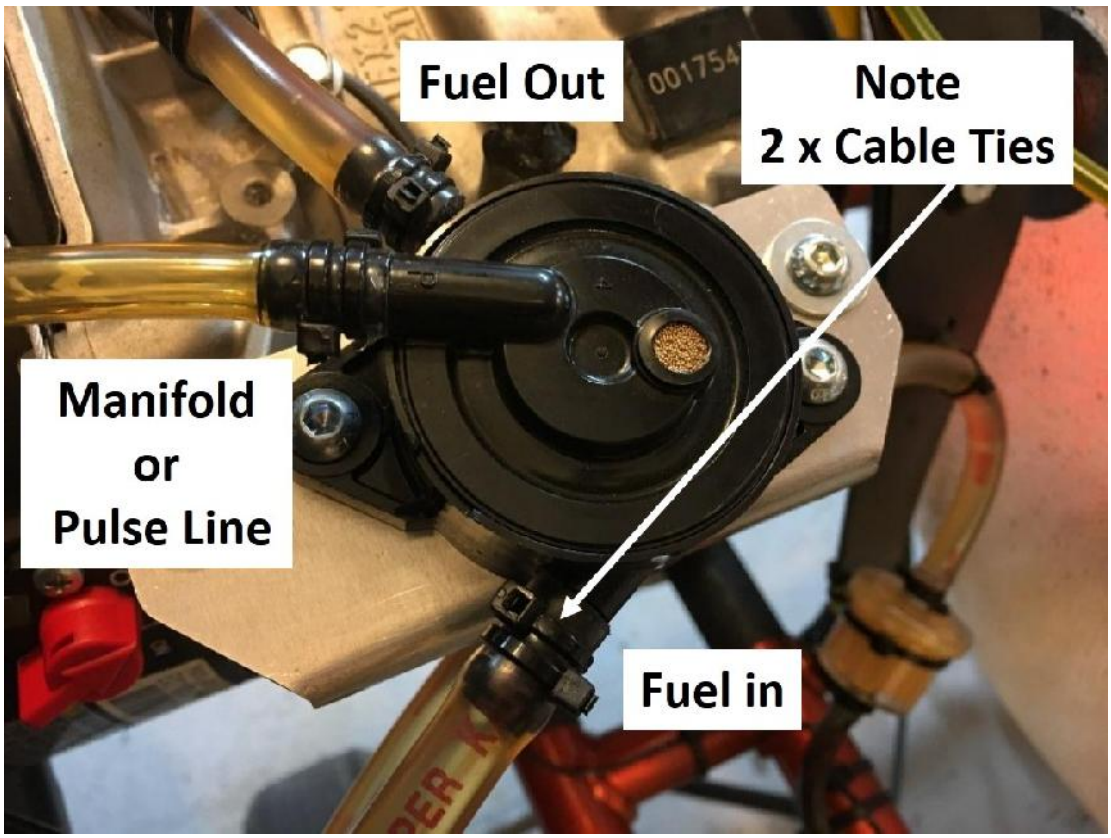
The fuel pump is commonly mounted to the top of the engine at the front.

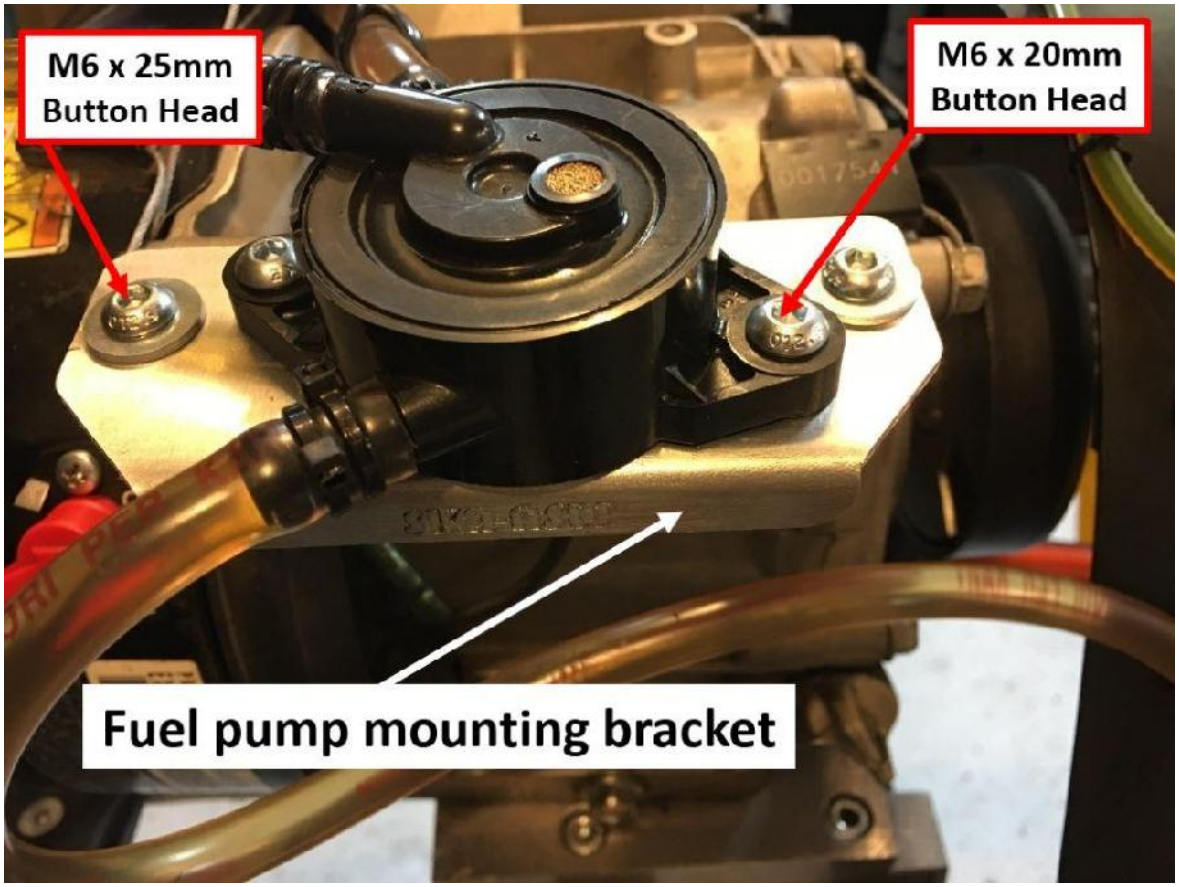
You can either manufacture a bracket or purchase a readymade bracket from SKANSW.

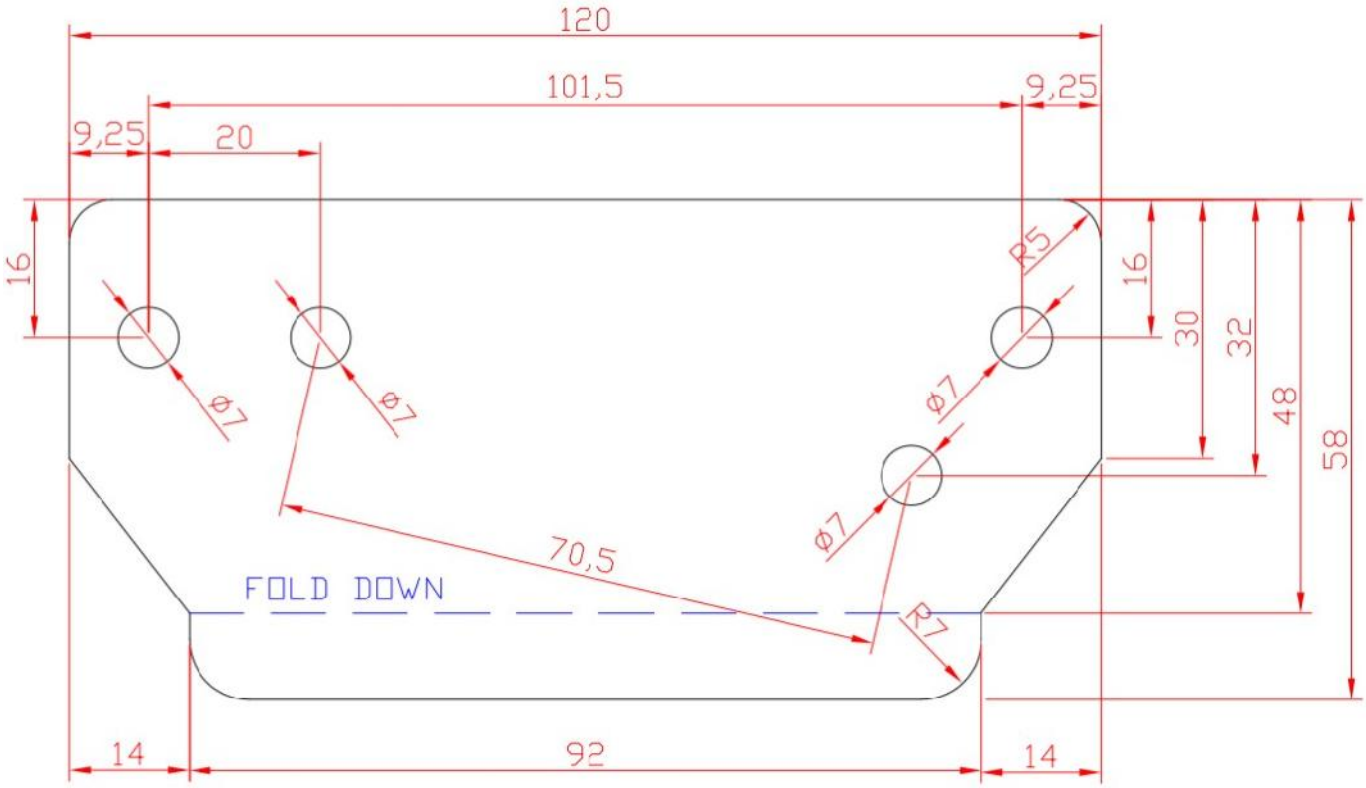
There are three hoses that connect to the fuel pump

1. Feed line from the fuel tank (via a filter)
2. Pulse line from the manifold
3. Supply line to the carburettor

See the images below identifying the ports on the fuel pump and SKANSW bracket. We have also included below a drawing of the bracket in case you want to make your own.





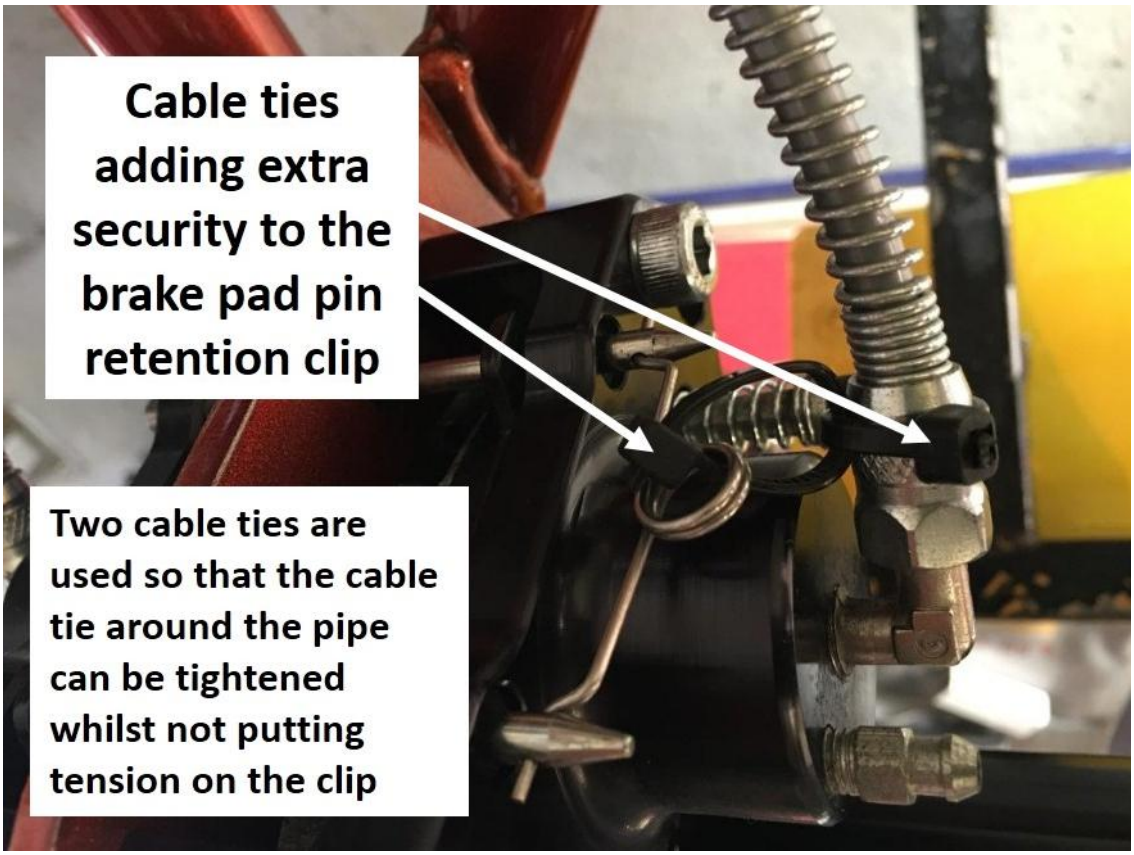


You can download a DXF file via the link below if you would like to get one laser cut.

https://www.dropbox.com/s/panb5xbtqp2shdc/FuelPumpMount.dxf?dl=0

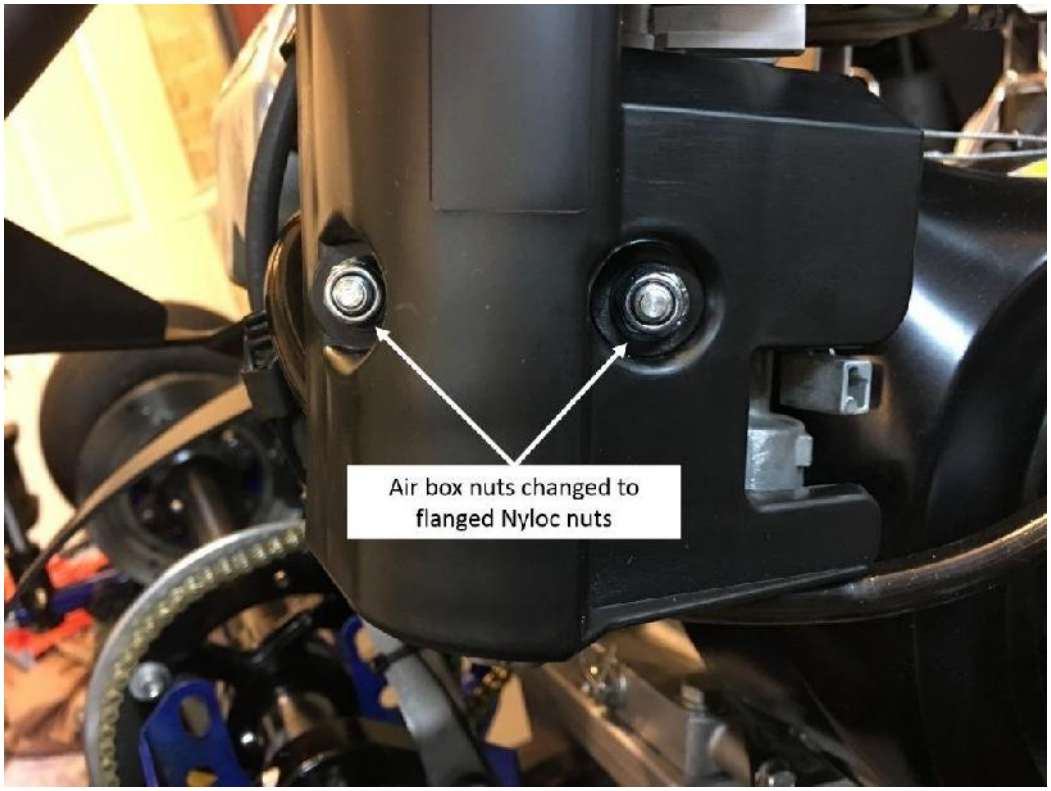
BRAKE PAD PIN CLIPS

If your brake calliper uses pins to retain the brake pads, you will most likely have a clip or clips holding those pins in. A lightly tensioned cable tie from the pin clip to the calliper will help prevent the clip falling out.



