



# Introduction To Four Wheel Driving Techniques

NISSAN PATROL CLUB SA Inc.

**Please Note: Four-Wheel Driving can at times be a hazardous activity. While the information contained within this document is considered accurate, neither the Nissan Patrol Club or any of its members will assume responsibility for any accident or damage as a result of using this booklet.**

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## Your Details

**NAME:** .....

**MEMBERSHIP NUMBER:** .....

**VEHICLE MAKE:** .....

**VEHICLE MODEL** .....

**REGISTRATION NUMBER:** .....

**FUEL TYPE (circle one):**                      **PETROL/DIESEL**

**TRANSMISSION TYPE (circle one):** **MANUAL/AUTOMATIC**

**EXTRAS (eg winch, radio etc)** .....

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SECTION	COMPLETED / DATE
<b>RULES OF 4WDING</b>	<input type="checkbox"/>
<b>4WD OFF ROAD FEATURES</b>	<input type="checkbox"/>
<b>CONVOY PROCEDURES</b>	<input type="checkbox"/>
<b>SAND</b>	<input type="checkbox"/>
<b>ROCKS &amp; HILLS</b>	<input type="checkbox"/>
<b>MUD &amp; WATER</b>	<input type="checkbox"/>
<b>RECOVERY PROCEDURES</b>	<input type="checkbox"/>

## 4WD OFF ROAD FEATURES

Modern four-wheel drive vehicles are equipped with many advanced electronic driver aids and safety features. Electronic traction aids may include traction control, stability control, hill descent control, trailer sway control and more.

If you own a vehicle with some or all of these features you need to consult the vehicle's manual and ensure you are familiar with all the features and their operation before you undertake any four wheel driving.

## Basic Equipment required

- Lots of adverts for recovery equipment are aimed at 4wd drivers on the east coast of Australia.
- Generally South Australia is sandy and rocky.
- One can buy extra recovery equipment as time goes on. There are some excellent aids available, but then, you have to find a storage place for them; (in or on your vehicle).

It is recommended that you have a basic recovery kit which consists of:

- **Snatch Strap:** Snatch straps are good for 'gentle' towing or snatching a stuck vehicle. (Snatch straps used incorrectly have killed people. You must know the recovery points on your vehicle – the vehicle manual should indicate where they are. Make sure they are 'Rated' Recovery Points, (that is – i.e. certified to be able to take the strain of a snatch strap or chain. Some vehicles that do not have a ladder frame chassis may require a Bridle Strap to distribute the load across the front of the vehicle in order to avoid damage to the vehicle).
- **Shackles** - to attach the Snatch Strap to your and the recovery vehicle. (Shackles MUST be load rated).
- **Long Handled Shovel:** Long handle shovels have many uses. The length lets one 'more easily' remove obstructions from underneath your vehicle. A long handle shovel could be used as a lever to help position a replacement tyre.
- **Fire Extinguisher.**
- **Air Compressor / Tyre Pressure Gauge:** Buy a good air compressor. It may be the most expensive item you purchase. (Tyre pressures are often reduced to suit various driving conditions. Inflating tyres with a slow compressor can be tedious. A better quality compressor should last longer.)
- **Board:** A board to put the vehicle's jack on when changing a tyre on soft ground.
- **UHF Radio:** UHF radio (channel 21 is the Nissan Club's channel). (A good outside antenna is important. This could be attached to a fixed unit or a suitable handheld.)
- A good first aid kit.

The nice to haves are:

- A tarp or equivalent - when lying on wet/dusty ground trying to change a tyre, etc.
- Gloves – to remove prickly branches caught under your vehicle, etc.
- An old towel or similar - to clean your hands.
- Side steps on your vehicle can be used to tap the side of your shoes; to remove the loose sand or dirt when climbing back into your vehicle.
- Squirty bottle with a soap solution for washing hands and putting out small fires.

Other Items:

- Wire hook for removing grass caught around drive shafts and exhaust systems. Do not park on vegetation with a hot exhaust system.

# Rules Of 4wding

## 4WDing Code of Ethics

As a 4wd-er there are certain attitudes and behaviours that help to ensure that we can enjoy 4wding without doing harm to others or the environment. This is called the 4WDing Code of Ethics.

The following is an overview of some of that information.

