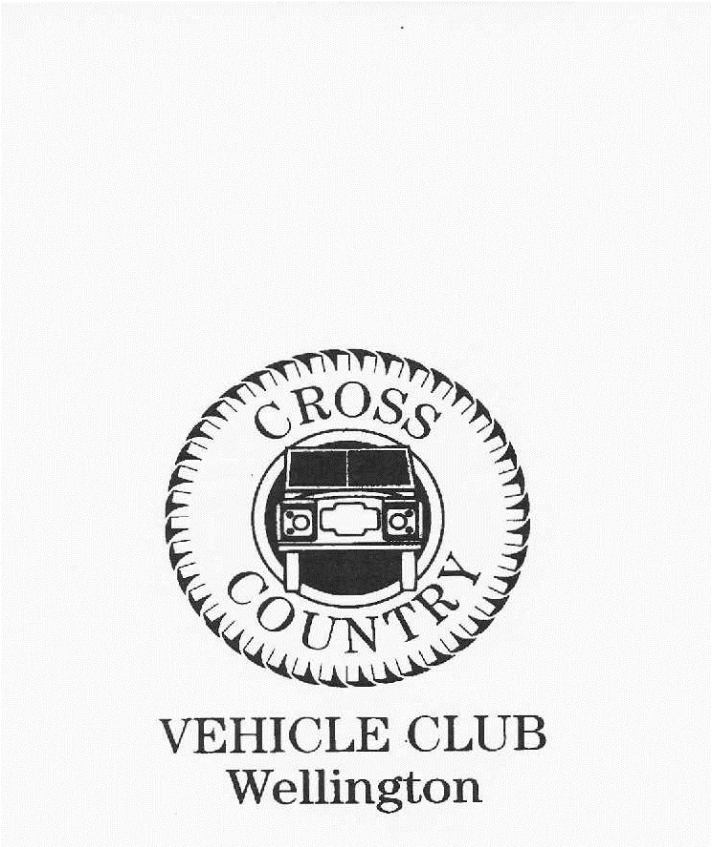

4WD VEHICLE FAMILIARISATION AND DRIVING TECHNIQUES

V3J. Nov 2005 (Adapted)

Contents

INTRODUCTION

These notes will introduce you to the Cross Country Vehicle Club (CCVC), technical terms and details about 4wd vehicles, safety requirements, equipment and driving techniques that will be discussed and practiced during the practical session of your 4wd Vehicle Familiarization trip.

CCVC Web Site

The Club web site www.ccvc.org.nz has information about trips, Club policy and notices.

Trip Categories

For safety, CCVC trips are designated as follows: Family Shiny, Shiny 4X4, Club 4X4, and Hard Yakka.

Members are not permitted to join a club trip if either their vehicle or personal level of experience is not up to that required for the category of the trip. A full explanation of each of the trip categories can be found in the Club newsletter, the CCVC Visitors Guide and on the Club web site. If in doubt, telephone and check with the trip leader, do not just turn up expecting to go on the trip.

Prospective members and visitors may only take part in Family Shiny category trips.

CCVC Safety Committee

The Safety Committee works to help maintain a safe environment for members when taking part in Club activities. This includes setting out requirements for training, safety equipment that Club members must carry in their vehicles and the mounting and load rating of vehicle recovery hooks.

CCVC Safety Officer

The CCVC Safety Officer is responsible for the establishment and maintenance of safety standards and the promotion of safe practices. Please help the Club maintain its excellent safety record by complying with the Club rules and safe driving practices. The Club Safety Officer's name and contact details can be found inside the front cover of the Club monthly newsletter.

Safety Equipment

CCVC rules require that all Club vehicles must have as a minimum the following equipment; Rated recovery hooks front and rear mounted to approved Club standards, fire extinguisher (0.9 kg dry powder or 1kg foam), basic tool kit, roll cage (if soft top vehicle), shovel, rated 5,000 kg kinetic recovery strap / rope, first aid kit, spare wheel and tools to change a wheel. Note, the fire extinguisher and first aid kit should be easily accessible and all items secured from movement.

Vehicle inspectors

The CCVC Safety Committee appoints approved people as Vehicle Inspectors. These are the only people who can approve the safety features and equipment required for the Vehicle Inspection Sticker (see below). The Club newsletter, web site and CCVC Membership Application Forms have a list of CCVC approved vehicle inspectors and their locations. Vehicle inspections are a free service so please remember that you are availing yourself of the inspector's valuable time, bookings may be required. It is strongly recommended that you discuss the fitting of recovery hooks with a Club Safety Inspector before you have them fitted to your vehicle.

Vehicle Inspection Sticker

Trip leaders may not allow you to go on a Club trip if your vehicle does not have a current Vehicle Inspection Sticker. Stickers are issued annually by a CCVC approved Vehicle Inspector. Some vehicles may need modifications (at a cost to the owner) to come up to the Club standard.

Roll Cage

All soft or open top vehicles must have a roll cage that has been approved by a Vehicle Inspector

Tow Hooks

All vehicles on Club trips (other than visitors on 'Family Shiny' trips) must be fitted with front and rear 10,000 lb. 'rated' tow hooks. These hooks must be attached to the vehicle by one of the approved methods as shown in the CCVC 'Tow Hook Mounting Guidelines' document on the CCVC web site. (See RECOVERY EQUIPMENT below for more on 'Rated').

KNOW YOUR 4WD VEHICLE

Short Wheelbase / Long Wheelbase

Short wheelbase (SWB) vehicles usually have less overhang at the rear and a smaller turning circle than long wheelbase (LWB) vehicles. Long wheelbase vehicles usually have more passenger seats, more room for luggage or equipment and a lower ramp-over angle (defined later).

Petrol Engine / Diesel Engine

Petrol engines develop their best torque at higher revs than do diesel engines; to get more power you use more accelerator. Diesel engines are able to produce high torque at low revs. Manual gearbox diesels also have high engine compression which provides good engine braking during hill descents.

Automatic Transmission

An automatic gearbox gives good traction control in sand, water and hill climbs and has no clutch to cause problems when in water. Normally leave the transmission in D (Drive) unless you want to crawl over boulders, slowly traverse ruts and ditches or to use engine braking for descents where L Low (Low ratio Low) should be used. It pays to practice using engine braking in both High and Low ratio to get used to when the gearbox actually changes down – it will not change down if the road speed is too high. NOTE: every type of automatic transmission has different characteristics, including lock-up torque converters (see Drive-over Braking or Left Foot Braking below).

You should become familiar with your vehicle by practicing driving as slowly as possible down steep suburban hills without using brakes. ALWAYS apply the handbrake and leave the transmission in Park when leaving the vehicle, NEVER leave the transmission in Drive.

Manual Transmission

Manual gearboxes provide good engine braking which helps control speed when going downhill.

Transfer Case

A transfer case is an additional section of the gearbox on a four wheel drive vehicle. It connects the engine drive to the front axle and may also include a 'Centre Differential' (see below).

High Ratio / Low Ratio

Most 4wd vehicles have both high and low ratio gears. High ratio is the normal range of gears for on road use. Low ratio is an extra gear that when selected allows the driver a second run through the

main gears but now in an extra low range. Low range is used for travelling extra slowly up and down very steep slopes or crawling over rough terrain. Some vehicles must be stopped before selecting low ratio, check your vehicle handbook. When off-road, always use low ratio to descend a steep hill.

When To Use 4WD

When travelling on a gravel road or track, selecting 4wd may help you maintain control. If the rear wheels should lose traction when cornering the front wheels will continue to pull the vehicle forward, this helps to keep the back end from sliding sideways and perhaps off the road. Do not use 4wd on a normal hard seal road unless your vehicle has a 'full time' 4wd transmission. When off road, do not try and see how far you can drive without engaging 4wd, when you become stuck you will inconvenience others who have to spend time and effort helping to recover your vehicle. You may also cause damage to the track by unnecessary wheel spinning when in 2wd (two wheel drive).

Freewheeling Hubs

Free-wheeling hubs are sometimes fitted to the front wheels of a 4wd; they allow the wheels to rotate independently of the drive shafts minimizing fuel consumption and mechanical wear. Manual freewheeling hubs require either a knob or bolt head to be turned at the hub of each front wheel or electrical switching from the dashboard prior to engaging 4WD. Automatic Freewheeling hubs self engage when the front hubs have torque applied to them. When this torque is removed such as at the point when forward movement changes to reverse during a failed hill climb, the front hubs might disengage. This could happen at a very awkward time so it is recommended that automatic free-wheeling hubs be replaced with manual front hubs, a simple job easily carried out (cost $250 - $400 for the hubs depending on type of vehicle).

Engaging 4WD

Generally, do not put a vehicle manually into 4wd unless travelling at less than 5 kph, however on some newer vehicles 4wd may be selected at higher speeds, read your vehicle owners handbook.

On a manually selectable 4wd vehicle, engage 4wd by moving the transfer case gear stick from the 2wd position to the 4wd position. If you have manually operated 'Free Wheeling' hubs on the front axle then they will have to be separately engaged before the vehicle can be used in 4wd.