AIR CLEANER NUTS

When the Subaru KX21 engine comes from the factory, the air cleaner lid is held on with a wing nut. The wing nut should be discarded and replaced by a Nyloc nut.



It's not really necessary to change the nuts that hold the air cleaner onto the intake studs. If you do change them, you may need to Loctite the studs into the cylinder head with medium strength Loctite to prevent them unwinding with the extra tension of the Nyloc inert.

ENGINE BREATHER HOSE CONNECTION TO THE AIR BOX

Where the breather hose connects to the air box, it is possible for the hose to loosen over time and in the wet, water may be drawn in through this hose. Fit two small cable ties to the hose where it connects to the air box.

OIL CHANGES

In order to preserve your engine, regular oil changes are necessary.

Good practice is to measure your oil on the way in to the engine and measure the oil when you drain it out. This will allow you to gauge how much oil your engine is consuming. If oil consumption was to suddenly increase, this would be a good early indication that a problem inside the engine may be developing.

There's a couple of safety measures that you can take before draining the oil, to prevent ever starting your engine without oil in it.

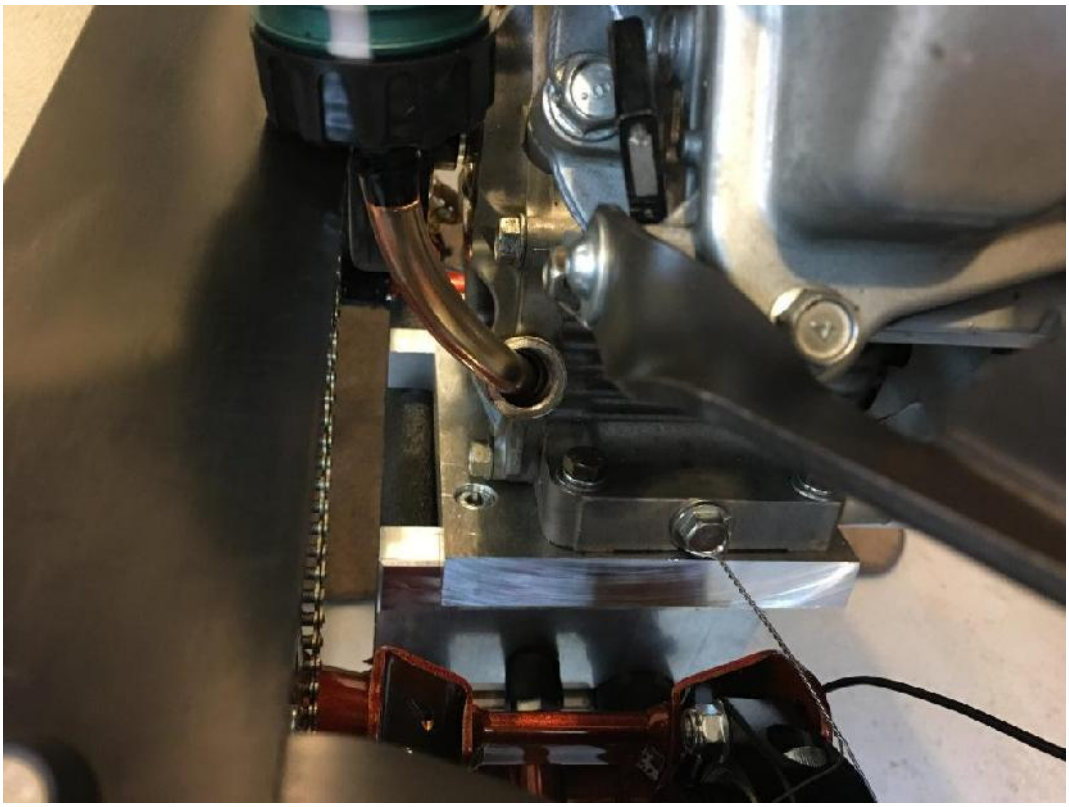
1. Put a sign on the pull starter that says "No oil in engine". We just print ours out onto bright yellow paper then laminate them to keep them clean. Use a cable tie to hold it on.
2. Remove the spark plug lead and ground it using an old spark plug or a spark testing tool.

Never take the sign off or reconnect the plug lead until you have re-filled the oil.

Always drain your engine oil when the engine is hot, not when it's cold. Take great care not to allow the hot oil to come into contact with your skin as hot oil can cause very serious burns.

We use an old one litre oil bottle that we cut the base off to put engine oil into the engine.

These bottles are typically supplied with gear oil in them. The hose on the cap makes it really easy to access the filler plug hole and get the oil into the engine without making a mess.



The most commonly used oil is the Briggs & Stratton Amsoil, this oil is available from Aussiespeed

If you are filling the engine with the recommended quantity of oil (600ml) and its puffing smoke on certain corners for the first few laps, you might need to slightly reduce the amount of oil you are putting in. Reduce the amount in very small amounts (10ml) until the issue ceases to occur. It has been reported that some teams have run down as far as 450ml, however, this is very rare and in my opinion too low. The oil in a Subaru KX21 is the cooling medium, if your oil level is too low, the cooling effectiveness will be reduced and engine longevity may be effected.

Equally, in a splash fed engine, excessive engine oil can reduce performance due to drag on the crankshaft as it passes through the oil bath and may even cause damage to the engine in extreme cases.

Use a test day to determine what the correct amount of oil is for your engine. Don't start with a low oil level and work your way up, start with 600ml and reduce it from there.

We (Dieci Racing) have never had to go below 570ml of oil.

We do use a mineral based oil for running our engines in as we believe it allows the rings to cut in more effectively, this is a matter of choice, many teams are running the synthetic AMSOIL from the start without issues.

Mineral oil and synthetic oil don't mix. If you do run in the engine in on a mineral oil, once you have filled your engine with synthetic oil for the first time, remove the chain and run the engine for 5 minutes, drain that oil and refill with fresh synthetic oil. Do not drive the kart on the first fill of synthetic oil after swapping over from mineral oil.

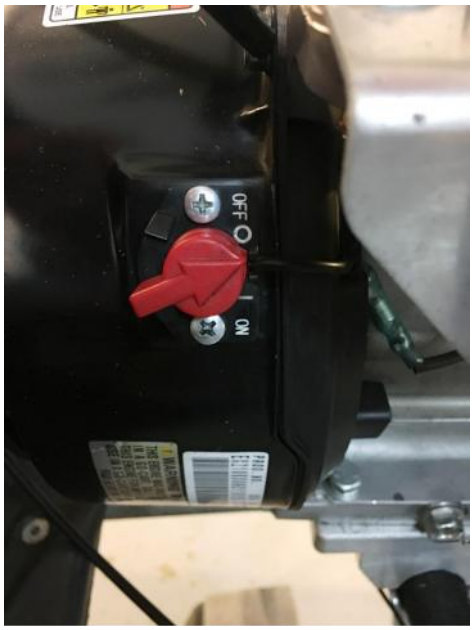
ENGINE RUN IN PROCEDURE

Caution: Whenever your engine has no oil or low oil, you should have the spark plug lead removed and grounded and a sign on the pull starter

Have the engine securely mounted and the drive chain removed

Ensure the engine has the correct quantity of oil in it, remembering that the engine is delivered without oil.

Ensure the kill switch is in the off position



Loosen the valve cover and lift it slightly at the bottom edge.

Remove the spark plug lead and ground it to any part of the block using a spare spark plug or a spark testing tool. Never pull the starting cord with the spark plug lead disconnected and not grounded, you may damage the ignition system.

Pull the engine through several rotations to get some oil moving around.

Reconnect the spark plug lead to the engine

Turn on the fuel, close the choke and turn the kill switch to the on position.

Start the engine, with the valve cover still loose

Run the engine with constantly varying the rpm between idle and 2000rpm whilst watching for the oil to start dripping out from under the valve cover. If oil doesn't start to appear within 60 seconds, shut the engine down and have it checked.

Once you have confirmed that oil is dripping out of the loose valve cover, you can be sure that the oil is making its way to the top of the engine. The engine should be shut down and the valve cover tightened.

With the engine level, check the engine oil level.

Start the engine again and run it for 2 minutes, constantly varying the revs without exceeding 2000 rpm, shut it down and allow it to cool down.

Start the engine again and run it for 3 minutes, constantly varying the revs without exceeding 2000 rpm, shut it down and allow it to cool down.

With the engine level, check the engine oil level.

Start the engine again and run it for 5 minutes, constantly varying the revs without exceeding 2000 rpm, shut it down and allow it to cool down.

Drain and discard the oil whilst the oil is still hot, allowing the oil to drain for 10 minutes

Re-fill the engine oil with clean oil

Refit and tension the chain

Restart the engine and drive the kart on the track for between 15 and 20 minutes, constantly varying the RPM between clutch lockup and 4000rpm

Shut the engine down, drain and discard the oil whilst the oil is still hot, allowing the oil to drain for 10 minutes

Refill the engine with clean oil

Go racing.

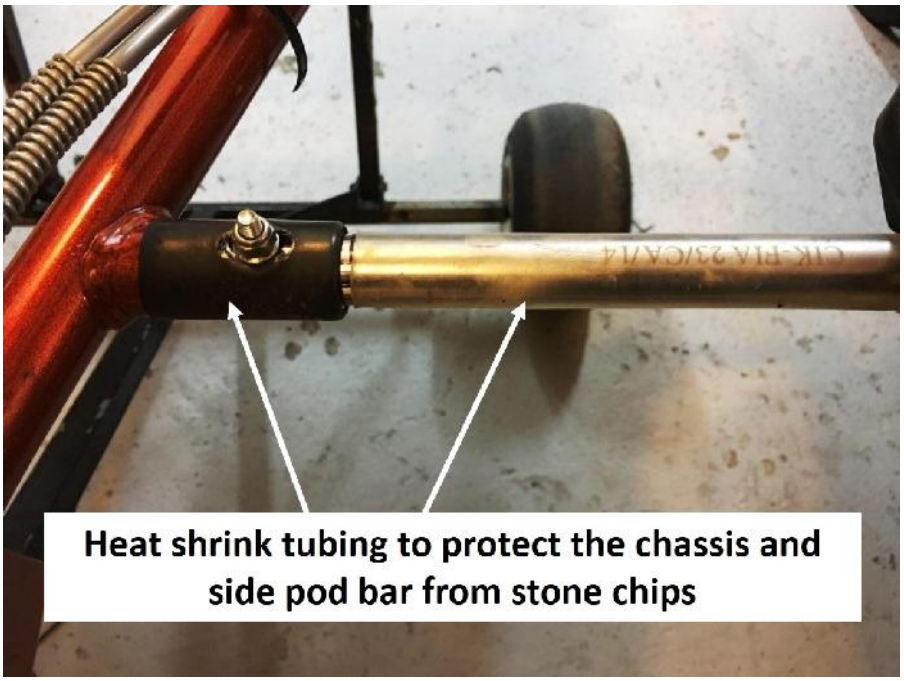
Remember: Mineral oil and synthetic oil don’t mix.

If you do run in the engine in on a mineral oil, once you have filled your engine with synthetic oil for the first time, remove the chain and run the engine for 5 minutes, drain that oil and refill with fresh synthetic oil. Do not drive the kart on the first fill of synthetic oil after swapping over from mineral oil.