- Drive only where permitted.
- Leave livestock alone.
- Leave gates as found.
- Respect wildlife.
- Keep the environment clean.
- Obey all fire restrictions.
- Extinguish your fire before leaving.
- Don't let your exhaust emit sparks
- Watch out for hot exhaust systems picking up vegetation – keep a wire hook and a squirty bottle full of water handy to extinguish any exhaust sparks.
- Obey restrictions on the use of Public Land and any road or track closure signs.
- Take adequate water, food, fuel and spares on trips.
- In remote areas travel with other vehicles.
- Let other people know where you are going and when you will be able to contact them next.
- The laws and regulations change from State to State. Information about the laws in each state is available on the internet, local information centres, interstate police, etc

## Duty of Care while on Club Events

During Nissan Patrol Club SA events the Club has a Duty of Care to your family, passengers and/or visitors. Similarly, you also have a duty to make sure that you are not doing things which might put you or others at risk.

## General 4WDing points

There are a number of general points to consider when undertaking any 4WDing, including (but not limited to):

- There may be times when an activity is dangerous. Be prepared!
- Long distances – and the potential impact of tiredness.
- Large convoy numbers lead to slow travel times.
- Judging travelling times e.g. is the distance short or long? is the track difficult or easy? Are there points of interest along the way? (allow time to stop and see these).
- Polaroid glasses can make driving in rain easier and reduce glare from sand, water and snow.
- Considering what needs to happen if accidents, break downs or medical problems occur - what steps would be required to get help?
- Personal considerations - medical/ tiredness/ toilet/ hygiene etc.
- Nature of the route to be travelled e.g. gravel/dirt roads, corrugations, wash-a-ways, fallen trees, roots/ etc.
- Distance between vehicles (e.g. vehicles strung out on a dusty track - keeping vehicles together in heavy traffic).

- When is vehicle momentum necessary or when is it dangerous.

**SAFETY, SAFETY, SAFETY!**  
**STOP. GET OUT and LOOK!**  
**THINK and ASSESS!**

Or another memory recall method -  
STAMP....Stop, Think, Assess, Manage, Proceed

**If you have any doubts at all seek advice from someone you know is experienced in the situation.**

**AT ALL TIMES**

- Keep at least one hand on the steering wheel
- Position your thumbs along the steering wheel rim
- Even in the most modern vehicles engines can stall or power steering can fail
- Front tyres can hit a large rock or with external pressure on the front wheels your steering wheel could rotate at a very high speed, breaking your thumbs!

## CONVOY PROCEDURES

The procedures listed below are to ensure the safety of club members.

When vehicles move in a convoy, a set of procedures have been evolved to ensure no one gets lost and there is minimal disruption to other road users.

- A Convoy Leader and a “Tail End Charlie“ are appointed.
- Convoy positions allocated.
- For trips not requiring specialist knowledge the roles of Convoy Leader and Tail End Charlie can be rotated through the group.

### Convoy Leader Role

- The role of the Convoy Leader is to navigate the next stage of the trip, set a pace that is appropriate to the prevailing conditions, designate appropriate rest and lunch stops and to notify convoy members of hazards and changes in road/track conditions.

### Tail End Charlie Role

- The role of Tail End Charlie is to assist in maintaining the integrity of the Convoy by acknowledging all radio communications from the Convoy Leader and alerting the Convoy Leader of difficulties being experienced in maintaining the pace. Tail End Charlie should also restore conditions to those existing prior to the progress of the convoy such as ensuring gates are left open or closed as found.

### Convoy Position

- Your Convoy Position will be allocated to you. Positions spread the inexperienced participants between more experienced drivers. Participants without a working UHF radio are to be preceded by, and immediately followed by, vehicles with radios. You must maintain your allocated Convoy Position unless the Convoy Leader authorises a change.

### Driver's Responsibility

- Each driver is responsible for the vehicle BEHIND. Keep the vehicle following you either within sight or radio contact at all times. In particular, at intersections wait until the vehicle BEHIND acknowledges he can see the direction you are proceeding. In conditions where visibility is poor, switch on the lights of your vehicle and check regularly by radio with the vehicle behind.

### Breakdown of Vehicles

- If a vehicle breaks down or becomes immobile for any reason, the Convoy must stop with the affected vehicle until it is again mobile, or the Trip/Activity Leader has confirmed that the driver is happy to be left alone or with helpers. In remote areas, at least one vehicle must stay with the disabled vehicle. Arrangements are to be made with those persons remaining behind so that contact can be re-established as soon as possible.