Increased Turning Circle

When in 4wd, the turning circle of a vehicle will be considerably increased due to the front wheels being engaged to the drive train through the front differential. Unless the vehicle is on a slippery or loose surface where the wheels can 'slip' on the road surface, an effect called `wind up' can occur.

Wind-up is when the axle on one side of the vehicle has a twisting load applied to it by the opposite wheel on the same axle. This is caused by the outer wheel travelling further (turning radius is wider) when a vehicle is turning. Wind-up on the front axle tends to inhibit turning and may impose loads that make it hard to turn the steering wheel.

Open Differentials

An open differential allows opposite wheels on the same axle to rotate at different speeds while under load. If one wheel is off the ground or on a slippery surface then that wheel will spin and the opposite wheel on the same axle will lose power and not turn at all. For non-ABS equipped vehicles this may be overcome by judicious use of the foot brake, or for the rear axle by a little use of the handbrake if it is a drum type brake acting on the rear wheels. Caution ! also see Transmission Shaft Brake under Handbrake below.

Limited Slip Differentials (LSD)

A limited slip differential is similar to an open differential at low speed but has spring-loaded clutch plates that provide some power to each wheel on the same axle up to a certain limit before slipping. This clutch in the differential sends some drive power to each wheel and helps keep both wheels on an axle turning. As the clutch can slip it assists but does not guarantee drive to the loaded wheel if you should become cross-axled and lift a wheel off the ground. You need speed or momentum to assist the LSD diff to engage. Note, a LSD may pop you out of a rut when you least expect it to happen and could compromise traction when on a sideling (side slope).

Closed Differentials

A closed differential acts like a solid axle between the wheels. Each wheel on the same axle is delivered equal power and turns at the same speed even if one wheel is off the ground. Closed differentials on either the front or rear of a vehicle are not Warrant of Fitness compliant (not legal on the road).

Centre Differential

Most 'All Wheel Drive', 'On Demand' or 'Full Time' 4wd vehicles have a centre differential which is located in the transfer case. If the centre differential can be manually locked then 50% of available power from the engine will be delivered to the front and rear axles. The centre differential allows the front and rear axles to rotate at different speeds and can be locked either by means of a transfer case lever or an electrical switch on the dashboard. You should not drive on a normal tar sealed road with the central differential lock engaged unless your vehicle handbook says you can.

Front Differential Lock

In some 4wd vehicles you can manually lock the front differential. If the Front Differential is locked, then 50% of the power available to the front axle will be delivered to each front wheel. Even if one front wheel is off the ground or spinning on a slippery surface the locked differential will provide rotational power to the other front wheel. Obviously, if the front differential has been locked then there will be no differential effect available at the front wheels - steering will be very difficult if not impossible! The vehicle will only want to move straight ahead. A front diff lock, if fitted, should only be used to get out of a very slippery or cross-axle situation. USE FRONT DIFF LOCKS WITH EXTREME CAUTION and ONLY AT VERY LOW SPEED. Vehicles have gone out of control and rolled over because the driver did not understand the limitations and dangers of front axle diff locks.

Rear Differential Lock

Some vehicles have rear differential locks. If selected, equal power will be delivered to each rear wheel. If one rear wheel is off the ground or spinning on a slippery surface the other wheel will continue to turn and if it is still on firm ground, provide traction. A rear diff lock is a very handy device, but it can cause you to jump out of ruts unexpectedly. Only engage it when you need it. DO NOT USE REAR DIFF LOCK ON A SIDELING. A locked rear diff works like a 'closed diff' and you may have the tail of the vehicle slide away when you are in a dangerous situation. If you have a rear diff locker and are in a safe place (no steep drop offs, gentle slope) try driving across a slope on wet grass and then over the crown of a low hill with your rear locker in and see what happens!

Auto Lockers – (they are actually automatic differential 'unlockers')

When the unlocking mechanism detects axle wind-up through the differential during cornering, one side axle will release, thus reducing wind-up. Auto lockers can be unsafe on a greasy sideling. In addition, they may pop you out of ruts unexpectedly. They MUST NOT be fitted in the front of a fulltime 4wd vehicle as they effectively disable the steering.

Traction Control

Some modern vehicles have electronic devices that sense the speed at which each wheel is turning. If any wheel is turning at a different rate to the others, an electronic brain decides that the wheel is spinning (skidding) and applies or releases the brake on that wheel and manages the power output to the other wheels to correct the situation. Some traction control systems only work for about 30 seconds without being reset so continuous wheel spinning in sand for longer than 30 seconds may turn off the traction control. There are both advantages and disadvantages of having a 'reaction control system' (See HILL CLIMBING and DESCENDING HILLS below for more details.)

There are several different names for traction-control systems such as DAC – Downhill Assist Control, when switched on it automatically applies braking on each wheel individually as needed to give a downhill speed of 5 – 7 kph without touching the brakes; HAC – Hill Assist Control, this gives maximum traction without wheel spin for hill starts without stalling.

Suspension

An 'Independent Suspension' has coil springs or torsion bars (or a combination of both) at each wheel. The springs allow each wheel to move up and down independent of what other wheels are doing as the vehicle moves over undulating ground. A MacPherson Strut has the shock absorber mounted inside a coil spring, which is attached to the wheel hub assembly. Double 'A' wishbones and McPherson Struts are examples of independent suspensions. A 'Fully Floating' suspension is not dependant on an axle for keeping a wheel attached to the vehicle. If an axle breaks a wheel will remain attached to the vehicle. A 'Beam Axle' is a very strong, solid axle that connects to the wheels on each side of the vehicle and provides very good articulation. The axle is suspended from the vehicle by either leaf or coil springs. A disadvantage is that it can give a hard ride and the effect of a bump at one wheel is also transferred to the opposite wheel.

Articulation is the term given to the amount of vertical travel that individual wheels can move up and down over bumps and hollows while each wheel still remains in contact with the ground.

Ramp Index is a measurement of articulation as measured by driving one wheel up a ramp till the other wheel on the same side is just about to lose contact with the ground.

Live Axles are driven axles. They are connected to the vehicle drive train.

Dead Axles are not connected to the vehicle drive train.

Ground Clearance

Have a look under your vehicle and see where all of the low points are. The differentials are usually the lowest points on the drive train. Note that the front differential and probably the transfer case are not on the centre line of the vehicle. If you expect to be using your vehicle off road in rugged areas such as riverbeds you may wish to have a guard ('bash plate') fitted under your vehicle to protect the engine sump and transfer case.

Suspension Lift / Body Lift

Some people modify their vehicles by giving them a 'Suspension Lift' by increasing the spring and shock absorber length, this will increase the ground clearance. A 'Body Lift' has blocks inserted between the body and the chassis creating space for larger wheels / tyres however, gear levers, brake hoses and fuel filler pipes may need extending if a body lift is done. Both of these modifications must comply with LTSA (Land Transport Safety Authority) rules if the vehicle is to be driven on the road.

Approach Angle is the angle between the lowest part of the body at the front of the vehicle and the ground where is touches the front edge of the front wheels. It is an indication of the steepness of

transition a vehicle can make from level ground to climbing a steep bank. If your front bumper hits a bank before the front wheels start climbing the bank then the approach angle of your vehicle is not great enough to climb that bank.

Ramp Over is the term given to the angular measurement that indicates how sharp a hump your vehicle can drive over. If you have a hump under the middle of your vehicle and you are stuck upon it rocking like a seesaw and going nowhere, then your 'Ramp Over' angle was too small for that hump!

Departure Angle is the angle of a line between the lowest part of the body at the rear of a vehicle and the ground where it just touches the rear edge of the tyres at the back wheels. It is an indication of the steepness of the transition the vehicle can make from travelling down a steep slope or bank to level ground. If your back bumper is hanging on a bank and your rear wheels are off the ground then your departure angle was not high enough to manage a transition from that slope back to level ground!

Cross-Axled is the term used when wheels on opposite corners (front and rear) of a vehicle are hanging over holes or depressions in the ground at the same time. Due to the action of the differentials when one wheel on an axle is off the ground, engine power is only delivered to that wheel. If a vehicle is cross-axled it will lose all traction on all wheels - unless you are able to lock a differential.

Overhanging Attachments

Some equipment fitted to your vehicle may affect the approach or departure angle of your vehicle and could become damaged if caught on the ground during an off road trip. Be aware that any of the following may become damaged or cause the vehicle to get 'hung-up':

Tow bar, bumpers, winch, trailer electrical connections, spare wheel, exhaust system, bull bars.

Engine Air Intake & Filters

Know where the engine air intake is located on your vehicle. Some vehicles have the engine air intake located low down behind a headlight. When crossing a river or deep water hole in a vehicle with a low-level air intake water could be sucked into the engine and cause serious '($)' damage. A snorkel extends an air intake and relocates it high up on the vehicle where water is unlikely to be ingested into the engine. A snorkel may also provide cleaner air to the engine (less dust higher up).

Disposable paper element air filters should be changed regularly if your vehicle is used on dusty roads or tracks, check your vehicle owner's manual for how often you should change the air filter.