PROTECTING YOUR CHASSIS

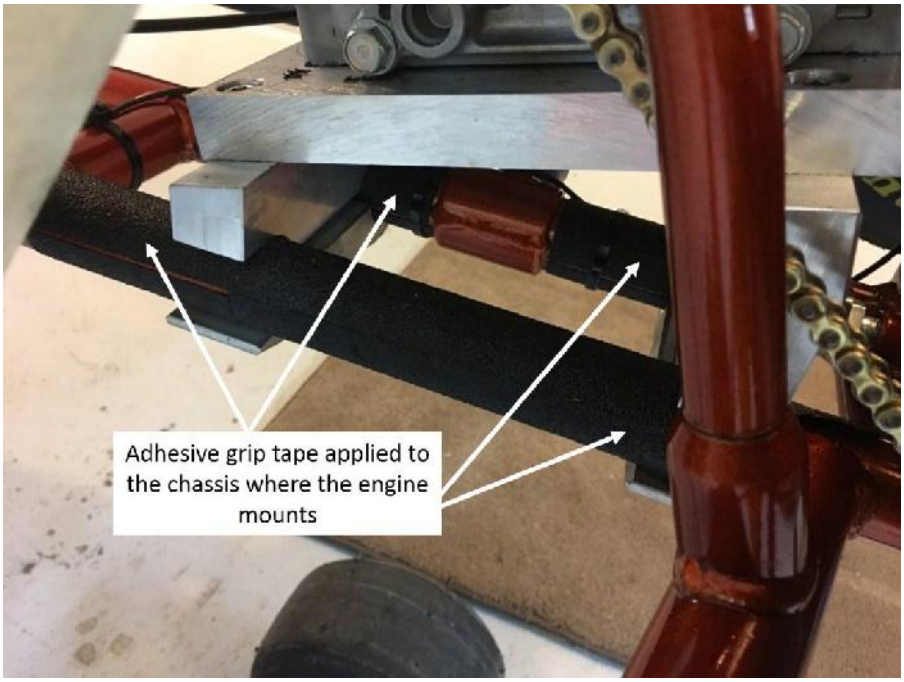
If you have been lucky enough to invest in a new chassis, you may want to add some protection to keep it looking good and prevent damage so that it maintains its value.

The image below shows how we have fitted heat shrink tube to the side pod mount and the side pod bars to protect them from stone chips



The image below shows how we have applied grip tape to the chassis rails where the engine mounts. This grip tape serves two purposes

1. It helps prevent the engine mounts from scratching the chassis
2. It grips the engine mount, reducing the need to overtighten the engine mount clamps which can crush the chassis.

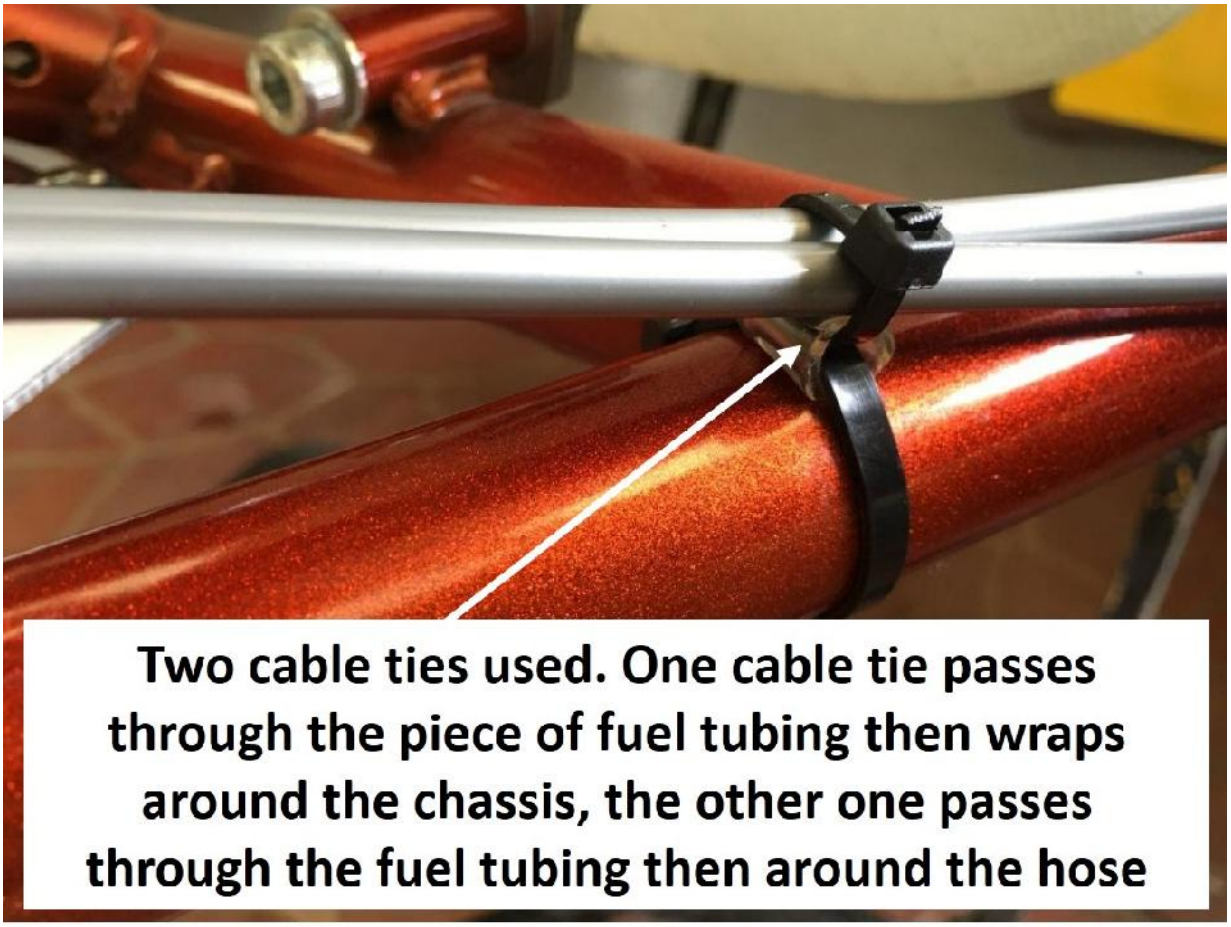


HOSE AND CABLE SECURITY

Below I have detailed three different methods of securing hoses, pipes or wires to the kart chassis.

My preference is the first method shown below as the fuel tube helps grip the chassis to stop the cable tie rotating with vibration without having to clamp the hose, or pipe too tightly.

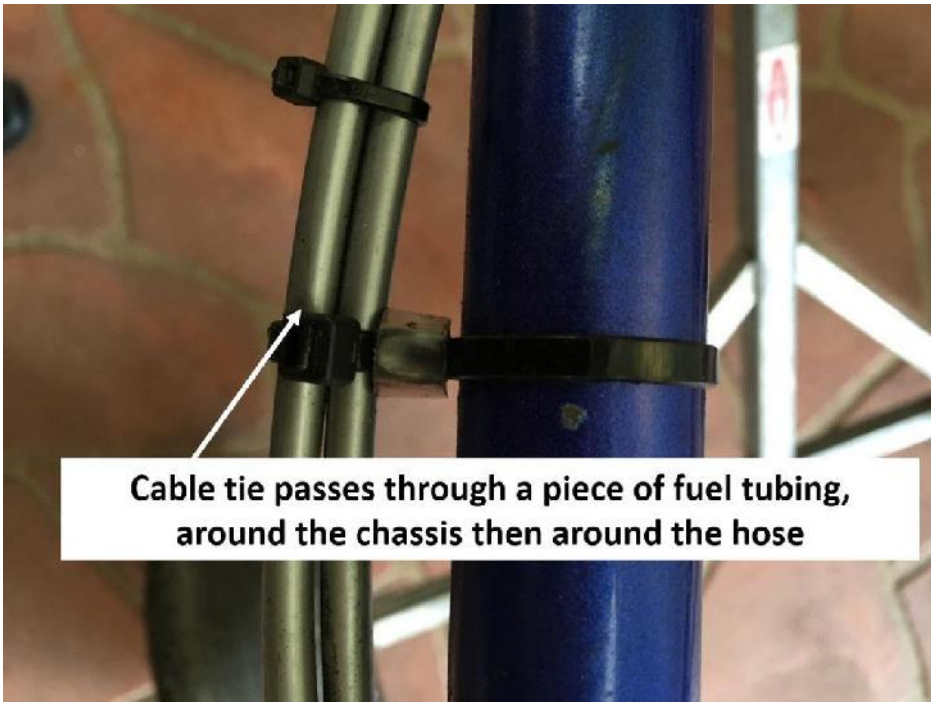
Two cable ties are used. One cable tie passes through a short piece of fuel tubing and then wraps around the chassis before being tensioned. A second cable tie then passes through the fuel tubing then, wraps around the item to be held.



Fuel filter held by the double cable tie method

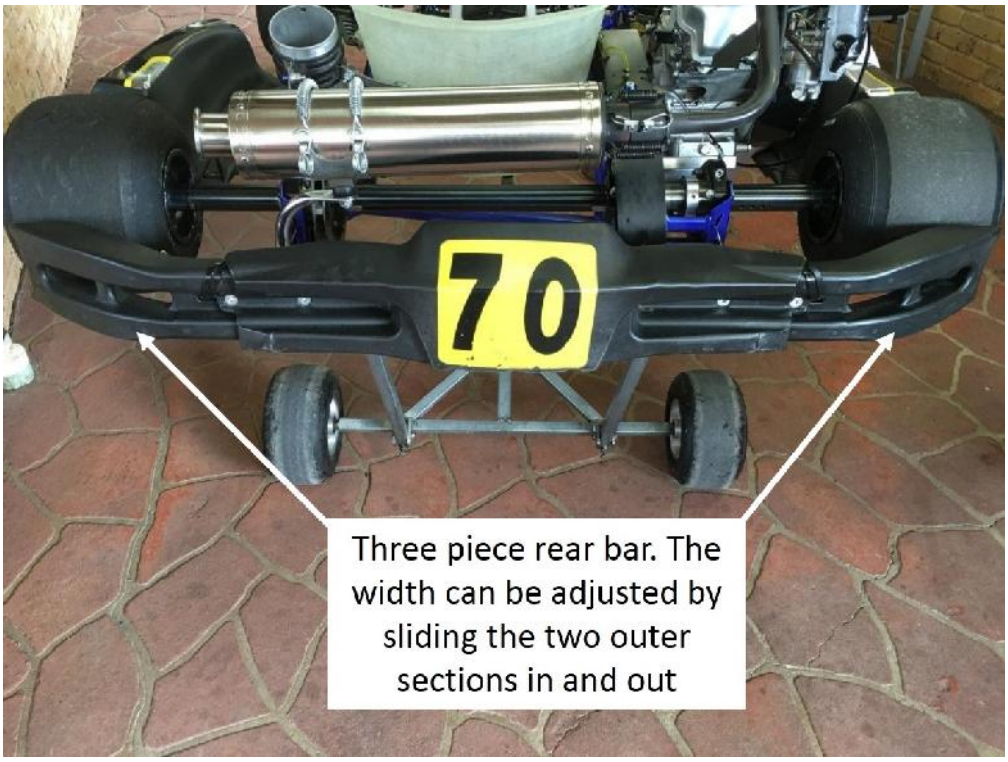
This method below, uses a special “Double head” cable tie. The double head design allows the cable to be wrapped around the chassis and tensioned before being wrapped around the item being held. These cable ties can be purchased from Bunnings. This is the same method used buy some of the chassis manufacturers.

The method below has a single cable tie that passes through a short piece of fuel tubing before wrapping around the chassis and then wrapping around the item to be held.

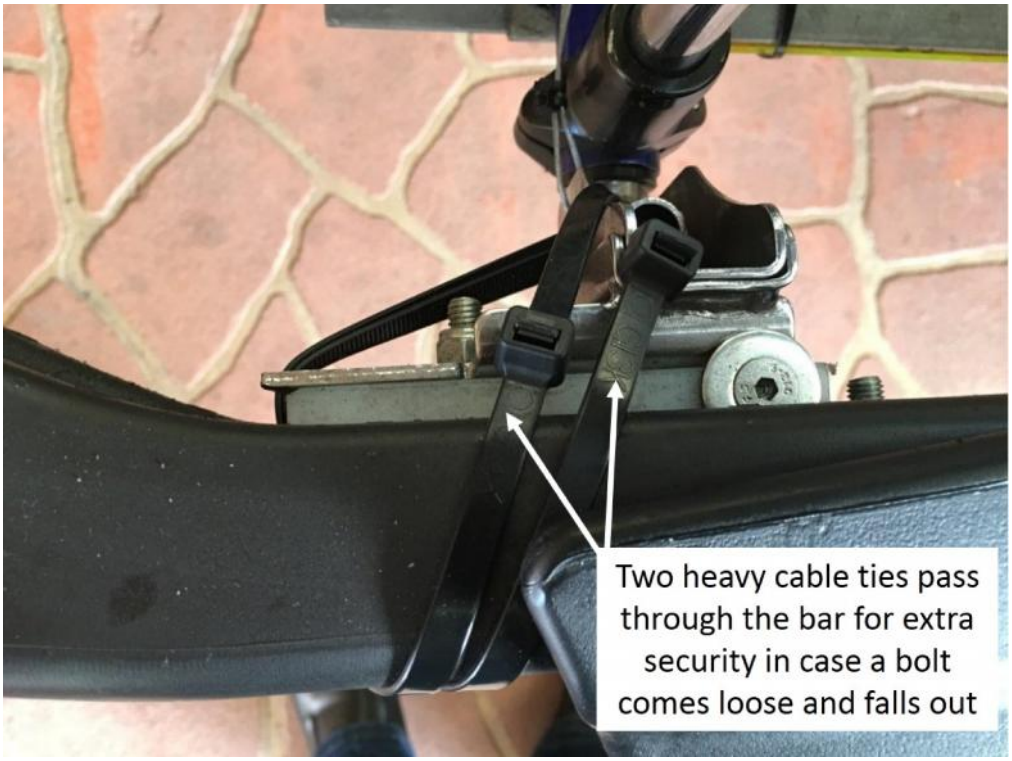


REAR BAR

We use a three piece rear bar to allow us to adjust the width of the bar when we adjust the rear track (width of the rear wheels).



The image bellows shows the use of two heavy cable ties to add extra security to the rear bar, These cable ties pass through the rear mount and then through a hole in the rear plastic bar. If a bolt were to come loose and fall out, these cable ties may help to prevent a forced pit stop.