### Leaving a Convoy

- If you want to leave the Convoy, for any reason, you must inform the Convoy Leader. If you are unable to make contact by radio you must liaise with another vehicle until you are sure that the Convoy Leader has authorised your departure.

### Convoy spacing

- When sharing the road with other traffic, please leave sufficient room between vehicles to allow other road users to overtake safely. In dusty conditions vehicles may need to be spaced up to a kilometre apart and Tail End Charlie may need to negotiate with the Convoy Leader to stop the convoy and allow other road users to overtake.

### Convoys in traffic

- Maintaining a convoy in built up areas where there is increased traffic should be avoided. Other road users will expect that attention will be focused on safe driving procedures and convoy procedures should only resume when traffic abates. This places a particular responsibility on the Convoy Leader to provide clear direction well in advance of any route changes or turn offs.

### Convoy vehicle numbers

- Convoys with many vehicles are difficult to manage and 10 vehicles should be regarded as an upper limit for a single convoy lest the activity come to resemble “herding cats”.

### Departure Warning

- The Convoy Leader is to give a warning 5 minutes before departure time. Be sure that you are aware of the departure times. If you’re not sure, ask the Trip/Activity Leader.

### End of days’ run

- The Convoy should end each day’s travel with sufficient time to set up camp in daylight, unless Members have been warned in pre-trip information, or all participants agree otherwise.

### Following the Convoy Leader

- Convoys are to follow the Convoy Leader, and not diverge from the route.

### Maximum Convoy Speed

- The maximum travelling speed for any Club Convoy shall be determined by the track/road surface conditions, the relevant State speed limits, and not faster than all participants are comfortable to travel safely with.

### Negotiating Hazards

- At any creek or river crossing, steep hill, sand, mud, or any other type of hazardous terrain, spectators, especially children, are to keep well clear of the track. Vehicles which have already negotiated the hazard must move well up the track to allow room for following vehicles.
- When a hazard has been negotiated successfully a radio call indicating that the vehicle is now clear will allow the next vehicle to proceed. A typical call would be, “<insert your name here> now clear”.

### Regulations

- All drivers must observe relevant traffic rules and regulations at all times.

### Rendezvous Points

- Convoy Leaders should, as far as possible, arrange rendezvous points in outer metropolitan or country areas so as to minimise convoy driving in heavy traffic areas.

### Safe Distance

- Keep a safe distance from the vehicle in front, particularly in hilly, dangerous or difficult terrain, or if the brakes of your vehicle are wet.

### Separation from the Convoy

- If you become separated from the Convoy, or you reach an intersection where there is no vehicle to show you the way, and you are unable to make radio contact with the Convoy, stop and wait for someone to come back to you.

### Steep Hills

- When ascending or descending steep hills, wait at the bottom (or top) until the preceding vehicle has cleared the hill, or has confirmed by radio that it is safe to proceed.

### Stopping the Convoy

- If your radio is inoperable and you require the vehicle in front to stop, endeavour to attract the driver's attention by flashing your vehicle's high beam. Do not do this at night when there are other vehicles approaching from the opposite direction. If this is unsuccessful, stop and wait for the vehicle behind to catch up.

### Stopping Places

- When arriving at a stopping place, care must be taken to minimise any damage to the site or environment etc. by not driving off the road or track, or making unnecessary tracks or fireplaces.

### Turn Acknowledgment

- Wait at every turnoff with your turning indicator lights flashing until the driver of the following vehicle acknowledges the turn by use of his/her turning indicators or radio.

### Two Hourly Stops

- Convoys should stop for at least 10 minutes every two hours to allow Members, and especially children, to exercise or rest. This also cools down shock absorbers on rough roads helping prevent early failure.

## SAND

This section covers the skills and knowledge you will require to drive on sand and covers these topics:

- Sand driving.
- Hill driving – uphill/downhill.
- Dealing with difficulties in hill driving - emergency descents (up and downhill).
- Driving on side slopes.
- Driving on slippery surfaces e.g. wet grass, pebbles and muddy roads. (note: we will also use sandy side slopes which act as slippery surfaces).
- Features of Nissan and other manufacturers vehicles which help in off road driving.
- When and how to use vehicle off road driving features.

Before driving

- Select 4WD
- Check tyre pressures: - Tyre pressures cause a lot of debate: a starting point: about 16 - 20psi in sand: - 20 to 30 psi on rocks: - 25 to 30 psi on rough gravel roads

If your vehicle has any of the following features

- Disable Stability Control - Stability Control can reduce momentum in sand.
- Engaging the Rear Diff Lock disables Traction Control - sometimes an advantage in sand.
- Experiment Driving with both Traction Control and Rear Diff Lock to see what works best.
- Experiment! - diff locks can make it more difficult to corner.