Oil Bath Air Filters consist of fine mesh screens coated with a thin film of oil. Dust sticks to the oil film as air passes through the mesh and into the engine. These filters may be cleaned and reused.

Bull Bars

Front protection bars in various designs are popular on 4wd vehicles, do not mount recovery hooks on them. Bull bars may affect crumple zones and air bag actuation. If fitting a bull bar, check that the type you choose is legal on your vehicle. Front bars may also reduce the vehicles approach angle.

Batteries

Four wheel driving is often on rough roads or tracks so ensure that your battery is securely mounted. Some owners fit quick-disconnect devices so that one turn of a knob will isolate all electrical circuits in case of an accident or electrical problem. If an electric winch is fitted to your vehicle it is important to ensure that winching operations do not flatten the battery. Some vehicles have a second battery fitted to provide power for the auxiliary equipment such as winches, air pumps, refrigerators etc.

Wheel Bearings

Encounters with mud, water and sand are normal activities when four wheel driving. It is not unusual for water and grit to get into the front hubs and contaminate bearing grease. It is good practice to regularly examine your vehicles front hubs to check for contamination. Clean and repack hubs with fresh grease as required.

Brakes

Brake pads, shoes and actuating mechanisms can be damaged by abrasive mud, grit and sand. Water (especially salt water) can cause rusting of brake actuators and springs. Sand, grit, pebbles and mud may fill the slots on vented brake discs. It is good practice to remove all wheels to check and clean the brake mechanisms after driving through rivers, mud, or on a beach.

Handbrake

Regularly check that your handbrake is serviceable and will hold on a very steep grade. Some vehicles have what is known as a 'Transmission Shaft' or 'Cardan Shaft' handbrake. A transmission shaft brake is a drum type brake mechanism mounted on the drive shaft. Find out what sort of handbrake your vehicle has, if you do have a transmission shaft handbrake, NEVER apply it while the vehicle is moving, it may cause the rear axle to wind-up and snap. Caution, a transmission shaft brake will not work if a rear wheel is lifted off the ground or is on a slippery slope due to differential action at the wheels. NEVER jack-up a vehicle with a transmission shaft handbrake without chocking the wheels first.

Anti-lock Brake Systems (ABS)

An ABS keeps the brakes from locking up when a driver stands on the brake pedal. It works by sensing the rotational speed of each wheel and momentarily releasing the brake on any wheel that is turning slower than the others. If your wheels lock-up on slippery ground you will lose steering control, ABS has been designed to prevent this, however most ABS only work at speeds above about 5 - 8 kph. Some modern 4wd's have combination ABS & Traction Control.

Wheel Rims

Wheel rims are easily damaged when driving over rocks and boulders on a beach or riverbed. Magnesium ('mag'), or alloy wheels are stylish, shiny and expensive when new but are easily damaged and spoilt if taken off road. Steel rims are relatively cheap, easily replaced or panel beaten back into shape if damaged. Many 4wd owners have two sets of wheels, the original vehicle rims with road tyres for use around town and a set of steel rims with mud grip tyres for off road use.

Split Rims are usually only found on heavy vehicles (trucks & buses) and not seen on modern 4wd vehicles these days. Split rims are made up of three parts, a conventional wheel centre with a normal size inner rim and a lower sized outer rim, a separate second rim and a split steel ring. Unless you are well practised, leave any work on a split rim to trade experts.

Spacers are packers that are fitted between a wheel rim and the hub backing plate. When fitted, the packer causes the wheel centreline to be offset moving the centre line of the tyre away from the body of the vehicle. This offset allows wider wheels to be fitted onto the vehicle without having the tyre rub against the vehicle body or brake hoses. Caution, spacers put extra load on the axle stub and the LTSA have strict rules about spacers and wheel rim widths (the track should not be widened by more than 50mm). If fitting spacers your vehicle may need to be certified by a specialist engineer.

Tyres

It is a common saying that 90% of tyre problems occur in the last 10% of the life of the tyre. Keep all your tyres in good condition and check regularly for cuts in the sidewalls. Don't forget to check the tyre on the spare wheel, it should also be in good condition.

Tyre Treads

There is no universal tyre design or tread pattern that will be ideal in all conditions. Tread patterns are made by cutting grooves into the surface of the tyre leaving a series of rubber blocks, gaps between these blocks are known as voids. The tread surface on a normal 'road' tyre as used on paved roads around town has a ratio of about 65% rubber and 35% void. Small cuts across the edge of the tread called sipes channel trapped water away from under the blocks into the main tread grooves. Road tyres are not suitable for use in muddy conditions or rough terrain.

Town & Country Tyres (also known as 'All Terrain' or 'AT' tyres)

AT tread patterns have deep coarse treads with a ratio of around 60% rubber and 40% void. AT tyres are alright on unsealed country roads but not really suitable for use on wet grass, slime or deep mud.

Mud Tyres (MT)

The tread surface on MT tyres is about 45% rubber and 55% void. MT tyres may also have large blocky chunks on the edge of the tyre known as lugs. These help traction when the sidewall of the tyre is in a rut or against the side of a bank or rock. A good mud tyre also has 'self-cleaning' properties. The deep blocks of the tread are wedge shaped with rounded lower corners so that mud and debris rather than being compacted in the grooves is squeezed out or flies off the tyre as it spins.

Please note, MT tyres make a lot of road noise, offer less traction, poorer water management and do not stop as quickly as normal road tyres when used on paved roads.

Directional Treads have a chevron (arrowhead) patterned tread and must only be mounted in one direction. The arrowhead formation points forward when looking down at the tyre from above.

Generally, the deeper the tread depth, the better the traction on a soft, slippery surface. If however, the surface is soft sand then the larger the tyre 'footprint' the better the traction.

Tyre Sizes

There are two different systems used to describe the size of a tyre, Imperial & Metric.

The Imperial system is in the form:

31 x 10.5 x R 15 (spoken as: thirty one, - ten point five – fifteen)

The first two digits in the example above (31) indicate that the tyre has a diameter of 31 inches.

The second group of numbers indicates that the tyre is 10.5 inches in width at the tread.

R indicates a radial ply construction and 15 means that the tyre fits on a 15-inch diameter wheel.

The metric system is in the form:

265 x 60 x R 15 (spoken as two six five - sixty - fifteen)

The first group of numbers (265) is the width of the tread in millimetres.

The second group of numbers (60) indicates the height of the tyre measured from the rim to the top of the tread expressed as a percentage of the width. R stands for radial ply and 15 means that the tyre fits on a 15-inch -wheel.

Note that both the imperial and the metric system use inches to describe the wheel diameter!

Load Index & Speed Symbol

After the size numbers stamped on the side of a tyre there are another two digits and a letter. The two digits indicate the 'Load Index' and the letter is the 'Speed Symbol'. The load index is a numerical code associated with the maximum load a tyre can carry at the speed indicated by the speed symbol e.g. 87S. The 87 is the load index, in this case equal to 545kg (1201 lbs), and the letter is a speed symbol, which in this case 'S', is suitable for 180 kph. Tables are available from tyre suppliers.

Ply Rating

During the construction of a tyre, reinforcing material of steel, rayon or cotton is used in layers known as plies. A tyre manufacturer may use different types of material and different numbers of plies when making tyres. For example cotton may be used in the sidewall and steel across the tread. The ply rating is the number of layers of these plies used in that particular tyre e.g. 4 ply steel on the crown and 2 ply cotton in the side walls.

Never use a mixture of tyres that are different sizes or have radically different tread patterns on your vehicle at the same time. Never use a mixture of cross-ply and radial ply tyres at the same time.

Benefits of Cross Ply or Radial Ply

The thinnest and most vulnerable part of a tyre is the sidewall. Cross ply tyres are often said to be good for off road driving as they do not flex in the sidewall as much as radials, this means that the sidewalls stay more upright and are not as exposed to damage on sharp rocks or stakes. Radial tyres, because of their softer sidewall construction, are able to 'flow' over small rocks and give a more comfortable ride then cross ply.

Tyre Pressure – Foot Print

The footprint of a tyre is that part of the tyre that is in contact with the ground. If the air pressure in a tyre is reduced, the footprint of the tyre is lengthened. When going off-road, it is good practice to reduce your tyre pressure (up to 10 psi. or 0.7 bar less than when on a sealed road). Talk to your trip leader if you have any doubt about what tyre pressure to use when on a 4wd trip. Caution, if you are using tubeless tyres and reduce the tyre pressure too much you risk breaking the bead seal where the sidewall of the tyre meets the rim. If the bead breaks away from the rim, the tyre will go flat immediately. When driving on loose sand use as low a pressure as you can without damaging your tyres or endangering your vehicle.

Be aware that steering is affected when you reduce tyre pressure. If you lower your tyre pressure DO NOT travel at speed and remember to reinflate your tyres before driving on a normal hard road surface.