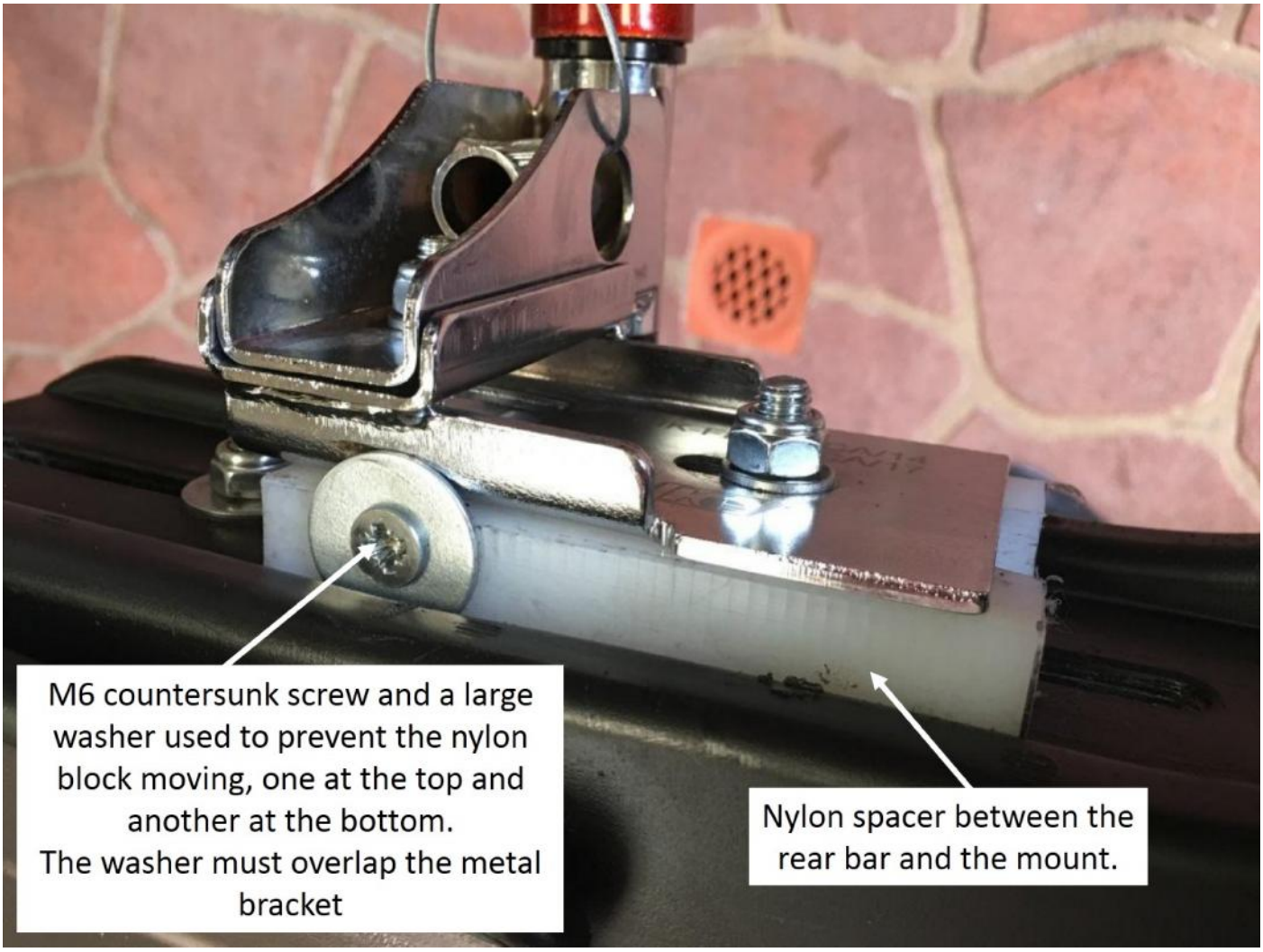


More often than not, we need to space the rear bar further rearward to clear the tyres sufficiently. Our preference is to put the spacer between the rear bar mount and the bar, not between the rear bar mount and the chassis. When the spacers are between the rear bar mount and the chassis, they seem to vibrate loose and wear in the chassis.

Here we have used some nylon that we purchased from a plastics supplier. If you don't have a plastics supplier close by, a thick nylon chopping board could also be cut down and provide several spare spacers.

You will noticed that we have used M6 countersunk screws and large washers to prevent the nylon spacers from rotating, this is very important. There's no need to tap a thread in the nylon, just drill a 5.0mm hole and the bolt will cut its own thread.

The nylon block should be cut to the same width as the slot in the rear bar, for most three piece bars, this width will be 60mm.



COMMUNICATION SYSTEMS

It's critically important to have an established system of communication between the driver on the circuit and the crew back in the pits.

You don't need to go out and spend big money on a full race comms system, a simple homemade pit board will do the job very well. Even if you do go out and get yourself a radio system, you will still need a pit board for when the radios fail.

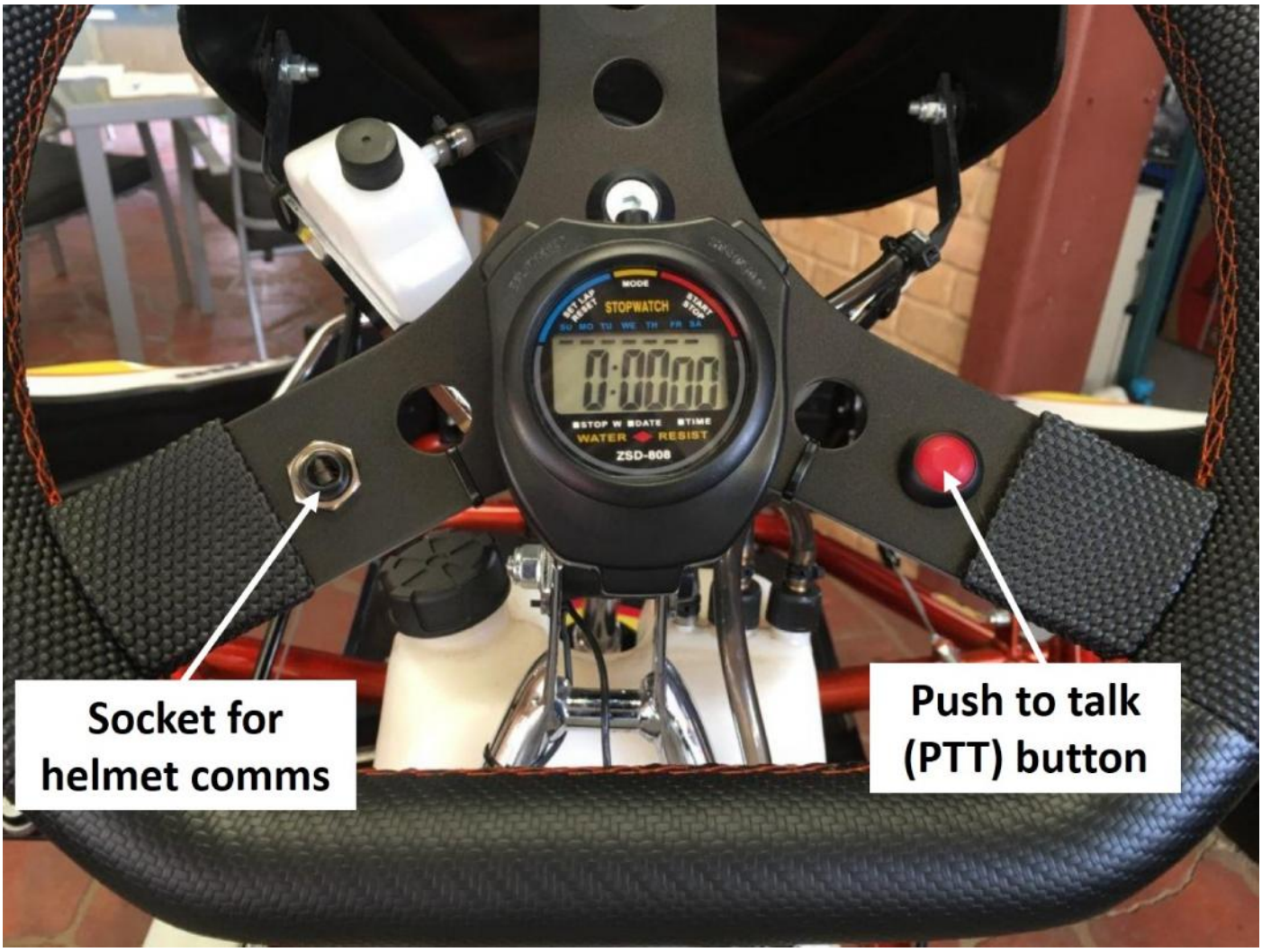
Below is an image of the pit board that we use when our radio fails. We have our drivers give a simple acknowledgement in the way of a single handed "Thumbs up" to let us know that they've spotted the board.

If you're going to purchase a radio system, you don't need to go out and spend hundreds of dollars. We use Baufeng radios that cost us about $50 each on eBay including delivery.

We then buy helmet comms kits on eBay that cost us about $25 a set. If you only plan on communicating from the pits to the kart, that's all you need. If you with to be able to have the driver communicate with the pit crew, you will need to modify your setup to include a push to talk (PTT) button and a socket to plug the driver in. We do have two way communication setup, however, 95% of the time, we have our drivers give a hand signal to acknowledge a message.

There are a number of teams that are using motorcycle Bluetooth communications systems. Whilst I haven't used these for racing karts, I have used them on motorcycles. The good quality systems have good range and very clear communications, however, the cheaper systems do suffer from a lack of range.

The image below shows our helmet socket on the left and our PTT button on the right of the steering wheel.



THROTTLE CABLE

The throttle cable gets a serious workout during an endurance event, you need it to be reliable and smooth.

We recommend that you replace the standard 1.2mm throttle cable with a 2.0mm throttle cable. The 2.0mm cable is most commonly referred to as a clutch cable and will be available from most kart shops. Make sure you purchase an inner and outer cable, the 2.0mm cable will not fit into a 1.2mm outer cable.

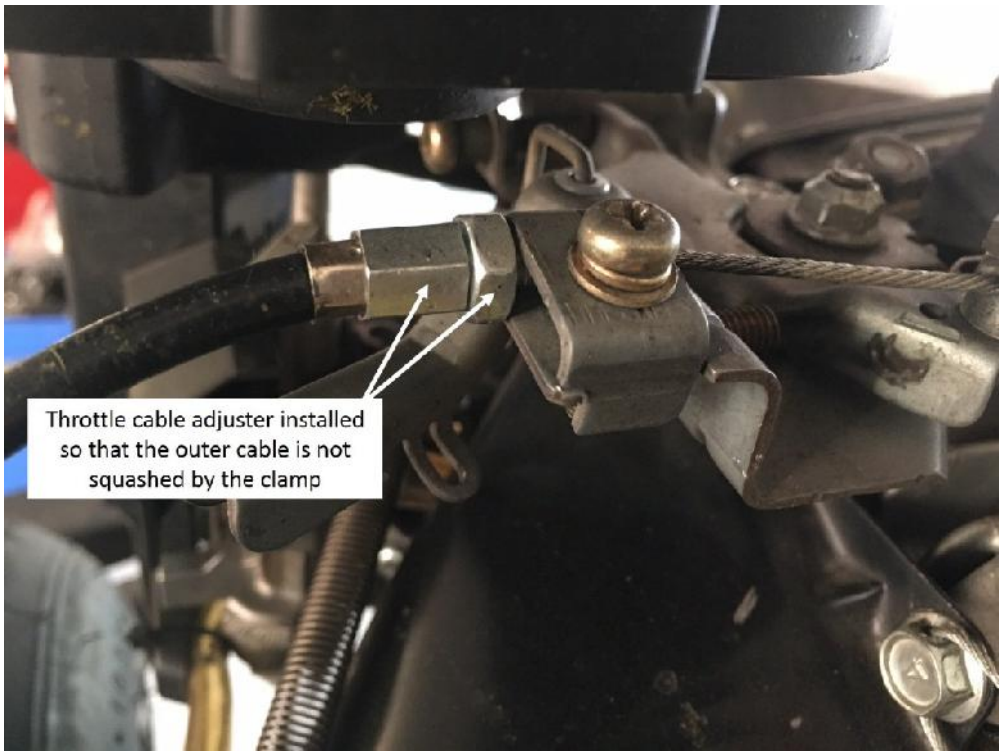
Throttle pedal design varies considerably across the different brands of chassis, below are some photo's showing how we connect and terminate the throttle cable on an Arrow chassis.

Where the cable loops around the bolt in the throttle pedal, it is not clamped by the bolt and the washer, it is free to swivel around a little bit, this prevents the strands becoming fatigued and breaking.

The throttle cable is double clamped and then the loose end is held in place with a piece of clear heat shrink.

Don't forget to use thread locking compound (Loctite) on the cable clamp grub screws.

If you insert the outer throttle cable into the clamp at the engine end, it may be crushed or loosen up over time. It's best to fit a throttle cable adjuster and clamp it and then just insert the outer cable into the adjuster.



DRIVER STINT MANAGEMENT

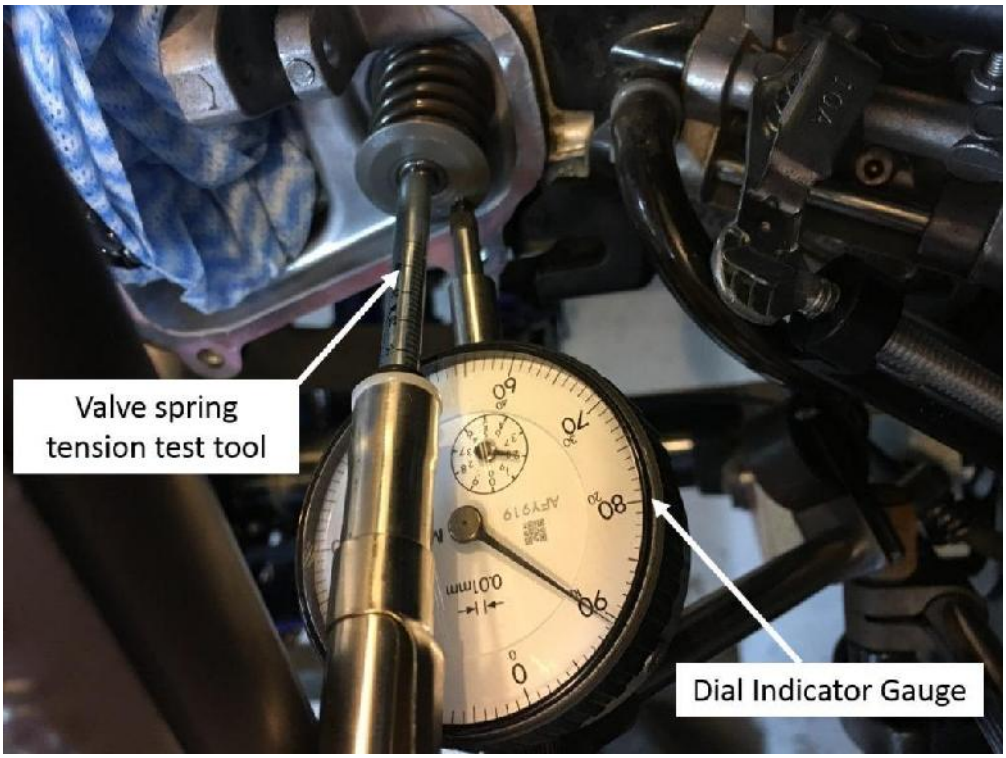
It’s a good idea to have a stop watch mounted on the steering wheel to help the driver monitor their own stint time. The stop watch is reset after just entering pit lane for a driver change and started by the new driver when in pit lane heading to the exit.