Basic theory of lower tyre pressures:

- soft tyres in sand help spread the vehicles load over a greater area of sand and reduce the depth the tyre sinks.
- a reduced tyre pressure when driving over rocks helps make the tyre more flexible and less prone to damage.

Other factors

- how much load is your vehicle carrying?
- what is the sidewall profile (depth of rubber) of your tyres
- do you know how your vehicle handles with low pressures?
- what speed are you going to drive at?

An answer:

- on sand see what people with similar vehicles and loads are using.
- on sand if you think you are going to get stuck lower your tyre pressure again.
- very low pressure may be down to 4 psi.
- the lower you get the more chance of tyre damage, overheating (the tyre flexes more and generates more heat) or sand getting between the rim and the tyre.
- the lower the tyre pressure, the easier driving becomes on sand.
- once off the sand you may need to reinflate your tyres.
- on rough tracks take breaks to allow you tyres and suspension time to cool down.
- EXPERIMENT.
- Select appropriate range (high or low) and gear
- Check if the track requires any maintenance e.g. levelling out, removing obstacles etc.

### Driving on the flat

- Select the best route (consider whether the sand is hard/soft, previous tracks etc).
- Ensure you have sufficient momentum.
- Consider your wheel placement.
- Drive smoothly.

### Driving up an Incline

- Drive directly up sand dunes if practical.
- Select the most appropriate route.
- Select the appropriate range and gear.
- Ensure you have sufficient momentum.
- Consider your wheel placement.
- Try to minimise wheel spin.

### Driving down an Incline

- Drive directly down sand dunes if practical.
- Select the most appropriate route.
- Select the appropriate range and gear (normally a low gear and range so your vehicle engine controls your descent speed).
- Ensure your momentum is maintained at appropriate rate.
- On manual vehicles - clutch is not used.
- Avoid wheel lock up.
- Modulate the brake / throttle when necessary.

### Achieving a downhill stop/controlled forward descent

- On uphill and downhill controlled stops and emergency descents keep in mind:
- You should aim to keep control of your vehicle at all times.
- The process below does not use traction control or downhill assist.
- This style of driving demonstrates how to manually control your vehicle.

The table below sets out the steps to achieve a downhill stop or controlled forward descent in either an automatic or manual vehicle.

*(NOTE: The process used in controlling manual vehicles on hill descents has now changed. Vehicles are NOT stalled. This change is to avoid turbo charger damage in modern vehicles).*

Automatic Vehicle	Manual Vehicle
1. Footbrake applied – vehicle stopped Keep footbrake applied	1. Footbrake applied and de-clutch. <b>DO NOT STALL</b> Vehicle left in gear
2. Keep footbrake applied	2. Keep footbrake applied
3. Low range first gear selected	3. Low range first gear selected
4. Check front wheel positioning	4. Check front wheel positioning
5. Check track ahead is clear	5. Check track ahead is clear
6. Gently increase the throttle	6. {a. Gently release the clutch} {b. Gently increase the throttle}
7. Footbrake eased off – vehicle moves	7. {c. Footbrake eased off – vehicle moves} a, b & c <b>MUST BE COORDINATED</b>
8. Brake /throttle modulated if required	8. Brake /throttle modulated if required
9. Additional braking applied if required	9. Additional braking applied if required
10. Descent completed	10. Descent completed

Steps 1, 2 ,5, 6 & 7 are similar to normal 'traffic light', Stop - Start.

The addition of steps 3, 4, 8, 9 & 10 provide extra safety and control when off road.

#### Achieving an uphill stop/controlled reverse descent

The table below sets out the steps to achieve an uphill stop or controlled reverse descent in either an automatic or manual vehicle.