Bead Lockers

A bead locker is a device for preventing a tyre from being mechanically forced away from a wheel rim when driving. When the air pressure in a tyre is reduced the tyre bead can more easily be pushed away from the rim if the tyre wall hits a rock. A method of keeping the bead pressed against the rim called bead locking is sometimes used. The traditional bead locker is a mechanical device that effectively is an external rim that bolts to a modified wheel rim and traps the bead edge of the tyre between the two. With the bolts tightened it assists in stopping the tyre either being pushed off the rim or the wheel rim spinning within the tyre (particularly at low pressures). Internal bead lockers are specially reinforced inner tubes inserted inside the tyre like a regular inner tube. However, this 'inner tube' is only able to expand within the limits of its reinforcing and only fills a small portion of the depth of available space within the tyre. It is however, able to expand sideways pushing the tyre bead against the rim acting as a bead lock. Fitting this type of bead locker requires modification of

the rim to allow for the fitting of another inflation point. One inflation valve is for the internal bead locking tube and the other valve is for the 'tubeless' tyre itself.

Tubes – In Tubeless Tyres

To allow for a large reduction in tyre pressure without risking breaking the bead seal or rolling a tyre off of a rim you can fit tubes inside your tyres. Even if a tyre should be pushed away from the rim and lose the bead seal, air pressure in the tube prevents the tyre from going flat. Many 4wd owners use heavy-duty tubes as used on tractors, the large heavy duty valves facilitate quick deflation to off-road pressure. If intending to use tubes inside tubeless tyres be sure to remove any manufacturer's labels inside the tyre before the tube is inserted as these labels can scuff a tube and cause a puncture.

Tyre Repairs

It is possible to repair the sidewall on a tyre. Some tyre shops will try and sell you a new tyre, if you need a side wall repaired ask a trip leader where you can get repairs done.

Changing the Size of Your Tyres

Some people change the height and width of their tyres to give greater ground clearance and a larger footprint. This may mean getting a set of wider rims with a different or altered offset so that larger tyres do not rub on the inner mudguards. Spacers could be used but may need to be certified.

Changing the offset will also affect the castor angle (the king pin axis line should meet the road at the mid-point of the tyre) and place undue stress on the wheel bearings.

A change to the offset and / or, the fitting of spacers may require Low Volume Vehicle Certification (LVVC), this is a certificate to show that the modifications have been done properly and the vehicle can be operated safely. It should also be noted that no part of the tread of a tyre is allowed to protrude beyond the width of the vehicle; if it does you will probably be refused a Warrant of Fitness. A change of tyre size that increases the diameter by more than 5% will require a recalibration of the speedometer or altering of the final drive ratio (diff gearing). This is to maintain legally accurate speedometer readings and in the case of diesels, to ensure that correct road user charges (per km) are paid. Torque will be reduced unless the differential gearing is changed. Larger tyres may also reduce brake effectiveness due the increased angular momentum of a larger rubber mass.

Chains

Tyre chains are not only for use on ice and snow. If you do not have mud tyres and become stuck on a slippery dirt road or track then tyre chains may well get you home. Put chains on long before you think you may get stuck. Some landowners do not allow chains to be used on their property as they dig-in and can churn up the ground on hillside tracks. Drive slowly; there will be considerable vibration through the wheels if you are driving on a hard surface. Avoid wheel spin when using chains as a spinning wheel is likely to snap a chain.

A question often asked is "should I fit chains to the front or rear wheels"? The only sure answer is, if you need to use chains then ideally they should be on both the front and rear wheels. If you fit chains to the rear wheels only you will have little or no traction and braking on the front wheels and rather ineffective steering. Total braking could be reduced by 50%

If you fit chains to the front wheels only and are driving down hill you risk having the rear of the vehicle wanting to slide and overtake you. Total braking could be reduced by 50%.

There are two main types of tyre chain, 'ladder' and 'diamond'. The ladder type chains are ok for general snow conditions. Diamond tyre chains are more complex, cost a bit more and are designed to

give more penetration and traction on hard packed snow or ice and when used in mud they give more lateral control on a side slope.

When fitting chains, care should be taken to ensure that they are tight and there are no loose ends. Carry soft wire or cable ties to tie back any loose ends securely. Several short 'stretchy' bungee cords to thread through the chains to maintain tension are useful. After fitting chains, drive slowly about half a km and then check to ensure the chains are tight and have not slipped. If a chain comes loose when driving it may flail inside a guard and cut a brake line.

If you own tyre chains, practice fitting them many times in good weather. It is no fun learning how to fit chains when your hands are wet and it is freezing cold.

RECOVERY EQUIPMENT (also see VEHICLE RECOVERY)

Tow Balls

NEVER attach a recovery tow strop or tow rope to a tow ball. Tow balls are not designed to withstand the shock load of a vehicle recovery when stuck in mud or sand. A tow ball may become a lethal missile and hurtle at through the vehicle being recovered or into bystanders.

Rated

This is the Safe Working Load (SWL) as calculated by the manufacturer. A shackle with a SWL of 12,000 kg stamped on the body will actually, in ideal conditions, handle much more than 12,000 kg but with many safety factors allowed for, the manufacturer has determined a SWL and stamped the shackle accordingly and says the shackle is SAFE when used up to the rated value.

Tie-down Points

All vehicles have factory fitted vehicle tie down points, do not confuse tie down points with recovery points. Do not use tie down points as recovery attachment points; they are for anchoring a vehicle during transport on a truck or ship and are not strong enough for use as recovery attachment points.

Tow Hooks

Tow hooks are a very important part of vehicle safety equipment and MUST have a manufacturers rating stamped on them. The rating of tow hooks and acceptable methods of mounting are laid down in the Club safety documents and can be viewed on the CCVC web site. There is no ideal mounting angle for tow hooks. Hooks may be mounted open side up, open side down, open side left facing, open side right facing.

Tow Hook Attachment Bolts

Metric bolts have a numerical shear strength loading code stamped on the bolt head.

Imperial bolts have angular marks pointing from the circumference to the centre of the bolt head. Add a value of 2 to the number of marks on the bolt head to get the grade, e.g. no marks will be a grade of 2 and 6 marks will be a grade 8. Tow hook attachment bolt shear strength, locking nut torque levels and approved mounting methods are shown on the CCVC web site.

Straps / Strops

Straps & Strops are the same thing; they are used for towing and recovery. Learn to identify the difference between stretch and non-stretch strops, misuse could be fatal!

Kinetic or Snatch Straps

Kinetic straps have elastic qualities and can stretch up to 20% of their length when dry and 10% when wet. Do not join more than two kinetic strops together as the resulting rebound may cause loss of control or exceed the safe load limits of your recovery tackle. Some straps have special coloured marker threads, which if broken, indicate that the strop has been over stressed. NEVER use a shackle to join kinetic straps; if a strap breaks the shackle could become an unguided missile!

Regularly examine all straps to ensure that there are no cuts, the stitching is sound and over-stress marker threads are intact.

Tree Protector

If a tree is used to secure any equipment it is good practice to use a tree protector. This is a short wide strap that can be wrapped around a tree to minimize damage to the bark of the tree.

Strop Management

Roll up a strops by starting from the middle. Double the strap and coil it like a fire hose so that both ends finish up on the outside. This helps avoid twists when you unroll them and leaves both ends in the hands of the operator. After use (usually in sand or mud) wash with water and a light detergent then dry before storing.

Joining Straps – Joining Sticks

Never tie knots in straps, ropes or cables it will seriously weaken them. To join a strop, thread the straps through each other and use a joining stick to enable the straps to be separated after the recovery has been completed (see the photos on the last pages of this booklet).

Ropes / Cables

Never attempt a snatch recovery using any type of rope that is not specifically made for kinetic use. It is handy to carry a length of rope or cable as the round cross section allows the rope to be threaded through a ‘pulley block’ to gain a mechanical advantage and / or change the direction of pull.

Synthetic Rope is very lightweight and will float but is more expensive than other ropes. It is extremely strong (more than ten times stronger than steel by weight) and easy to handle. Keep synthetic rope covered to avoid ultra violet light (sunlight) and free from abrasive grit. Sharp or abrasive items can easily damage synthetic rope.

Hemp Rope is easily damaged by sharp objects and should be kept clean and dry. Inspect regularly and destroy immediately if it shows any signs of rotting, unravelling, broken strands, cuts etc.

Wire Rope or cable must be handled with care, use leather gloves to avoid injury due to sharp strands. Wire rope should be kept lightly greased and clean from sand and grit. Old wire rope that has kinks, broken strands or is rusty should be destroyed and replaced.

Snatch Block

A snatch block is a pulley block with swivel opening side plates, this allows the block to be placed on a cable or rope while both ends of the cable are fixed, thereby removing the need to thread the cable through the block. If multiple blocks are used on a recovery rope attached to a vehicle then a large mechanical advantage can be gained. Another use for a snatch block is to change the direction of pull by attaching it to a vehicle or tree when it is being used as an anchor point.

Shackles

All shackles must be rated. There are two types of shackles (also known as a ‘clevis’), one type is known as a ‘Bow’ shackle and the other called a ‘D’ shackle. Bow shackles are so shaped to be used

with multi leg slings and will show any deforming caused by overloading (straightening of the sides). If this is evident the shackle should be discarded. 'D' shackles are mainly used for single leg slings. Shackles must NEVER be used to join kinetic ropes or straps. If you should lose the threaded pin that closes the shackle do not replace it with a bolt, as the bolt will not be rated.