VALVE SPRING TESTING & REPLACEMENT

There's two schools of thought in relation to valve springs.

1. Check the valve springs with a pressure gauge, if they're within tolerance, leave them in there.
2. Change them after every endurance event.

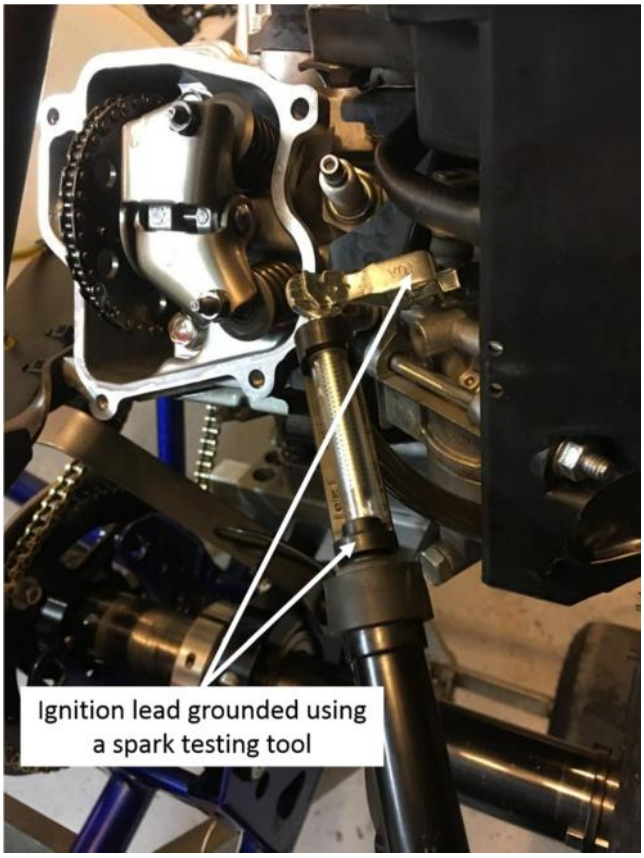
To check the valve springs, we use a belt tension gauge and a dial indicator. The dial indicator is not a necessity, you can just use your finger to feel for when the valve move a fraction. If you have a dial indicator, it's best to use it as the results will be more accurate.



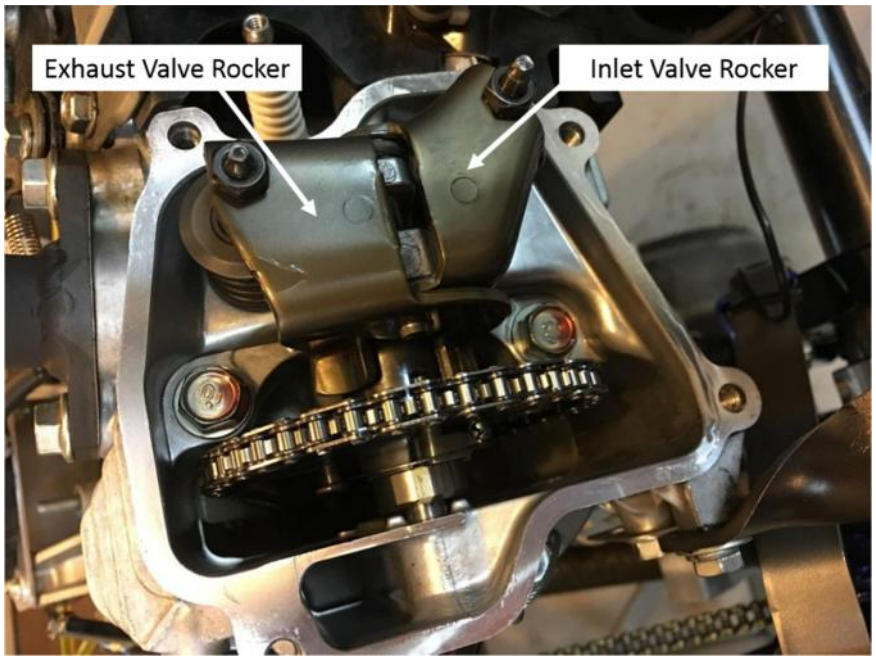
The method used here is to push on the valve to the point where the valve is just starting to lift off the seat, this is the seat pressure that the spring is applying to the valve, the current regulation is a maximum of 16psi.

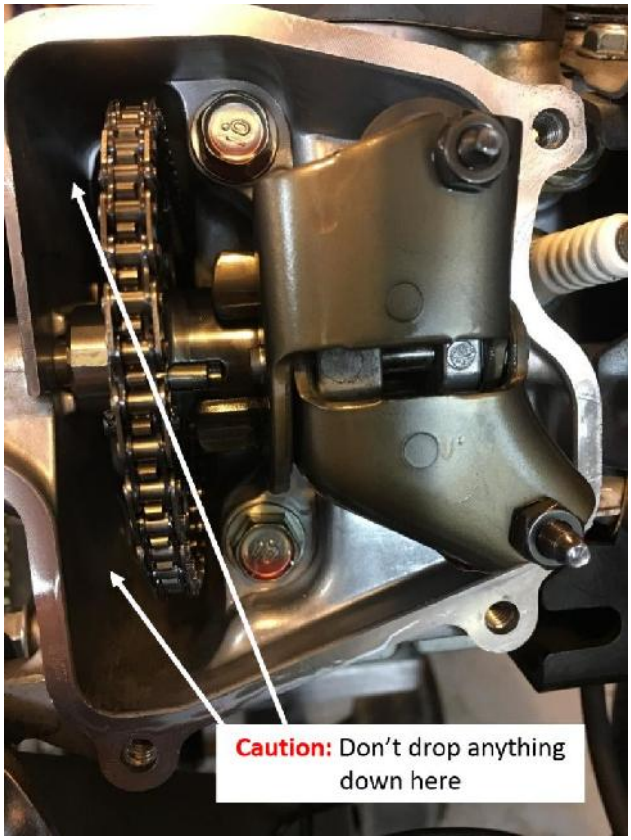
If you need or want to change the valve springs, here is an outline of how we do it.

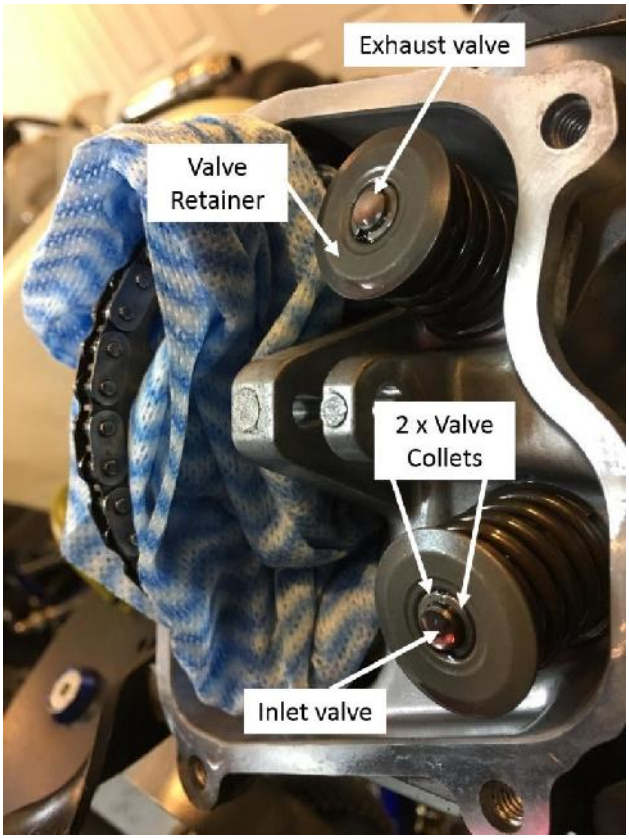
a) Disconnect the ignition lead from the spark plug and ground it



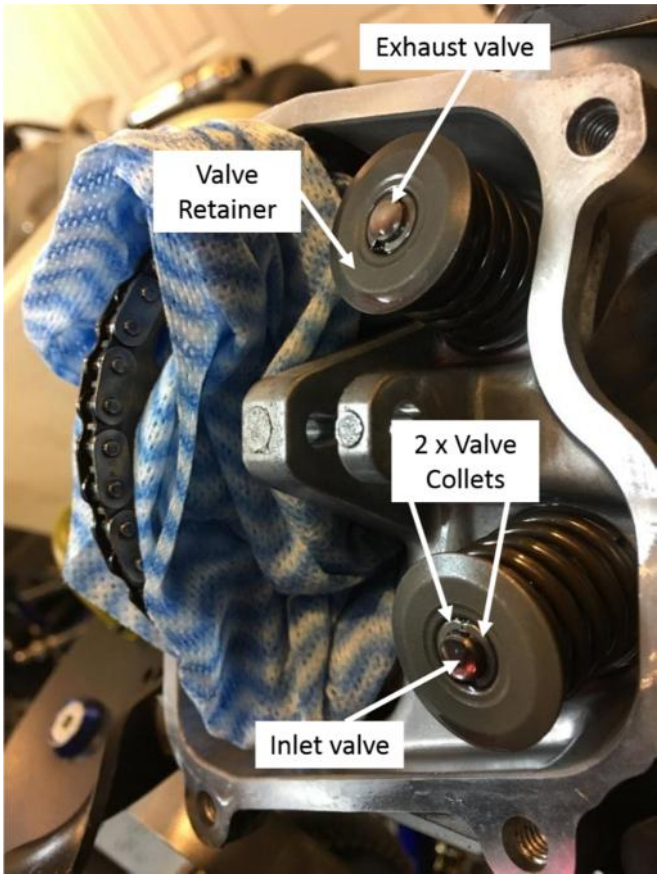
b) Remove the spark plug
c) Rotate he engine to TDC on the compression stroke
d) Remove the valve cover





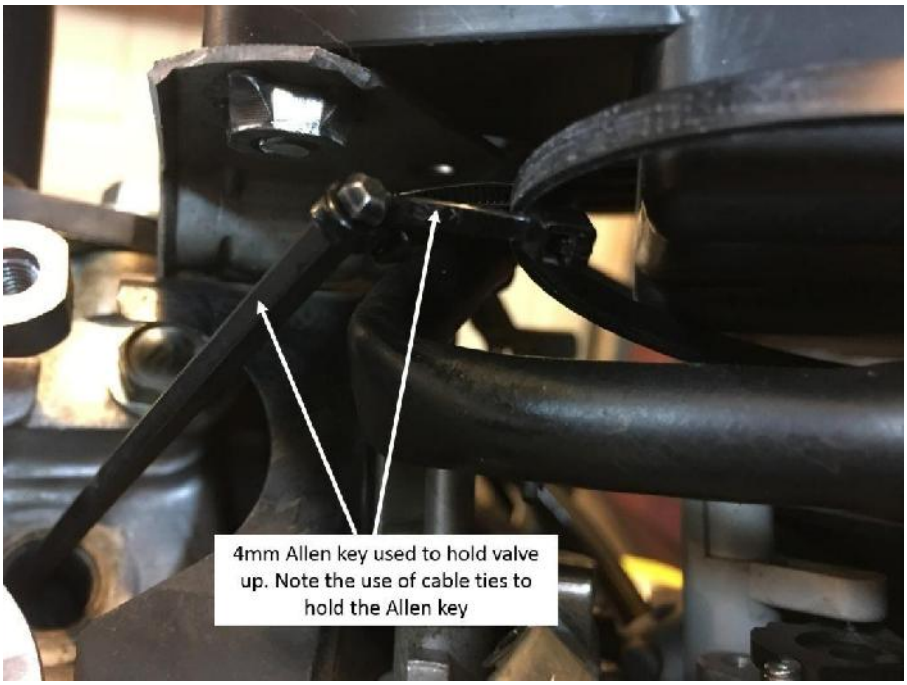


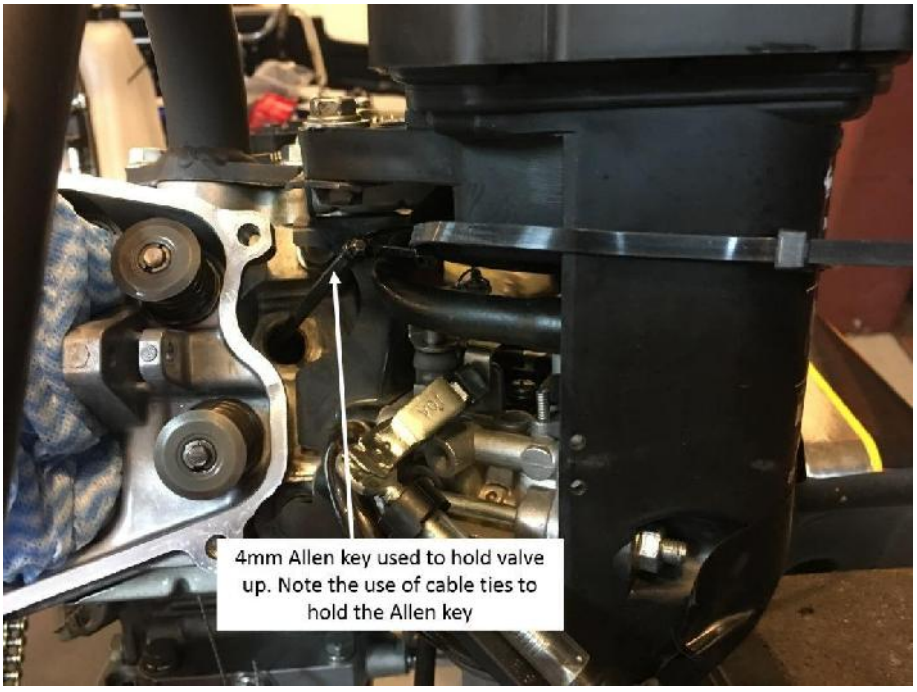
e) Pack a lint free clean rag around the cam gear and timing chain so you can't drop anything into the timing case.