*(NOTE: The process used in controlling manual vehicles on hill descents has now changed. Vehicles are NOT stalled. This change is to avoid turbo charger damage in modern vehicles).*

Automatic Vehicle	Manual Vehicle
1. Footbrake applied – vehicle stopped	1. Footbrake applied and de-clutch. <b>DO NOT STALL</b> Vehicle left in gear
2. Keep footbrake applied	2. Keep footbrake applied
3. Select low range reverse gear	3. Select low range reverse gear
4. Check track is clear behind	4. Check track is clear behind
5. Check front wheel position	5. Check front wheel position
6. Look behind using external mirrors and/or reversing camera	6. Look behind using external mirrors and/or reversing camera
7. Gently increase the throttle	7. { <u>a.</u> Gently release the clutch} { <u>b.</u> Gently increase the throttle}
8. Footbrake eased off – vehicle moves	8. { <u>c.</u> Footbrake eased off – vehicle moves}

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9. Additional braking applied if required	9. Additional braking applied if required
10. Brake/throttle modulated if required	10. Brake/throttle modulated if required
11. Descent completed	11. Descent completed

Steps 1, 2 ,4, 6, 7, 8, 9 & 10 are similar to normal roadside Stop and Reverse.

The addition of steps 3, 5, & 11 provide extra safety and control when off road.

## **ROCKS & HILLS**

Things to remember when driving on rocky terrain

- Rocks are not as forgiving as sand.
- Too much speed can lead to vehicles bottoming out and causing vehicle damage.
- Vehicle tyre pressures
- too soft and your vehicle tyre side walls and rims may be damaged
- too hard and the tyres can't flex allowing sharp rocks to penetrate
- - a starting point: - 20 to 30 psi on rocks:

When driving on rocky terrain follow these steps:

- Check the track for obstacles.
- Select the most appropriate route.
- Undertake any track maintenance if necessary
- Selecting the most appropriate range and gear - (this will be discussed and reasons given).
- Utilise the appropriate momentum – not too fast or slow - (this will be discussed and practised).
- Place your wheels appropriately.
- Follow the planned route.
- Modulate your use of the brake / throttle appropriately if required.

## **MUD & WATER**

This section covers these topics:

- Water crossings.
- Driving in mud.
- Vehicle recovery methods.
- Use of snatch straps.

Preparation will prevent water damage to your vehicle:

Pre trip check-

Are your differential and gear box breathers attached and elevated?

Are your door drains unblocked?

Are the head lights and alternator and other electrics protected from water?

Extra equipment -

Snorkel, Exhaust extension

## Water Crossings

When undertaking water crossings keep in mind:

Water crossing can vary from very easy to very dangerous.

### Tips for undertaking water crossings

- Before crossing even a shallow creek it is a good idea to stop and let the vehicle(s) cool down a bit. Dipping a hot axle into a cold creek is a sure way of encouraging water to get sucked past axle and hub seals – regardless of the breather arrangement on the axle. Unfortunately, oil seals are designed principally to keep oil inside the housings, not to keep water out.
- If the vehicle in front of you went through easily, it may have missed a hidden wheel rut or hole.
- Assume nothing; a dark area may be hiding a deep hole or rock.
- Pre preparation can help greatly if you become stuck.
- Water speed/ pressure can be deceptive and very dangerous.
- If your vehicle starts to float you lose traction.
- Open your vehicle windows and take off your seat belts before entering deep water so you can quickly escape your vehicle if it starts to sink.
- When checking water crossings up north beware of crocodiles. (Have people acting as lookouts).
- Your vehicle brakes may not work when you leave the water.
- Exits from creeks/ rivers can become very slippery.
- It is also wise to leave the air conditioner switched off during a crossing to stop the condenser heating up and triggering the electric fan that is often fitted to aircon condensers.

### Follow these steps when undertaking the actual water crossing

- Where ever possible walk a water crossing, check the crossing entry, the depth, obstacles, the bottom and exit before entering. A long stick can be useful for probing holes
- Take personal safety precautions when checking crossing. (Even a dry water course can become a deep torrent in seconds).
- Make sure your recovery equipment is prepared and readily available.
- Disable your vehicle's fan as appropriate. (In later model vehicles with a viscous coupled fan, a simple cord loop from the fan blade attached to a solid structure in the engine area works well).
- Give your engine, differentials and gear box time to cool down.
- Make sure engine components are sealed against water entry.
- Fit a vehicle blind (sometimes called a "bra") as appropriate.
- Make sure the engine is sealed against water entry (especially air intakes).
- Prepare the vehicle for the water crossing, that is, open windows, do not use seat belts.
- Put the vehicle into 4WD mode - appropriate range and gear selected.
- Enter the water with the appropriate momentum
- Make sure that a bow wave is established & maintained.
- If in a manual vehicle - undertake the crossing without changing gears (as changing gears in a manual vehicle can result in a slipping clutch).
- Stop your vehicle at the exit to drain excess water (keeping in mind that others may be following you out of the water).