Recovery Chains

Do not use if they are not 'rated'. Never 'snatch' a vehicle using a snig or any other type of chain.

Chains can be used with a hi-lift jack to create a hand winch.

Bridle Strap

If you have recovery hooks on each side of your vehicle a short strap such as a tree protector, can be used as a bridle between the tow hooks to distribute recovery loads between both hooks

WINCHES

Power Take Off (PTO). The drive power for this type of winch comes from a drive shaft connected to the engine. Both capstan and drum type winches can be PTO winches.

A Drum Winch is a winch that winds and stores the cable layer by layer on a windless type drum.

A Capstan Winch does not hold any reserve cable. A couple of turns of cable are wrapped around the rotating capstan and held taut by the operator to maintain a friction lock.

Electric Winches are drum winches powered from the vehicle battery. They draw a lot of power and can get very hot. Be aware that under severe use the drum temperature of an electric winch could get high enough to cause critical damage if using a synthetic rope.

Hydraulic Winches are drum or capstan winches that get their rotating power from a motor driven by hydraulic fluid under pressure. The hydraulic fluid is delivered by hose from an engine driven pump.

Shear Pins are safety devices (sometimes known as a fuse), installed in a winch drive mechanism.

They are designed to break and disconnect a load before the winch self-destructs or the cable breaks.

A pawl mechanism prevents cable spooling out if the shear pin breaks. Shear pins look like a short medium size nail with a waist (designed weak point). A sheared pin is relatively easy to replace although you may have to crawl under some vehicles to do this. Replacement requires the broken bits of the old pin to be knocked out, the shafts between the winch motor and the winch gearbox aligned and a new pin inserted (not easy though if you are the middle of a bog or river!)

Hand Winches. A common type has a straight handle that is manually rocked backwards and forwards, which, with the aid of a ratchet mechanism winds the cable onto a small drum. Another type of hand cable puller, sometimes known as a 'come-along' has a similar arm action but the winching system has a cable gripping friction lock and pulls the cable through the body of the winch.

A 'live' winch rope or tow strop is any rope or strop that is connected at both ends to an anchor point or vehicle. Treat with caution, DO NOT STEP OVER A LIVE ROPE OR STROP!

When winching, keep the vehicle wheels turning at the same speed (or slightly faster) than the in-feed speed of the winch – in other words try and assist the winch.

ALWAYS keep at least six full turns of a winch rope on a winch drum.

A Hi–Lift Jack can also be used as a winch. The jack is used horizontally and can be used to pull up a chain almost the full length of the jack. The chain is then locked off, and the jack released, reset at

full length and the operation started again. In a series of short pulls of about a metre each time the jack can be used as a very successful hand winch.

An Armstrong Winch is simply a long rope or strop with lots of people using the strength of their arms and traction of their feet to pull on the rope. You may be very surprised how effective a one-team tug of war can be!

JACKING

Read your owner's manual, know where your vehicle jacking points are located. When driving off road you need a robust jack that may have to be used in restricted space on uneven ground. A jack is usually used for lifting the corner of a vehicle to change a wheel but when on a 4wd trip it may be used to lift a vehicle so that material can be packed under a wheel to drive out of a hole, or lift the vehicle to remove an obstruction stuck beneath it. If you have to lift a vehicle to do repairs NEVER get under a vehicle when it is jacked up. Always chock wheels and use something to support the vehicle and prevent it from crushing anyone if the jack should fail (and they occasionally do). You could stack two spare wheels under a vehicle as an emergency safety cushion.

Base Boards

When using a conventional jack it is very important to use a base-board to spread the load on sand, mud or soft ground. A piece of 10 mm plywood about 300mm square under the jack will do fine.

Hi Lift Jack

A hi-lift jack is a large, heavy-duty lever operated jack and as its name suggests is capable of lifting much higher than the jack supplied with a vehicle. They can also be used as a vice, a hand winch and a spreader. 'Caution'. The higher the lift the more unstable the vehicle becomes. A vehicle will also need special lifting points for a hi-lift jack to be attached to (usually on a bumper or protection bar).

Most 'shiny' 4wd vehicles do not have any suitable lifting points where a hi-lift jack can be used.

Air Jacks

A deflated air jack is slid under the vehicle and an inflating hose held over the vehicle exhaust pipe to inflate the air bag. A mat or piece of old carpet is usually placed on top of the bag to prevent it being punctured or cut by any sharp parts of the vehicle. This type of jack is very useful in water, mud or sand. The air bag has an advantage over conventional jacks as it does not have to be placed anywhere special under the vehicle except, of course, it is important to avoid a hot exhaust pipe as this could melt the flexible air bag!

HILL CLIMBING

High torque is required for hill climbing. Use a gear that will comfortably allow you to climb the hill without the engine labouring. However, keep in mind that you will be travelling slowly and airflow through engine radiators will be limited. Keep an eye on the engine and transmission temperature gauges when driving a long hill climb. If you have a belt driven radiator fan and either temperature is climbing, then use a lower gear and increase engine revs to get more air moving through the radiators. An air conditioning system uses considerable engine power, turning it off may help lower the engine temperature. Do not over-rev the engine and keep up vehicle momentum.

When climbing, the weight of a vehicle acting at the centre of gravity will be angled towards the rear. Traction and braking will be more effective on the back wheels and less effective on the front wheels. If your vehicle has been in water shortly before you start climbing a hill, check your brakes to make sure they are effective. Do not start a hill climb with wet brakes. In the event of a failed hill climb or another vehicle stopping and preventing you moving forward you will suddenly be dependent on your brakes and will expect them to be working properly!

FAILED HILL CLIMB

Manual Transmission

Always use low ratio when climbing a very steep hill. If the hill becomes too steep for your vehicle or you lose traction and are unable to continue climbing then you are in a 'Failed Hill Climb' situation. Select reverse gear immediately and start a controlled descent in reverse. Be careful, use cadence braking and maintain traction.

DO NOT ALLOW A VEHICLE TO RUN BACKWARDS USING THE CLUTCH

Start slow – Stay slow – Stay in control!

Stay in gear at all times. If you miss the gear change into reverse, do not allow the vehicle to move backwards with the clutch depressed. Stop the vehicle and start over, stall the engine if necessary.

Hold the vehicle on both the foot brake and handbrake, select reverse gear, and centre your steering wheel and front wheels so you know which way the vehicle will move when started. Let out the clutch, release handbrake, slowly release footbrake, the vehicle should hold its position by resting on engine compression. Flick the start switch and the vehicle should start instantly in reverse.

When parking on a steep hill, use the hand brake, leave in gear and angle the wheels away from the downhill slope if you are going to get out of the vehicle.

Automatic Transmission

Select reverse as fast as possible. BUT avoid putting into reverse gear whilst still moving forwards.

After selecting reverse gear you may also need to blip the throttle to accelerate the engine a little, this will re-engage the automatic transmissions torque converter.

Drive-over Braking or `Left Foot Braking for Automatics'

To ensure that the torque converter stays engaged a little throttle may be required with your right foot but as you do not want the vehicle to accelerate in reverse you need to use your left foot on the brake pedal at the same time – this is not a normal driving technique, it requires lots of practice!

Traction Control

This is a type of ABS in reverse and pulses the wheel brakes. The traction control system will 'see' which wheel is turning the fastest (a spinning wheel that is off the ground or on a slippery surface) as a wheel that has lost traction and so applies the brake on that wheel to get the differential to deliver more power to the other wheel on the same axle. A drawback however may be that the ABS system does not allow you to deliberately spin the wheels and clear the tyre treads of any loose mud etc.

Positioning Your Vehicle For A Turn

When approaching a very tight, uphill hairpin corner, look ahead and position your vehicle so as to take the corner in one bite if possible. If it looks like you will need to make more than one bite at the corner then try and manoeuver wide to avoid becoming cross-axled and losing traction.

DESCENDING HILLS

Start slow – Stay slow – Stay in control!

Always use low ratio when descending a steep hill. If you have to park on a steep hill use the hand brake, put vehicle in gear and angle the wheels away from the slope if you plan to leave the vehicle.

If you cannot see the track over the front of your vehicle – get out and have a look or get someone to give you directions - do not make guess at what is in front of you.

Automatics

Use the same technique as described in, Failed Hill Climb, Drive-over Braking. This is sometimes known as `Left Foot Braking'. Select low, 1st or 2nd gear, brake with your left foot and to ensure that the torque converter stays engaged use a 'very little' throttle with your right foot. As you do not want the vehicle to accelerate downhill, you need to use your left foot on the brake pedal at the same time – this requires practice. Hold the vehicle stationary by applying just enough brake to do so, and then move the vehicle forward by applying a little accelerator to overcome the effect of the brake, reducing pressure on the accelerator will bring the vehicle to a stop. Practice this technique on a flat road, do not try it on a steep four wheel drive track without practice.