f) Remove the rocker pin
g) Remove the rockers

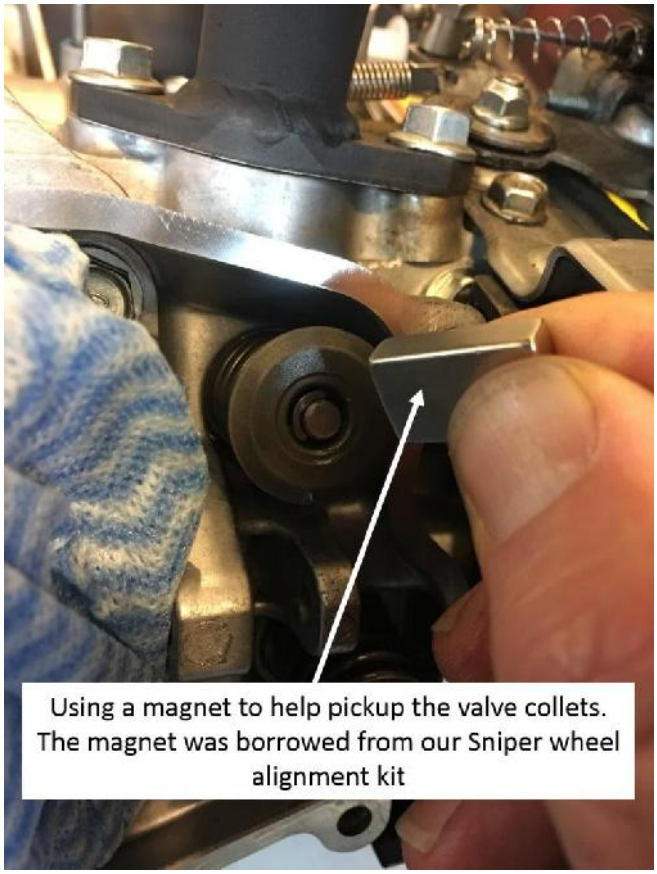
h) Make yourself a valve holding tool out of a strong piece of wire (approx. 3mm thick) or use a long 4mm Allen key. You will see in the image below that we have attached 2 cable ties to the ball end of the Allen key, one is tight around the Allen key, the other is left with a loop. This is so we can do the job with one person. We use another large cable tie around the air box to hold the Allen key so we can use two hands to remove the collets.



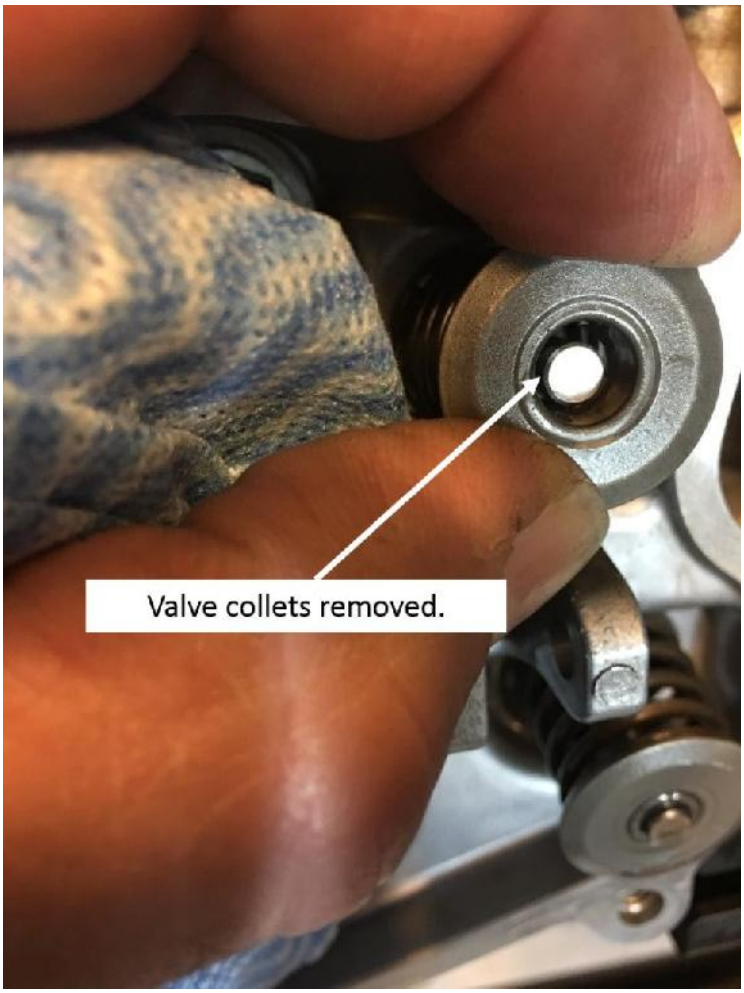


i) Insert the bent wire or Allen key in through the spark plug hole and place the end of the wire under the valve to hold the valve up. The next steps are a lot easier if you have someone that can hold the wire or Allen key for you.

j) Push down on the retainer ring to allow for the collets to be removed, we use a magnet to remove the collets so they don't get dropped.

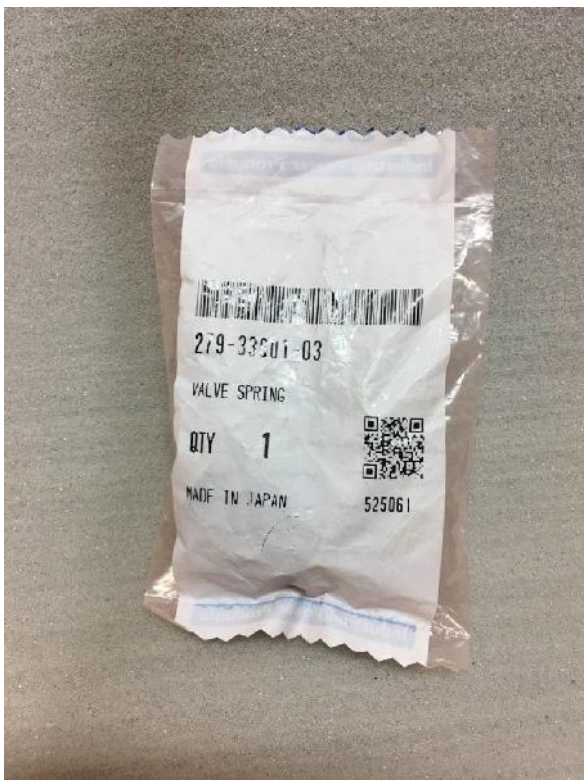


k) Remove the retainer ring, valve spring and spring shim.

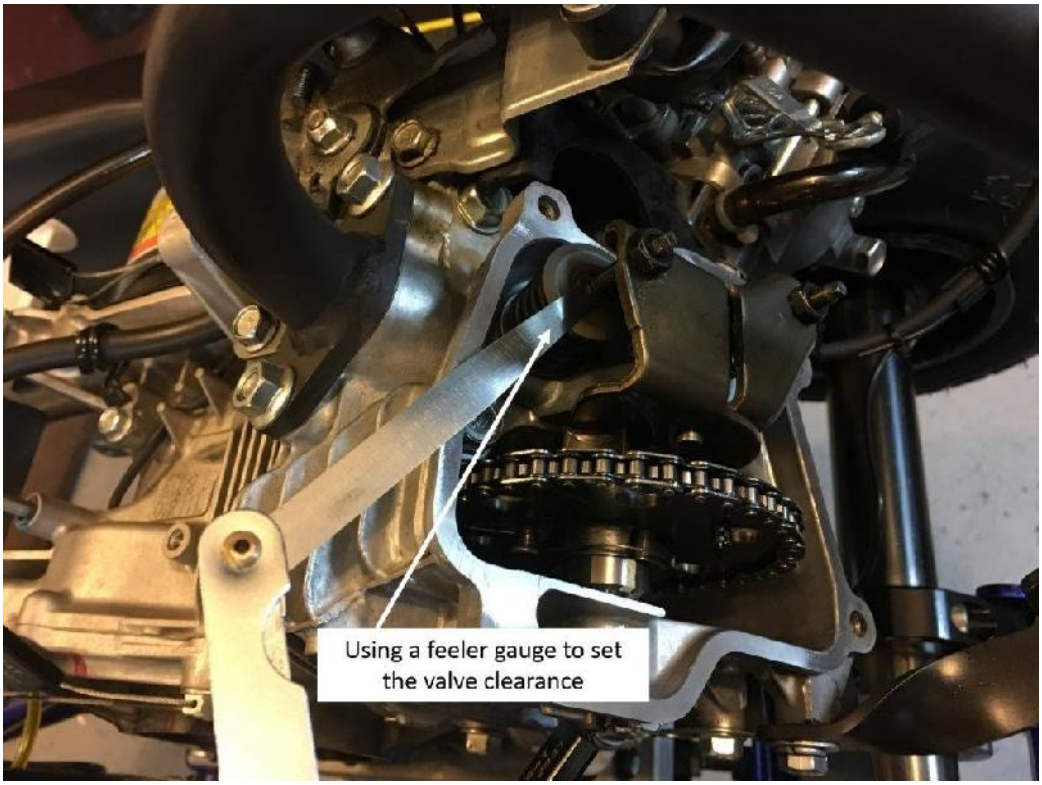


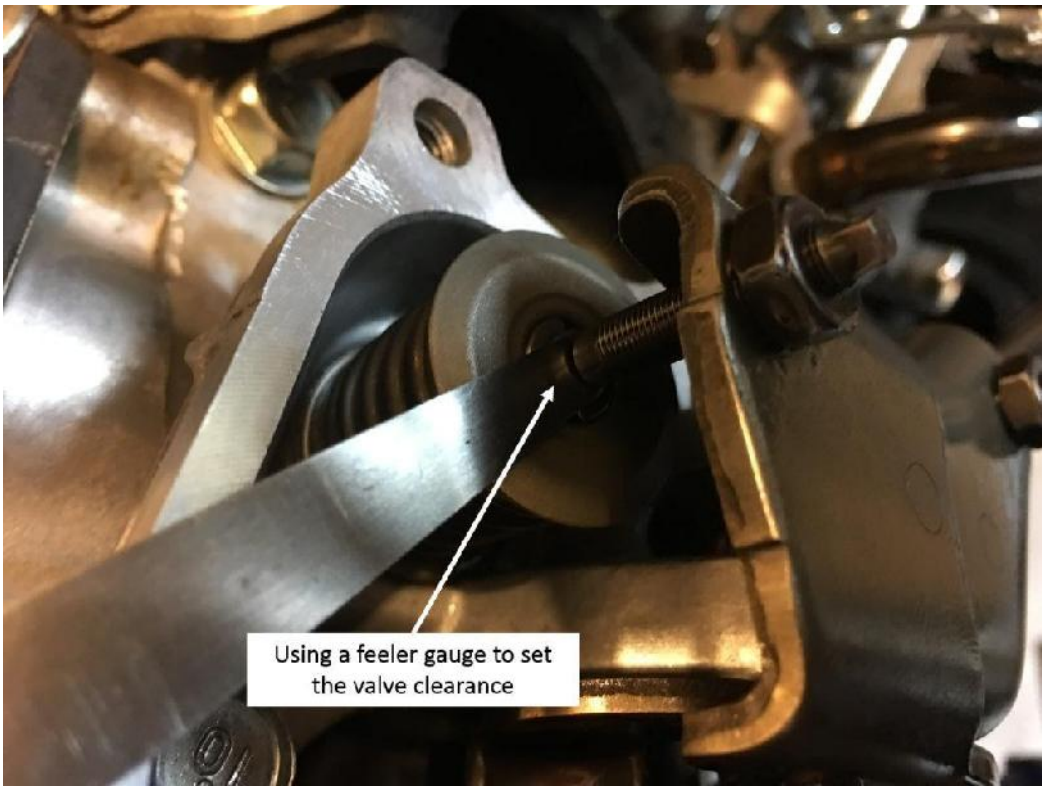
l) Measure the old spring and the new spring, the new spring should be 29.2mm high with the shim.

Note in the photo below that the spring and shim are only measuring 28.2mm so an additional shim may be required to get the correct height and therefore the correct pressure. You should always confirm that you do not exceed the maximum spring pressure as set by the regulations, currently 16 pounds. The spring and shim in this picture tested at 14 pounds when installed.



m) Fit the new spring with the shim between the cylinder head and the spring
n) Place the retainer ring on top of the spring
o) With your assistant or cable ties still holding the valve up, push the retainer ring down and put the collets back in
p) Replace the rocker gear, making sure you're using the mushroom type rocker pin.
q) Set the valve clearance to the specified setting





BRAKE FLUID REPLACEMENT

Brake fluid in racing applications needs to be regularly replaced. In doing so, you flush out any contaminants that make be in the system and prevent premature wear of the cups and seals.

Conventional brake bleeding methods work well and allow you to flush the fluid and draw out any air that may have accumulated in the system.

We like to use a suction bleeder because it simplifies the task and allows you the benefit of being able to draw out contaminants that may be sitting in the corner of your master cylinder by using the hose like a vacuum.

Try to use one brand and type of brake fluid, it's not recommended that you mix fluids in the same system.