- Modulate the brake / throttle if required.

### After the Crossing

- Dry brakes out.
- Check engine - e.g. engine oil for water.
- Remember that gearboxes, diffs, front and rear hubs, and brakes can all ingest water causing failure if left.

### Driving in mud

#### When driving in mud remember:

- There could be hidden objects in the mud which could cause vehicle damage.
- Hidden wheel ruts can change your direction.
- Undertake track maintenance as required.
- Adjust tyre pressures if necessary - (Inflated tyres can give more ground clearance).
- Select 4WD mode.
- Select an appropriate route.
- Select the appropriate range and gear (changing gears in a manual could produce a skid).
- Ensure you have sufficient momentum.
- Check your wheel placement.
- Avoid detouring off the track – detours could be worse than the track as the base may not be as firm.
- Wheel ruts may have a firmer base than the rest of the track
- Accelerate smoothly.
- Undertake track maintenance if required.
- After driving, clean any excess mud off your vehicle.

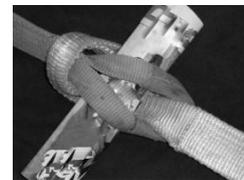
# RECOVERY PROCEDURES

## Using Snatch Strap(s)

- Snatch straps can be used for gently towing a vehicle.
- Snatch straps are a giant elastic band.
- Snatch straps used by 4wders are normally rated up to 8000kg.
- A stretched snatch strap should be considered as a lethal weapon which can easily kill someone. A stretched snatch strap stores a lot of energy.
- **NEVER USE A TOW BALL TO SECURE ONE END OF A SNATCH STRAP - TOW BALLS HAVE BROKEN OFF AND HAVE KILLED!**

## When using snatch straps:

- Appoint a recovery coordinator.
- Select the most appropriate safe recovery technique.
- Select 4WD mode.
- Locate the vehicle recovery points on both vehicles to be recovered.
- Align the recovery vehicle with the vehicle to be recovered.
- Check the snatch strap(s) to ensure they are serviceable i.e. safe to use.
- Attach the snatch strap(s) to both vehicles correctly.
- Ensure that all accessories are used correctly, if appropriate.
- Attach arrestor appropriately. (In order of effectiveness - A WELL secured chain, a WELL secured weighted bag, a WELL secured large blanket).
- Coordinator briefs both drivers on range and gear to use (the snatching vehicle usually uses low range bottom gear and the snatched vehicle usually uses low range second gear).
- 1st car, 1st gear, 1st start, 1st stop. 2nd car, 2nd gear, 2nd start, 2nd stop.
- Ensure that bystanders are cleared from the area to a safe distance (twice length of snatch strap(s) is usually recommended) and that all passengers/ pets except for the drivers are out of the vehicles.
- Put personal safety procedure in place.
- Undertake the recovery.
- Make sure the vehicle is stopped without over-running the snatch strap, with both vehicles in a safe location.
- Join snatch straps using a dowel (cut off broom handle) or rolled up news paper/magazine to allow the joint to be loosened after use.



## Using Maxtrax or similar

The proper way to use one is to dig out and clear a small hole around the wheels, back or front depending on the direction you want or need to go or all four depending on how stuck you are, so that you have some space on the underside of the tyre. You need to wedge the maxtrax under the wheel in the space you've cleared, making sure that the teeth on the board, which are key to its design and use, are right under the wheel so they have a good grip on the tyre. Once you've done that try keep the maxtraks as straight and flat as possible to the tyre by filling any spaces underneath it. The design of the maxtrax and the placement and type of the teeth allow the motion of the tyre to pull the board under the wheel with as little spin as possible. You don't want wheel spin when using this board as it can damage the board or the teeth. The Maxtrax comes with a little leash or other form of cord which helps pack up the boards and bind them down when not in use, and so that after you've used them, if they have become buried in the ground you can easily retrieve them without having to dig them out. When using the boards best to keep

the leashes off to the side so they don't become buried themselves.

Once the boards are set up clear anyone from the car to prevent injury or accident and get in the vehicle and start it up. To prevent wheel spin and damage to the boards set your car to neutral, or select low gear and set the vehicle in the direction you want to go if you have a modern 4x4 or off-road vehicle. The car should move on its own using momentum and gravity to pull the maxtrax under the wheel with minimum movement to the wheels themselves. Once you're on the boards, slowly and carefully accelerate the car from whatever area it's stuck in with the maxtrax acting as solid sturdy ground. In situations where you need to go uphill and that is where you became stuck retrieve the boards and place them in front of the front wheels in the same manner and use them as a temporary solid road to travel uphill without becoming stuck again. Again be careful when doing this to avoid damage to the maxtrax themselves.