Vehicle Weight

When travelling down a hill the weight of the vehicle acting at the centre of gravity will be angled forwards giving increased traction and braking at the front wheels and less effective on the rear.

Changing Gears

Make your gear selection before you are established on the downhill slope. Use a gear one lower than you would use to climb the hill. Be careful, if you should miss a gear change or have a problem with the clutch you will lose the effect of engine braking.

Braking

When descending a hill it is VERY important to maintain traction at all times. You must have effective braking and steering to remain in control of your vehicle. If the track is slippery it is very easy to lose traction by braking and causing the wheels to turn at a slower speed then the vehicle is actually moving forward. When this occurs you are skidding and your tyre tread will rapidly become clogged making the braking even more ineffective. You may actually have to accelerate the wheels slightly and hope that your large void mud tyres advertised as being `self-cleaning' really do! If you are going to lose control it is better to lose it at 5 kph then 20 kph.

Drive slowly as you approach a wet clay or muddy area on a track, don't race up to it and then be surprised if your brakes have little or no effect. If you are on a rough rocky section of track you can take advantage of the hard surface to slow the vehicle or clear your treads while you are still able to effectively use your brakes. If your vehicle loses traction you have to increase the vehicle wheel speed up to the speed that you are moving forward at to regain traction. If it is safe to do so try changing up a gear, this will increase your speed a little but at least you may now have control again.

Start your descent slowly in either your lowest gear or at least one gear lower than you would use to climb the hill. If track conditions permit (good gritty or rocky surface), you can use your brakes (see 'Cadence Braking' below) to maintain a slow descent. If you are in your lowest gear and the vehicle continues to slowly accelerate, try turning on your air-conditioning, this will add more load to the engine and increase the effect of engine braking. DO NOT follow close behind another vehicle.

REMEMBER; Start slow – Stay slow – Stay in control!

Cadence Braking

If you have to use your brakes then use them carefully and in very short pulses to slow the vehicle without actually stopping the wheels turning. This is known as Cadence Braking

Descent Control or Traction Control

This is a type of ABS in reverse, it releases the wheel brakes in short pulses to obtain braking without skidding. Traction control checks to see that all wheels are turning at the same speed. Any wheel that is turning slower than the others is skidding so the traction control releases that individual wheel

brake momentarily till all wheels are again turning at the same speed. A drawback however is that you may not be able to blip the throttle and spin the wheels to clear the tyre treads of any loose mud.

Use Of Ruts

Ruts can be useful on a slippery track. By deliberately positioning your wheels in ruts, the sidewalls of your tyres can have a braking effect if gently turned against the side of a rut. Ruts may also help guide you around twists and turns when your steering is not very effective due to loss of traction.

Positioning Your Vehicle for A Steep Descending Turn

When approaching a tight, downhill hairpin corner, look ahead and position your vehicle to take the corner wide. If it looks like you will need to take more than one bite at the corner, try and start wide then turn, manoeuvring on the part of the track with the least camber to avoid becoming cross-axled and losing traction.

Catching a Slide

If your vehicle loses traction and is still moving then you are sliding and you have lost control. You must regain control immediately. If the vehicle is not going to stop by itself, try gently accelerating to see if your tyres can clear their treads and bite the ground to regain traction, ease off the brakes. If you have a choice, stay in ruts they may help to guide you like railway lines with little steering required.

Run-Out

Plan an escape route. Look around to see where you can head for if things do not work out as planned.

STABILITY

Centre of Gravity

The centre of gravity (C of G) of an unmodified 4wd vehicle is usually at about the height of the driver's seat and alongside of the driver on the centreline of the vehicle.

High C of G

A 4wd is designed to have a high ground clearance. By being higher off the ground the centre of gravity will be higher and the vehicle roll-over angle less than a low vehicle such as a family car. This must be taken into account when deciding what angle of slope you can safely drive across.

A vehicle with a high C of G can roll over easier than a vehicle with a low C of G. A sideways force in the range of +0.8 to +1.1 G is all it takes to roll over a high C of G vehicle. A sudden swerve or a slide that stops against a bump or rut may result in side loads that cause the vehicle to roll over.

Lowered tyre pressures will increase the effect of any body roll. Do not overload your vehicle, stopping distances are increased. Any load on a roof rack will also affect stability.

Live Loads

Live loads such as animals or humans can alter the centre of gravity by moving around inside the vehicle. Loose freight or a tank of liquid should also be considered a 'live load'.

Side Slopes (Sideling)

If you need to drive across a slope and it looks a bit steep, try walking the slope before you attempt to drive across it. If you have difficulty walking across the slope then your vehicle will also have a problem. If your vehicle starts to slide sideways when crossing a side slope, there is only one thing to

do – turn into the slide and drive down hill immediately. Look to see where your down slope run-out may be before you attempt to cross it. If you don't turn and drive down slope immediately there is a chance that your vehicle could roll over.

When crossing a slope most of a vehicle's weight will be on the down slope wheels. If the vehicle does start to slide then a small bump may be all it takes to lift the up-hill side of the vehicle slightly and start a roll over. If you only have to traverse a short distance it may be possible to dig yourself a rut for the up slope wheels, this will lower the effective angle of the slope and forms a channel to prevent the wheels breaking away into a slide.

The maximum side slope angle that a normal 4wd vehicle can safely negotiate is about 25 degrees or 15 degrees if you have a loaded roof rack. Any angle greater than this and you should be sure that the ground surface is firm and has excellent traction. The vehicle may not roll until the slope angle is much higher, but the vehicle can slide sideways resulting in loss of control.

SOFT SURFACES (Sand, Beaches, Snow, Ice, Mud)

All of the above may have either a hard or soft surface and require special driving techniques.

Tyres

If your tyre treads have become clogged with mud then traction will be poor. A very careful throttle blip to accelerate the wheels may clear the tread by throwing off any soft debris

Tyre Pressure

Reducing tyre pressures by half will increase the size of the tyre footprint by over 25%. Generally you should always reduce tyre pressures when off-road driving EXCEPT, when using tyre chains.

High Torque is required when driving through clinging sand, snow or mud. Try and travel at a low to medium speed, avoid wheel spin and over revving. Try and use the highest gear that allows you to still make good headway without the engine struggling.

Sand Hills

Approach straight on when climbing or descending. If you start to slide when descending, accelerate gently to keep steering control. Be very careful when moving down steep sand dunes, as far as possible try not to drive across the slope to avoid sliding sideways and a possibly roll over.

Turning the Steering Wheel To Gain Traction

Gently turning the steering wheel from side to side through about 30 degrees from centre may allow the side lugs of tyres to dig in and aid traction. Do not try this if you are still making headway as the wheels turned at any angle other than straight ahead act as a bulldozer and causes more drag. Be careful though, if your vehicle suddenly gains full traction it may take off in the direction that the wheels are pointing and not the direction you want to go.

Reversing If Stuck

If you become stuck while moving forward in snow, sand or water, try putting the vehicle immediately into reverse and backing out over your own wheel tracks onto a firm surface but avoid wheel spinning as this will just dig a deeper hole!

Additional Hazards

Beware of hidden objects when driving through water or on snow, sand and mud.

Items such as seaweed could hide driftwood or rocks on a beach. Muddy water may hide logs, boulders and deep holes. When driving on a beach be aware that tides may cut off your return. Do not travel at speed near the water, large waves moving up a beach may force a sudden swerve and

roll-over (especially if you have reduced tyre pressure). Don't park on saturated sand near the water's edge – your vehicle may sink!

When driving in snow, whiteout conditions may occur at any time reducing visibility to zero and making driving hazardous if not impossible. Snow may hide holes and drains or the edge of the road.

Keep your speed down when driving in soft sand or snow. A sudden swerve could cause a rollover.

RIVERS / WATER HOLES

Check the Water Depth

Know the depth of water that your vehicle can safely negotiate without floating – usually not much more then wheel height! If the depth of water or strength of current is too strong to walk across then think very carefully about attempting to drive across. If you are unable to walk across then you should not try and drive across in a small to average sized 4wd vehicle.

Engine Air Intake

Know where your engine air intake is located. Do not allow water to get into the engine air intake, it can kill your engine and be VERY expensive! Some vehicles are fitted with snorkels to lift the engine air intake well above water level. In an emergency it may be possible to temporally disconnect an air intake or redirect it within the engine bay to avoid ingesting water.

Engine Management Computer

Know where the computer is located (usually under the carpet above passenger's feet below the dashboard). If water enters your vehicle and gets into the computer it could be a long walk home and cost a lot of $.

Breather Pipes – Differentials, Transfer Case, Gearbox

Check the height of breather pipes. If necessary have them extended to a higher point so they will not suck in water when transmissions cool rapidly when entering water.

Radiator Blinds

These are usually home-made devices that can quickly be attached to cover the front of the radiator before entering water. The 'blind' prevents water flowing through the radiator and being sprayed all around the engine bay by the fan. Water can even bend fan blades into the radiator! A square of canvas with pre-fitted domes or short ropes to tie onto the grill would work well. You can try slipping a plastic land agents 'house for sale' sign down between the air conditioning radiator and the engine radiator. Removing the fan belt before entering water is not usually done these days, use a radiator blind instead. Remove any radiator blanking device after crossing the water.