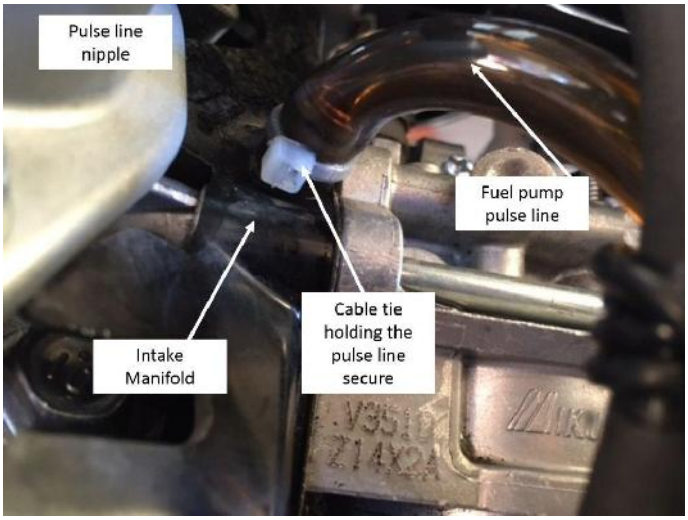
FUEL TANK

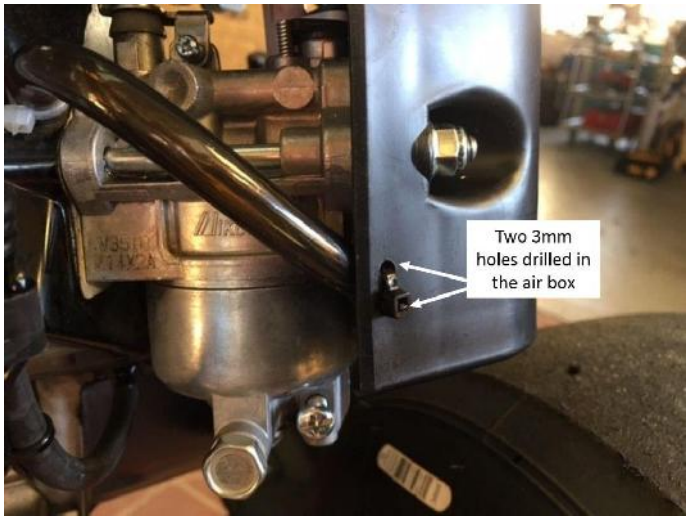
Many karts come with a fuel tank that is 7 litres or less. For endurance racing, you want to have a tank that is as big as the regulations will allow you to use. Currently the regulations state that a maximum capacity of 9.0 litres is permitted.

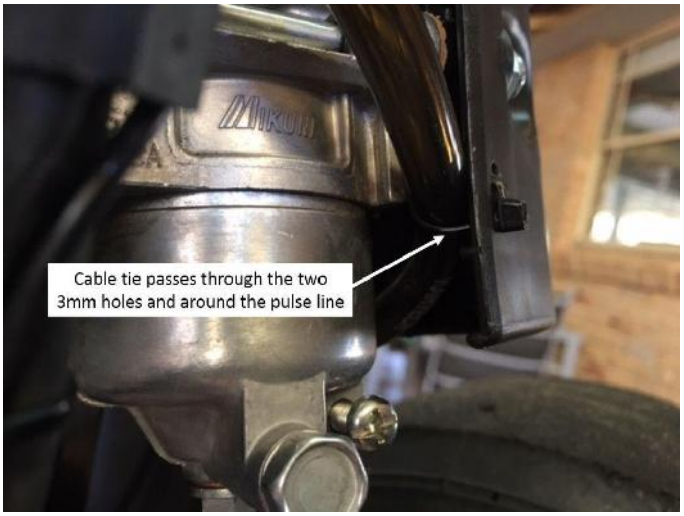
Here we have replaced the original tank with a 9.0 litre fuel tank.

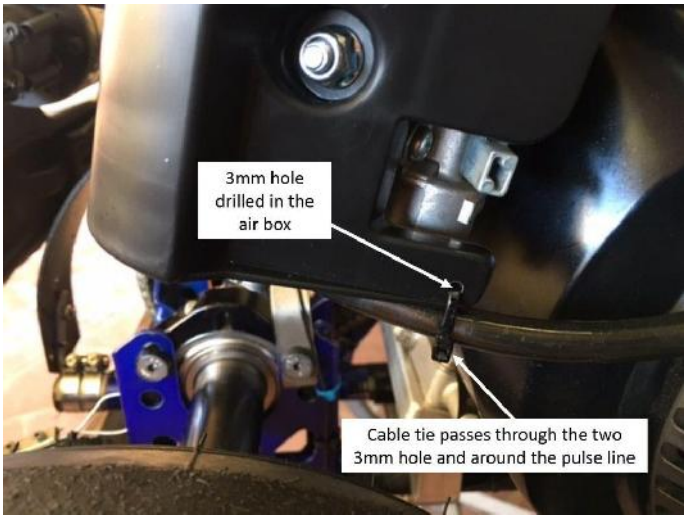
FUEL PUMP PULSE LINE CONNECTION TO MANIFOLD

The fuel pump pulse line connects to a little nipple that is a press fit into the intake manifold. There are two things that you need to be careful of with this nipple. The nipple can come loose and fall out if it is loaded by the hose or the hose can fall off the nipple. The best way to avoid these issues is to put a cable tie on the end of the hose where it connects to the nipple and to support the hose close to the nipple so the nipple is not loaded up. If the hose has become hardened, replace it. If the hose is hard, it will not seal and the cable tie won't hold or seal it.









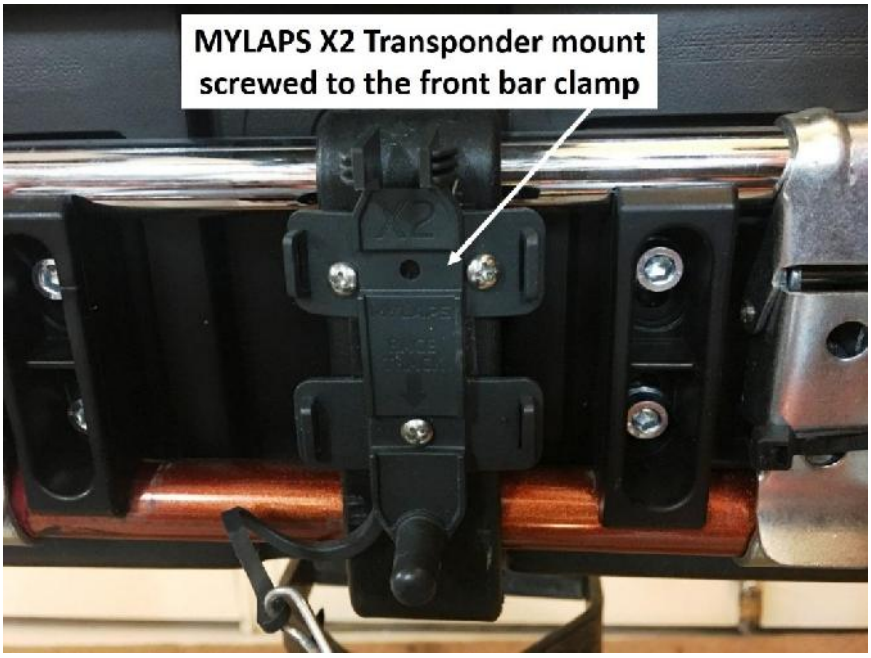
TRANSPONDERS AND TRANSPONDER MOUNTING

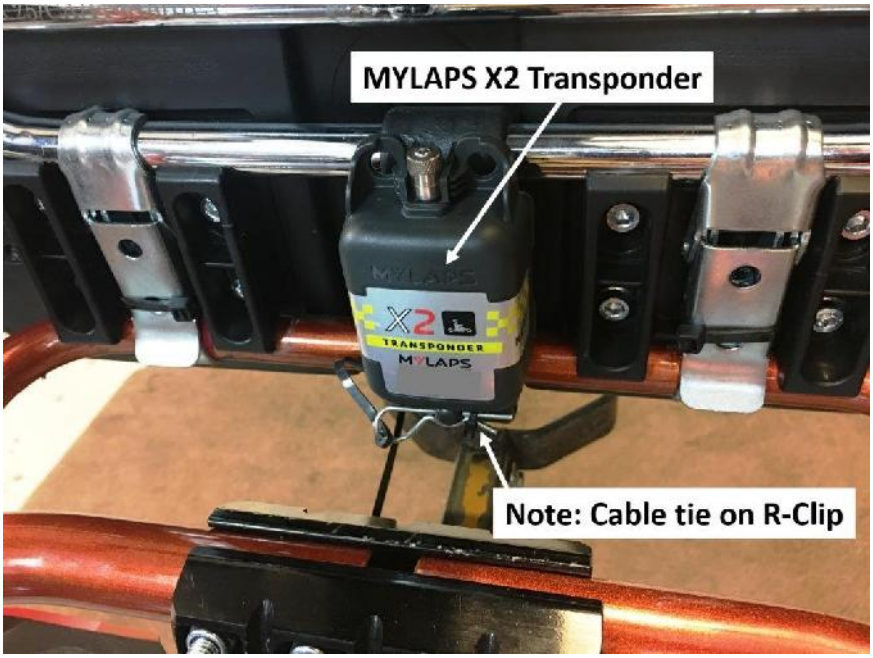
Transponders are used to trigger the timing when the kart is on track and to identify when the kart visits pit lane.

We use a MYLAPS X2 transponder that we purchased with a five year subscription. You can either purchase the device or rent the device from MYLAPS.

The most important thing to remember is, to charge your device fully before race day, preferably the night before the event. If it's a two day event, top it up with charge after day one.

Use the correct mount to attach your transponder to the kart remembering to put a cable tie on the r-clip so it cannot fall out.





WET WEATHER ENGINE AND CHASSIS CHANGES

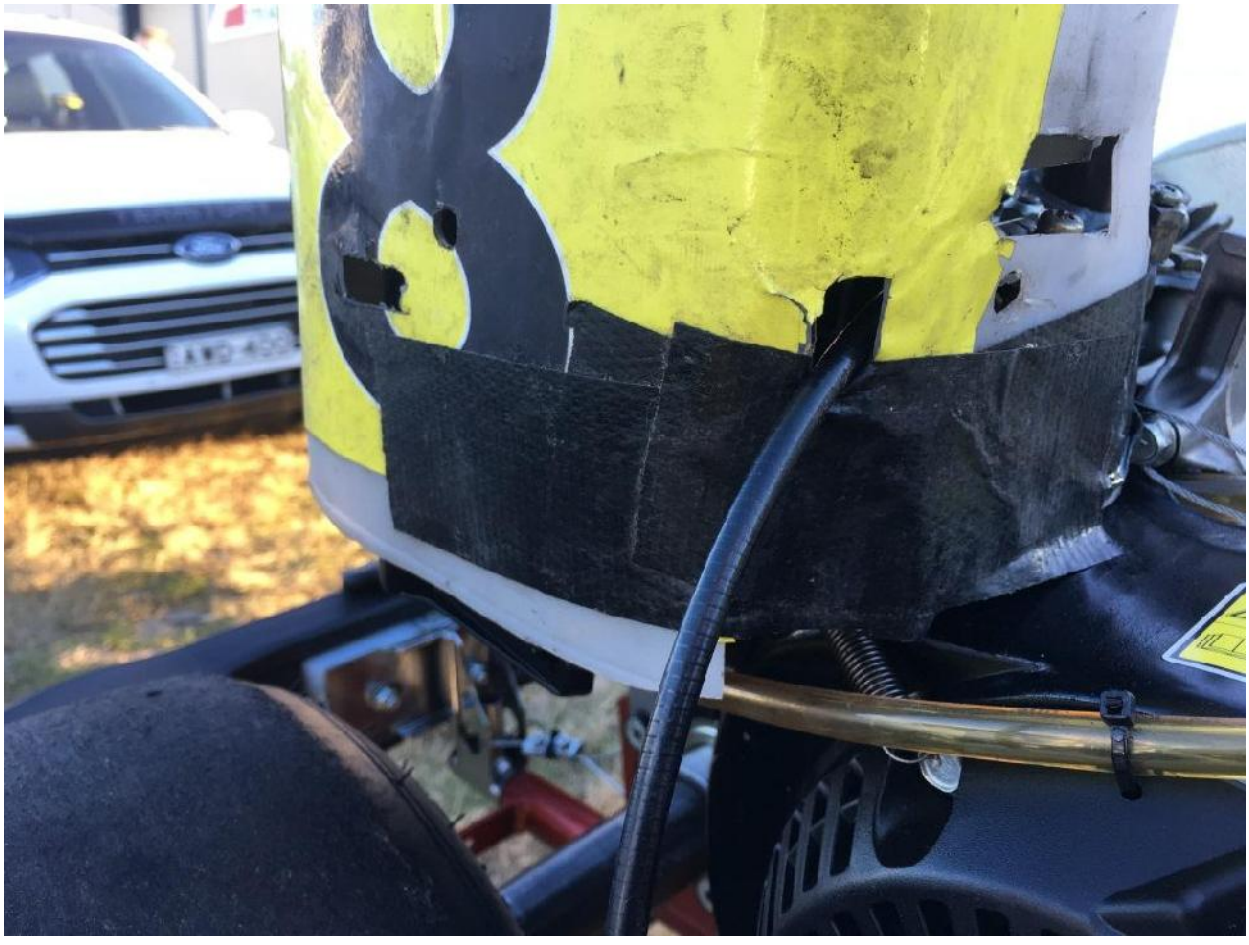
When racing in wet conditions there is a risk of water being thrown up off the right rear tyre into the intake system. If this occurs, the air cleaner can become saturated, starving the engine. One method that has been used successfully to help prevent this occurring is to cover the air cleaner assembly with a cut down, 5 litre, plastic container.

Another issue that can occur in wet weather is moisture can be drawn into the crankcase, contaminating the oil. You should pay attention to this in between sprint races and during practice in the wet by checking to see if your oil is turning milky. It's a little harder to manage this in an endurance race as it would take too long during a pit stop. Preventative measures that could be employed holding the breather hose on the air cleaner housing securely with two small cable ties and ensuring the breather hose is a tight fit in the valve cover.

The images below are courtesy of Brian Freestone from Pro-Axle racing and Pro-Axle Narellan. Brian is a huge supporter of Subaru Karting and the Subaru Karting Association of NSW, we encourage everyone to support businesses that support our club and our sport.