## Winching

Before you start:

Always carry a pair of heavy duty gloves, especially with winches that have wire rope. The wire can develop barbs that will easily lacerate unprotected hands. Although less common with synthetic rope, gloves are still recommended to avoid rope burn.

Use a hook strap to pull the line away from the fairlead, this simple method could save your fingers in the end.

Carry rated D-shackles. These are the safest means for connecting a winch to a vehicle, chain, or strap

Consider purchasing a winch kit, this will include everything needed for a proper recovery

Never use a recovery strap for a winching operation, these are intended to stretch and will store lots of energy. If there is a break then the recovery strap acts as a rubber band for a shackle or winch hook.

Take your time assessing the situation, and plan accordingly

Make sure your battery can handle the additional load. A minimum of 650 cold cranking amps is recommended

## Rigging a winch

Proper rigging is important, always use a strap, shackle, or stake. Never wrap a line around on itself. There are three basic lines one can use, they are:

### Single Line

Pull line to anchor point, and secure it with a strap, shackle, or a combo of the two.

Attachments can be a tree, vehicle, or stake.

Lock the clutch, connect the remote, and put line under tension.

Drape a blanket, coat, or other object on the line once it's tight. This will counteract a line whipping about dangerously if it breaks.

Begin winching operation with short controlled pulls while operating your vehicle.

### Double Line

You can use a snatch block to increase your pulling power over short distances.

Connect the snatch block at the anchor point, draw your line around and attach it to your vehicle

Drape a blanket, coat, or other object on the line once it's tight.

### Triple Line

The same technique applies as the double line, the difference is that two snatch blocks and two anchor points are needed.

Try to maintain a 90 degree angle between the winch and first anchor.

Double check all connections before operation.

Begin winching operation with short controlled pulls while operating your vehicle.

# EVALUATION AND FEEDBACK

## Glossary

- ABS: Anti-Lock Braking system.
- ADR: Australian Design Rules.
- Anti-Roll Bar: torsion bar between left and right ends of an axle - it increases roll-stiffness which can improve on-road handling but can also restrict axle-articulation off-road.
- Approach Angle: the angle at which a line drawn from the leading part of the vehicle's bodywork and touching the front tyre meets the ground. It gives an indication of the steepness of a step-up that a 4x4 can approach without its nose digging in. The bigger the angle, i.e. the closer it is to 90 degrees the better for off-road work.
- AWD: All Wheel Drive: Taken literally AWD means all four wheels can be driven, but there is some ambiguity as to just what "driven" means. If a centre diff is used between the front and rear axles then all wheels share equal torque (unless one slips and an LSD or diff' lock takes over). A cheaper arrangement is to drive one axle via a viscous coupling or similar. In this case one axle receives no torque until the other axle slips.
- Bridle Strap: Used on some vehicles to distribute the force applied by a snatch strap to both sides of the vehicle. . A tree trunk protector could be used as a bridle strap.
- Centre Differential: incorporated in the transfer case of a full-time 4WD vehicle to allow the front and rear axles to rotate at different speeds during cornering.
- Common Rail: a very high pressure fuel delivery device found on most newer diesel engines.
- CV Joint: Constant Velocity joint, used in drive-shafts where the input and output shaft must rotate smoothly at the same uniform speed of rotation.
- Departure Angle: the angle at which a line drawn from a vehicle's rear most bodywork touches where a rear tyre meets the ground. It gives an indication of the maximum steepness of a step- down that a vehicle can negotiate without dragging the rear bodywork. Long body overhangs reduce the departure angle. The closer the angle is to 90 degrees the better for off road work.
- Differential: has one input and two outputs, e.g. allows left and right wheels on an axle to revolve at different speeds during cornering.
- Differential Lock: Diff' Lock: a differential lock in an axle differential and/ or in the centre diff' above, i.e. it makes the half-shafts rotate at the same speed.
- Direct Injection: where fuel is injected directly into the cylinders of an engine.
- ECU: Electronic Control Unit - heart of the engine management system of a modern vehicle.
- EFI: Electronic Fuel Injection.
- Four Wheel Drive: Taken literally 4WD means four wheels, all of which are (or can) be driven.
- Full Time 4WD: all four wheels are driven at all times. Strictly, a centre diff' should be employed to share equal torque to front and rear axles.
- FWH: Free Wheeling Hubs. Normally used to lock the front wheels to the drive shafts, which are driven from the motor.
- Hydraulic Stall: if water is drawn into the engine cylinders, e.g. during a water crossing, it will stop the engine immediately, often bending the con-rods, because water is incompressible.
- Indirect Injection: where fuel is injected into a small combustion chamber that leads off the main cylinder in an engine - especially in (some) diesel engines.