Entry Point / Exit Point

Carefully check that your entry and exit points are clear before entering a river. If you need to reverse, is it practical to use the entry point to get back out again? Are you sure that your chosen exit point is attainable and the riverbank is not too steep to climb out? If in doubt walk your intended route first.

DO NOT drive up to the river edge as soon as the vehicle in front has started the crossing, leave room for the vehicle in front to reverse out again if required.

Hidden Obstacles

Look out for hidden objects just waiting to cause you grief. Deep holes, large boulders or tree branches may ruin your day. Pick your route carefully, watch carefully where others in front of you go. If you see them suddenly lurch or drop into a hole make a mental note to avoid those spots.

Traveling Against the Current or With the Current

If you have a choice, it is best to cross a river driving either straight across or angled downstream.

This avoids the current pushing water up into the engine bay or the vehicle having to fight against the current when heading upstream.

Bow Wave

When crossing a river or pond try to do so at a speed that produces a small bow wave about 20 – 25 cm high (about one and a half hand spans). Behind a bow wave a trough is formed beneath the engine area. Be aware that your bow wave could cause problems for someone driving towards or alongside you. If you are in a tunnel a wave pushed ahead of you may reflect back off of the wall of the tunnel and come up under your engine. Be observant of what is happening around you when in water. Do not travel too fast!

Headlights

Most working forests require that you have headlights on at all times. Switch off your headlights before entering water. If cold water comes in contact with a hot light bulb the bulb will almost certainly fail. After finishing water crossings for the day get out of your vehicle and look at your lights to see if there is any water inside of the glass before you switch the lights on again. Modern polycarbonate lens and or globes are not subject to the same likelihood of failure in cold water.

If you have a manual gearbox and change gears when in water you risk getting mud and water between the clutch plates causing the clutch to slip. If you do have to change gear in water, accelerate the engine before releasing the clutch pedal, centrifugal force may help clear the clutch plates.

After crossing a river or large puddle it is tempting to park, switch off and watch other vehicles make their crossing. If you have a petrol engine it is a good idea to leave the engine running for a while, this keeps the fan moving hot engine air around the ignition and other electrics to dry them out.

Test your brakes after you come out of water. Gently ride the brake pedal for a short distance to dry out brake shoes. Caution! Do not start a hill climb or descent with wet brakes!

If you plan to make a lot of river crossings seek advice about how to prepare your vehicle by protecting items such as the alternator, ignition system and starter motor, these items can be expensive to repair.

VEHICLE RECOVERY

Kinetic Snatching.

Kinetic straps are designed to stretch up to 20% before inertia is overcome and a slingshot effect assists (hopefully) with a successful recovery of a stuck vehicle. Ensure that there are no persons other than the driver in any vehicle directly involved with the recovery. Drivers should be secured with seatbelts on and have heads back against their headrests. The forces generated during a snatch recovery can be in the same magnitude as the weight of the vehicle, i.e. tonnes!

Clear any piled up debris from around the stuck vehicles wheels. A recovery vehicle is then hooked up to the stuck vehicle and takes up any slack in the strap between the vehicles. When the person

controlling the recovery has checked that both drivers are ready and gives the go-ahead, the recovery driver moves off and attempts a simple tow. If this does not succeed then try again but this time with about two metres of slack in the strop. The tow vehicle moves forward at normal take off speed. If this fails try again but now with three metres of slack in the strop. If there is still no success do some more digging around the stuck vehicle and try using multiple vehicles or a winch recovery.

Danger Zones.

When winching or kinetic snatching another vehicle, make sure that no one is standing where they could get hurt if an equipment failure occurs. If a kinetic strap under extreme tension breaks it can recoil and whip out at great speed doing very serious damage to anything in its path. Plot out in your mind where any cable or strop might go during recoil if it should break. The danger zone usually fans outwards at about 60 degrees from the line of pull either side of the point of breakage. No one should be standing in this zone, allow a significant safety margin as well.

WINCHING

Only one person who has a sound knowledge of recovery techniques should direct everyone involved.

This person should be identified to all those people involved with or observing the operation. This avoids instructions coming from different people which may cause confusion. Each driver should know what is going to happen, what signals are going to be given and how far or hard the tow, winch or snatch is going to be.

Ensure that all occupants are secured and sitting upright. There should be no person other than the driver in any vehicle directly involved with a recovery. Sturdy gloves should always be worn when handling steel winch cables.

Winch Rope Dampener

To try and slow down any recoil if a rope breaks, a sack or similar sized item should be draped over the midpoint of the cable to act as a drag parachute. This also acts as a flag to indicate where the (sometimes hard to see) winch rope is. Any repositioning of the dampener should only take place if winching has ceased and the person in charge of the operation gives the go-ahead.

ALWAYS use rated tow hooks, cables, shackles and strops when recovering a vehicle. NEVER use a tow ball as an attachment point.

Before any winching commences the person in charge shall ensure that ALL people are moved out of the danger zone in case of an equipment failure.

When a winch cable has been hooked up at both ends it must not be handled or stepped over.

A winch should not be operated whilst rigging till the person in charge gives the all-clear.

Once winching commences all directions shall be given by the person in charge or their designated assistant. Vehicles must avoid running over winch cables. A steel cable may become permanently kinked and weakened if it is deformed over a rock, a synthetic cable may be abraded or cut.

When winching and using a tree as an anchor point, a non-stretch, wide strap (Tree Protector) should be used to prevent damage to the tree.

Only rated shackles appropriate for the load being handled by the winch should be used.

If it is necessary for someone to assist with the feeding in (or out) of a winch cable, hands should come no closer to the fairlead then 1 metre or the point where they become unsighted by the winch operator (driver).

Recovery Loads

Loads incurred when recovering a vehicle can be very high. In the following tables LW is the Loaded Weight of the vehicle being recovered.

A pull of 100% of LW is required to free a vehicle stuck up to the top of the sidewall of a tyre.

A pull of 200% of LW will be required to free a vehicle stuck up to the hubs of its wheels.

A pull of 300% of LW will be required to free a vehicle stuck up to the body.

Add the following load if a vehicle is to be recovered up a slope.

15 degrees - add 25% of LW

30 degrees - add 50% of LW

45 degrees - add 75% of LW

Recovery Using Multiple Vehicles in Tandem.

If one vehicle is unable to get enough traction to pull or snatch free the stuck vehicle then a tandem recovery can be tried. A normal tow strap is attached between the tandem recovery vehicles and a kinetic strap laid out as normal between the last recovery vehicle and the stuck vehicle. The big advantage of using tandem vehicles is the traction that can be achieved by having four extra wheels on the ground. ENSURE that the middle vehicle is in a straight line with the other vehicles.

Using Another Vehicle As An Anchor.

This type of recovery is rather difficult to explain. A demonstration is the best way to appreciate the method and outcome. If two wheels on one side of a vehicle have slipped off the track and down a bank, a straight pull from the front will not pull the vehicle back up onto the track, it will simple pull the cast vehicle forwards. If another vehicle is hooked to the rear as an anchor, a pull from the front will tend to pull the cast vehicle into line between the anchor and tow vehicles. If a recovery is required in a direction that is not in line with the rescue vehicle, say around a bend, and there are no handy trees to attach a pulley block to, then it may be possible to use another vehicle as an anchor point to change the direction of line pull. Park the anchor vehicle in a safe position and by using a block attached to the anchor vehicle run a line from the stuck vehicle to the rescue vehicle.

If the anchor vehicle begins to slide during the recovery consider digging holes for the wheels of the anchor vehicle, putting a log or rocks in front of its wheels or adding another vehicle in tandem with the anchor vehicle.

Learn how to join straps in the approved manner without tying a knot in them, use a joining stick to ensure that you can undo them again. DO NOT join straps using a shackle as the shackle could become a lethal missile in the event of a strap failure.

TOWING

When towing a trailer off road, articulation and break-over angles become very important and a conventional tow ball and hitch may not be suitable. If twisting articulation or break-over angle becomes excessive, disconnection or breakage of the coupling may occur.

When towing another vehicle that has broken down be aware that a vehicle without a running engine has no power assisted brakes or steering. Stopping and steering a vehicle without power assist is very difficult and dangerous. In some circumstances it may be useful to tether a third vehicle behind the ‘dead’ vehicle to assist with braking. Caution, if any vehicle gets into difficulties then other vehicles attached by ropes or strops may also be compromised. Make sure that all drivers know the plan.

Use a marshal to give directions when manoeuvring in a tight spot. An extra pair of eyes can spot where your wheels are heading and how much space you have to move in.

RETURNING TO 2WD AFTER BEING OFF ROAD

Select 2WD. Disengage four-wheel drive. Do not use 4wd on hard surface roads unless your vehicle has an all-wheel drive transmission system.

Tyre Pressure. After being 'off road' it is very important that you re-inflate your tyres to normal road pressure. Running with reduced tyre pressure is ok for slow speed travel on an unsealed surface but is unsafe at normal road speed and will damage your tyres. When pumping up your tyres take the opportunity to inspect them for any cuts that may have occurred while driving off road.