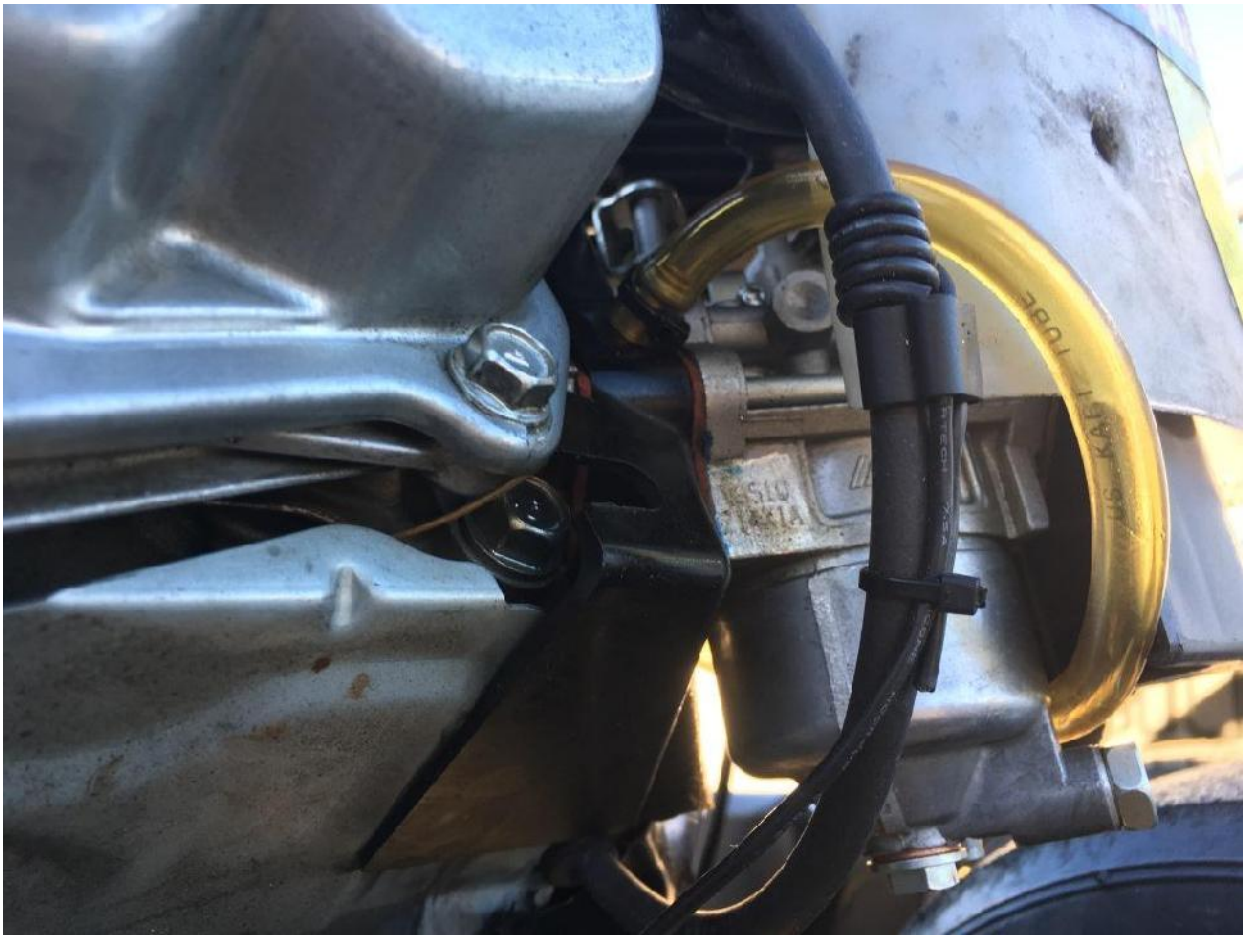
Pro-Axle Narellan – (02) 4648 2002 – www.pro-axle.com.au/narellan-nsw

49 Topham Road, Smeaton Grange, NSW, 2567




SIEGSPEED


OHC



TDC AFTER RUNNING

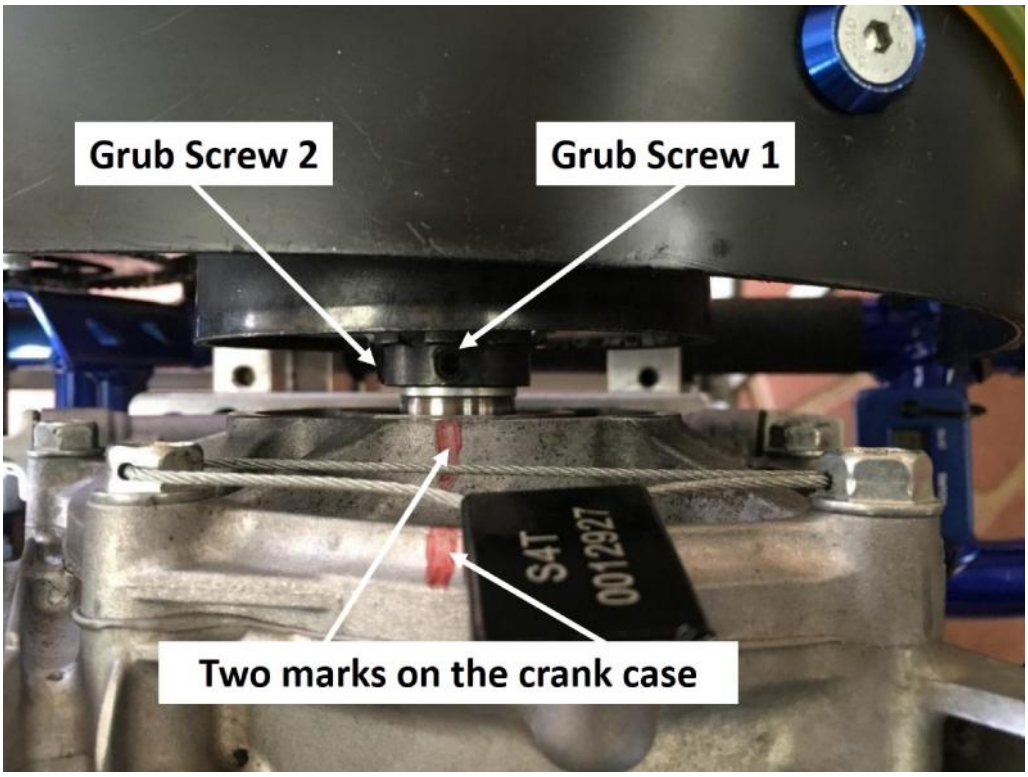
To help preserve the valve springs, it's good practice to set the engine to Top Dead Centre (TDC) on the compression stroke as soon as you turn the engine off.

To make this task easier, I like to put two marks on the crankcase that line up with the keyway on the crankshaft.

When the clutch is fitted to the engine, you cannot see the keyway in the crankshaft, however, there is a grub screw in the clutch (grub screw 1) that lines up perfectly with that keyway, so we use that instead.

To get the crankshaft positioned correctly to mark the crankcase, do the following:

1. Remove the spark plug
2. Ground the ignition lead
3. Slowly pull the engine over until you can see the piston coming up towards the top, use a torch if you need to.
4. Put a clean wooden dowel or steel rod down through the spark plug hole until it touches the piston
5. Using a spanner on the clutch crankshaft bolt, continue to turn the engine whilst feeling with the dowel for the piston to reach its maximum height. At TDC, you may rotate the crankshaft back and forward (in both directions) to confirm you have found TDC.
6. Now put two separate marks on the crankcase so that the two marks and the grub screw all line up when you are at TDC. If you just put one mark, you will find it harder to set TDC as the position of your eye can vary.



TYRE PRESERVATION

Tyres are best preserved by keeping them cool, dry and away from chemicals and direct sunlight.

We use black shrink wrap, the same type that they sell for packaging.

When we're at home, we take the wheels off, wrap them up and put them in the wardrobe.

SUITABLE CHASSIS

The most common chassis used in this category are the Arrow 28N and Arrow 31C chassis, however, any chassis that was or has been designed to run in a low power single engine class should be suitable. For example, Chassis that were designed for running in Yamaha J or Clubman classes will work well.

R-CLIPS

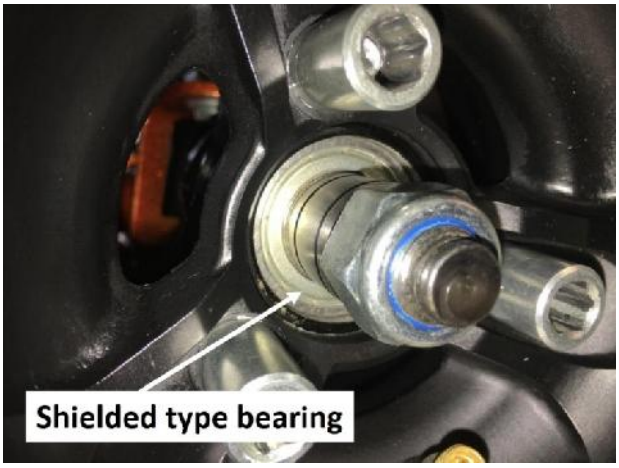
R-clips can be dislodged with light impact or get caught on clothing etc. If you put a cable tie around the open end of the clip, it will help keep them in place.

WHEEL & AXLE BEARINGS

Our preference is to use sealed bearings as opposed to using shielded bearings.

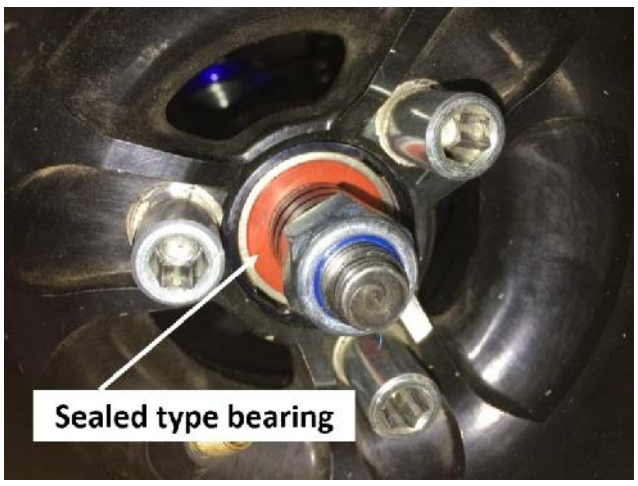
Shielded bearings do spin more freely due to the lower drag. The problem with shielded bearings is that they allow water and debris to enter the bearing, contaminating the grease and causing premature wear of the bearings. To avoid this premature wear occurring, you need to frequently clean and re-lubricate the bearings.

The bearings are very difficult to clean and re-lubricate without removing the shields however, the shields are often damaged during the process of removing and re-fitting them.



By using a sealed bearing, you prevent low pressure water and debris entering the bearing and in doing so, you significantly reduce the need to service the bearings. The other positive aspect to using sealed bearings is that when it comes to servicing the bearings, you can remove the seals easier and generally without damage.

Sealed bearings don't spin as freely as a shielded bearing, however, the drag imposed by the rubber seal is so low that it has a negligible effect on the performance of the kart. If you are looking to shave an extra 1/100th of a second off your lap time by reducing bearing drag, spend the time at the track, working on your driving skills instead of spending hours working on the bearings. The gain will be ten times more beneficial.



ENDURANCE RACE STRATEGY MANAGEMENT

A good strategy in an endurance race is as important as reliability and kart speed.

The first thing to consider is, how many drivers will you use? You can run a six hour enduro with a minimum of two drivers and an eight hour enduro with a minimum of three drivers My suggestion is this, if you're just starting out and you have access to some experienced kart drivers, bring them into the team, bring in two for a six hour and three for an eight hour. They will help you with kart setup and they can do the first two stints, you can drive the third shorter stint.

Stint one use your fastest driver, stint two use your second fastest driver and stint three is your slowest driver.

Stint time should be as long as possible for your two fastest drivers. We are limited to a maximum stint time of sixty minutes so, run your fastest drivers for fifty five minutes. By running for fifty five minutes, you leave enough time for the kart to be weighed, filled with fuel and do a driver change. Remember, the pit loop (timing system trigger) is on pit exit so, your driver's stint time ends when your next driver is heading back out.

Fuel management is the key to working out the duration of your third driver's stint. In our experience, the Subaru KX21 engine uses about 37 grams of fuel per minute. You can measure this by draining the tank of all fuel then, using a set of digital kitchen scales, put exactly 2.0kg of fuel in the tank. Now we go out on the circuit and drive the kart at race pace for 30 minutes, make sure you use a stop watch to measure the exact time. Drain all the fuel out of the tank and weigh it. Now for the maths.

Fuel in – Fuel out = Fuel used	2000 – 834.5 = 1165.5 grams
Fuel used / time on circuit = Consumption per minute	1110 / 31.5 = 37 grams per min.

If we have a 9.0 litre fuel tank, for safety, we allow for 10% in reserve, we have 8.1 litres of useable fuel. Unleaded petrol weighs about 748.9 grams per litre. We can work out our tank capacity in grams as follows:

Capacity in litres x 748.9 = capacity in grams	8.1 x 748.9 = 6066 grams

Now that we can work out how much time we have in our tank with the following calculation.

Capacity in grams / Consumption per min. = Time	6066 / 37 = 163 minutes

Now we can work out our stint times. Driver one = 55 minutes, Driver two = 55 minutes leaving 53 minutes for driver three.

Never assume that the 9.0 litre tank that you purchased is actually 9.0 litres, fill it up and measure exactly how much it holds, it will, most likely be less than 9.0 litres.

The next thing to consider with strategy management using the sample above is whether or

not your third driver needs to do the full 53 minutes. Your third driver will be slowest driver, they should be in the kart for the least amount of time.

Even though we refer to it as a six hour race, it's actually 5 hours and 55 minutes (355 minutes)

Race duration / max stint time = stints required	355 / 55 = 6.454
55 x Decimal time = minutes	55 x 0.4545 = 25 minutes

In the example above, we would run with the following strategy:

Stint Times (Minutes)	Running Total (Minutes)
Driver 1 = 55	55
Driver 2 = 55	110
Driver 3 = 40	150
Refuel	
Driver 1 = 55	205
Driver 2 = 55	260
Driver 3 = 40	300
Refuel	
Driver 1 = 55	355

If your fuel tank is less than 9.0 litres, you may need to consider reducing driver three's stints, particularly driver three's first stint as you would have used 6 minutes' worth of fuel during qualifying. For example, an 8.5 litre tank will give you 154 minutes at 37 grams per minute, leaving only 38 minutes of fuel for driver 3 after using 6 minutes of fuel in qualifying.

You will also notice that we have our fastest driver in the kart for the longest amount of time, second fastest driver for the second longest and our slowest driver for the least amount of time.

At the second re-fuel, you won't need a full tank (unless weight at the end of the race could be an issue), just carry enough fuel for 55 minutes plus a safety margin. In this case I would put in about 2500 grams or just under half a tank, this will give us 70 minutes of fuel which is, plenty for a 55 minute stint. There's no need to carry extra weight if you don't have to, extra weight will slow you down.