- **Intercooler:** a small radiator used to lower the temperature of air compressed by a turbo-charger (or super-charger). This increases its density, so more air can enter the cylinders - for more power.
- **Kinetic Recovery:** the use of momentum and a snatch strap to extricate a bogged vehicle.
- **Live Axle:** uses a rigid axle tube. Half-shafts pass down centre of tube. This system is strong and simple, and ground clearance does not reduce under braking, but it has more unsprung weight than independent suspension.
- **Locker:** replaces the planet and side-gears in a diff', torque goes to the non-slipping wheel, may give "twitchy" handling as both wheels are rotating at the same rate.
- **LSD:** Limited Slip Differential.
- **LWB:** Long Wheel Base, usually counting anything over 100" (2540mm).
- **MPFI (Multi-Point Fuel Injection):** see MPI.
- **MPI:** Multi-Point Injection, EFI system where fuel is injected into the intake of each cylinder rather than at one point (throttle body injection) - allows more precise fuel metering.
- **Open Differential:** a "normal" differential without diff' lock or LSD features - axle loses traction if one wheel slips.
- **Overdrive:** a top gear that is higher than 1:1. Originally overdrives were only provided as optional units bolted onto the original gearbox, and often employing epicyclic gears. The term is now also applied to the top (usually 5th or higher) gear ratio in the main gearbox when it is higher than 1:1.
- **Oversteer:** tendency of a vehicle to turn more sharply than the driver intended, probably leading to a rear wheel skid and eventually a spin, especially rear wheel drive vehicles when too much acceleration is applied.
- **Panhard Rod:** provides sideways location of a live axle.
- **Part-Time 4WD:** a vehicle that is normally in two-wheel drive but one that can engage drive to the other two wheels.
- **PTO:** Power Take Off, unit bolts onto transfer case (usually), and is used to drive a winch or other special equipment. (Found on older 4wd's and tractors).
- **Ramp-Over Angle:** The minimum internal angle of an inverted-V ramp that a vehicle can drive over without dragging its belly, i.e. a measure of the sharpest bank it can drive over. A typical figure is about 150 degrees; the smaller the better off-road.
- **Snatch Strap:** Nylon elastic strap used in kinetic recovery.
- **Super-Charger:** A turbine driven directly by the engine to compress the engine intake air.
- **Sway bar:** see anti-roll bar.
- **SWB:** Short Wheel Base, usually counting anything under 100" (2540mm).
- **Torsion Bar:** Type of spring, rod or bar twisted by suspension movement, esp.' independent front suspension.
- **Transfer-Case:** Secondary gearbox used to transfer drive sideways so that it may then be carried forward, around the engine, to the front diff' and axle. Usually also provides high and low gear ratios.
- **Transmission Wind-Up:** Stress in the transmission system caused by wheels travelling different distances (e.g. cornering) but unable to be relieved because diff' locks are engaged or because part-time 4WD is engaged. Transmission wind occurs on hard surfaces. On soft surfaces wheels can slip to relieve transmission wind-up. Transmission wind up can cause expensive repairs.
- **Turbo-Charger:** (or Turbo) is a turbine driven, forced induction device, that increases an engine's efficiency and power output by forcing extra air into the

- combustion chamber. The turbine is driven by the vehicles exhausts gases.
- Understeer: Tendency of a car to turn less sharply than the driver intended, especially a front wheel drive vehicle under hard acceleration.
- Universal Joint: Flexible coupling connecting the gear box to the driven wheels.
- Viscous Coupling: An arrangement of discs in a viscous fluid that allows two shafts to rotate at the same or only slightly different speeds. It can be incorporated in a differential to allow a slow, but not a high speed, differential action, i.e. preventing wheel-spin without transmission wind-up.
- Wishbone: A-frame component of independent suspension systems.