Free Wheeling Hubs. If you have free-wheeling hubs, unlock them so they are in free-wheel mode on hard seal roads.

Clean Headlights and Number Plates. If you have been on a muddy track your headlights, indicators and number plates may be covered with mud, wipe with long grass if you can't find anything else or a Police vehicle may have cause to stop you.

COMMUNICATIONS

Cell Phones

Require the use of repeater stations so unless you are in line-of-sight of a repeater aerial a cell phone will not be any use in hilly back-country areas.

AM CB

Radios operating at 27 MHz are not used very much these days. UHF CB (PRS) 40 Channel UHF CB operating at 477MHz are usually known as PRS (Public Radio Service) and are becoming very common. They operate in an FM band and have very clear reception. Their range is generally limited to line of sight or about 3km, they are very good for use in a convoy situation.

Club Radio

CCVC use tone E-band VHF radio frequency of around 150 MHz. These radios may be purchased through the Club. On Club trips CCVC uses its own VHF frequency and on 'Family Shiny' trips PRS Ch 30 may also be used.

Radio Aerials

For best transmitting strength, aerials should ideally be mounted in the centre of the roof of your vehicle. Unfortunately this is also a place where they can be easily damaged by low flying trees.

Most people mount external aerials on their vehicle bull bars (if fitted) or on a front mudguard where they can be seen by the driver and folded down if in danger of being damaged. For best reception, aerials should be tuned to a ¼ or ½ wavelength of the frequency being used, e.g. the aerial for the CCVC vhf 'club radio' is about 500 mm or 1m in length.

Communications Etiquette

These days there is little formality and you can use normal conversational style when using a radio. It is good procedure to use "Roger" or "Copy" to confirm you have received and understood a message. "Over" means that you have finished speaking and expect a reply. Communication should be kept short and to the point, minimising chitchat that may interfere with emergency transmission by another convoy member. Please do not play music, swear or talk over someone else.

VEHICLE MAINTENANCE

Regularly check the fluids in your vehicle; Battery, brake, clutch, radiator, power steering, engine oil, transmission oil, transfer case oil, differential oil. If any oil is white and soapy looking then it has been contaminated with water and should be changed. Grease the drive shaft universals, wheel bearings, suspension ball joints and swivel pins. Check brake pads, discs, shoes, drums, handbrake adjustment, especially after driving in sand or mud.

Check drive belts and idlers for alternator, radiator fan, air-conditioning, power steering.

Change air & oil filters at intervals recommended by vehicle manufacturer.

Check radiators (air con, engine, oil cooler, auto-transmission) are not blocked by mud, grasses, bugs.

Regularly check that your fire extinguisher is serviceable and accessible. All dry powder extinguishers should be given a shake and rotated monthly.

If you drive 'off road', wear & tear on your vehicle will be increased and you will need to carry out service checks more often than for vehicles only use 'on-road'.

Insurance

Are you insured? Read your vehicle insurance policy carefully. Some insurance companies do not cover vehicles when they are not on a formed road or 'off-road'. If you have doubts ask other club members which company they are insured with and why.

Number Plates

Check that your vehicle registration plates are securely attached to your vehicle. Use at least four nuts and bolts on each plate so that they do not work loose and come off or get caught in bush or mud.

Loose Articles

Look under your seats, loose articles could roll forward under the driver's feet when travelling downhill on a bumpy track.

Keep a small plan of your vehicle fuse locations in the glove box. It can be difficult checking each fuse one by one on a wet cold night if your lights are not working after fording a river.

The following items could be very useful when away from home on a 4wd trip. Warm clothing, Torch, Wet weather clothing, Toilet paper, Drinking water, Insect repellent, Snack food, Maps, Personal medications, Plastic bags (for rubbish, wet clothes & muddy footwear).

First Aid

All CCVC members on trips must have a first aid kit. Trip leaders carry a supplementary first aid box to assist with larger incidents. During the trip-briefing trip leaders will identify persons in the group with first aid experience.

Always travel with caution when off road. Be prepared, you may come across other vehicles, walkers, trail bikes, horses or cattle at any time. Consider all roads and tracks to be two-way and expect to meet on-coming traffic at any time! Use normal road rules even when not on a formed road.

Night Driving

When driving on a 4 wheel drive track at night PLEASE remember to watch your following distance. Make sure that your headlights do not annoy the driver in front by flooding the inside of their vehicle either through the back window or reflecting from rear-vision mirrors. At night, a driver needs to

concentrate on the unlit track in front and does want to be distracted by having more light inside the vehicle from the vehicle behind, than can be seen on the ground ahead!

Parking

When stopping for lunch, cup of tea or photo shot etc. park in an orderly fashion, close up and leave as much room as possible for other vehicles. It is very annoying to find a vehicle taking the space that three vehicles could share if the first vehicle was sensibly parked!

GENERAL EQUIPMENT

Equipment that you should consider having in your 4wd. vehicle.

- Tool Kit, General tools plus specialist tools that your vehicle may require for roadside repairs.
- Air Pump, To re-inflate tyres after being off road. Some people adapt a dive tank for an air source.
- Tyre Pressure Gauge, To check pressure after an air-down (lowering pressure) or re-inflation.
- Vehicle Spares, As required e.g. spark plug & lead, radiator hoses, hydraulic oil, fan belt, fuses etc.
- Kinetic Recovery Strop
- Recovery Strops, At least one short (for use as a bridal or tree protector) and one long.
- Strop Joining Sticks, At least two.
- Rated Shackles, At least two.
- Snatch (Pulley) Block
- Rope, To fit snatch block.
- Gloves, For handling wire winch ropes and logs.
- Plastic Rubbish Bag, To hold wet, muddy recovery strops and gumboots or put on floor of vehicle to save carpet when your boots are muddy.
- Fire Extinguisher, 1 Kg (minimum) dry powder.
- Torch, Working !
- Trouble Lamp, With a lead long enough to reach the rear wheels.
- Shovel or Spade, Preferably with a steel handle.
- First Aid Kit
- Bow Saw, A hand saw with coarse sharp teeth suitable for cutting small logs.
- Chainsaw (& safety equipment) If you travel on forest tracks a chainsaw can be handy.
- Cargo Net / Tie Downs, To hold down all your safety equipment and spares.
- Water Depth Gauge, A stick to check the depth of water holes (or a mark on the dash board J).
- Spark Arrester, A gauze spark arrester on exhaust to prevent a bush fire (mandatory in some forests).

CONVOY RULES

- Recognise the authority of the trip leader.
- No dogs or firearms.
- Guests are the responsibility of the person who invited them.
- Always wear seatbelts when driving.
- No drinking and driving.
- Keep the vehicle immediately behind in sight.
- Wait at all intersections to ensure the following vehicle makes the correct turn.
- Keep your position in the convoy - no passing.
- Do not use excessive accelerator and dig holes by unnecessary wheel spinning.
- Do not leave the convoy without telling the trip leader.
- When driving in a working forest always have your headlights turned on.

- Leave gates as found.
- Take home all of your rubbish
- Following distance –
  (i) Ensure the vehicle in front has cleared an obstacle before you attempt it.
  (ii) Allow room for the vehicle in front to reverse if necessary to make another attempt at an obstacle.
  (iii) When travelling on the open road, leave room for other road users to overtake you and move on through the convoy.
  (iv) Keep well back from the vehicle in front when on a steep or slippery slope.

Corner Person.

When travelling in a convoy on public roads it is sometimes handy to use a 'corner person'. The trip leader is in the lead and when the convoy comes to an intersection the second vehicle is directed to wait at the corner to indicate the direction of travel to other vehicles in the convoy.

When the tail vehicle comes to the intersection it will flash headlights or make contact by radio to indicate to the corner person to re-join the convoy immediately in front of the tail vehicle.

Tread Lightly

CCVC encourages its members to follow the principles of the 'Tread Lightly' program

The mission statement of Tread Lightly is to encourage recreationalists to be responsible and apply low impact principles to all outdoor recreational activities.

Tell Someone Where You are Going.

Before you go on a trip always tell someone where you are going and any emergency plans (alternative routes) and when you expect to return. Drive safely, have fun and tread lightly.

FURTHER READING & INTERNET VIEWING

4WD North Island, 102 Off Road Adventures by Andy Cockroft
4WD South Island, 107 Off Road Adventures by Ken Sibley & Mark Wilson
Winching & Recovery: http://www.pirate4x4.com/tech/billavista/Recovery/index.html
Article about kinetic straps: http://www.beaver.com.au/news/Snatch%20Strap.pdf
Winch cables: http://home.gci.net/~trey/cable.html
Winch manufacturers web site: www.innovation-engineering.co.uk/theory.htm
Hints for beginners & selecting a 4x4 vehicle: http://www.4x4.net.nz/4xFun/default.htm
Explanation of tyre terms: http://www.etyres.co.uk/glossary-tyre-terms
Some good information here: http://www.safari4x4.com.au/80scool/training/training.html
Tyres: http://www.chris-longhurst.com/carbibles/tyre_bible.html