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FOREWORD

Congratulations in taking the bold step to add this 2nd edition of the AAWDC's driver training manual to your book collection. We are equally excited about this book and we trust that the content will increase your confidence when driving off-road. The more confident you are the more you and your passengers will enjoy off-roading and the more you will be sensitive to the impact that you may have on the environment.

The previous edition was published in 2003 and turned out to be a success amongst 4x4 club members, off-road drivers, off-road trainers and the public at large. When that edition went out of print the on-going demand for the manual got us to review, improve and re-print a 2nd edition.

The AAWDC Driver Training Manual has been improved in many ways which can be loosely grouped into three areas:

- Incorporating new technology of modern off-road vehicles as well as new methodologies and equipment in the training industry resulting in more in-depth content.
- Integrating new areas impacting on the off-road industry such as legal, environmental, communication, navigation, fire safety and fire fighting, first aid, overland travel as well as cross-border protocol requirements.
- Merging the internal skills base and expertise with knowledge and experience of specialists outside the AAWDC realm, such as off-road equipment suppliers and manufacturers, off-road service providers as well as off-road subject matter experts and associations.

This manual is also a call on all 4x4 clubs and other players in the off-road industry to contribute not only to the content thereof, but to off-road driver training in general. This is especially important to ensure that sensitivity for the environment becomes a way of life for all off-road drivers.

The manual was compiled under the leadership of Alan Goodway and his team of unselfish contributors who certainly deserve the best of accolades. It is the desire of the AAWDC that all users will embrace the expert guidance as the compilers intended it to be.

May we all further develop our off-road skills in such a way that the environment be the ultimate beneficiary.

Association of All Wheel Drive Clubs of Southern Africa 2016.

LEGAL ISSUES

Introduction

Most things in Southern Africa are regulated by law. Laws come in different formats. Firstly, we have the law that is captured in a statute. This is the law that has gone through the Parliamentary process, and is published in the Government Gazette.

Custom and Practice are things done by people for a time, which was not written up in 'law', but has become the norm. Custom and Practice we can term as 'Common Law'.

It is well known that the Government has put a mandate on the 4x4 industry in South Africa, to initiate a process of self-regulation for the future.

The Road Traffic Act

Currently the Road Traffic Act (RTA) 93 of 1996 governs compliance on our roads. The most important issues are:

- Having a relevant and legal drivers licence
- Having a roadworthy vehicle



Drivers of 4x4s must ensure that they hold the correct category of drivers licence for their vehicle and trailer. The legality of the vehicle is also important:

- Are the modifications made to the vehicle legal? Check suspension, lights, and other accessories.
- Will the vehicle pass a roadworthy test? Is the weight and carrying capacity within the law? This also applies to towed trailers and caravans.

It is an offence to allow an unlicensed driver to drive a 4x4, even off-road. The insurance consequences could be disastrous if an unlicensed driver damages the vehicle. The Road Traffic Act applies equally.



The National Environmental Management Act (NEMA)

There are various other Acts that are relevant to this Act. The Biodiversity Act, Air Quality Act, Protected Areas Act, World Heritage Convention Act and the Waste Act to mention a few.

One of the main issues that 4x4 drivers need to bear in mind is that no one may unlawfully, intentionally or negligently commit any act or omission which causes pollution or degradation of the environment. The prohibition is wide and the penalty is severe. As it talks about 'any person', 'any act' or 'failure to comply' any of which could result in a fine or imprisonment. The Environment is seen as a serious issue and all 4x4 drivers should be aware.

The National Environmental Management and Biodiversity Act (NEMDA)

Its purpose is to provide management and conservation of South Africa's biodiversity within the framework of the NEMA; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair sharing of benefits of bio-prospecting involving indigenous biological resources.

Environmental Conservation Act - Implemented Beach Ban

Beach driving was banned in South Africa in 2001. The only exclusions are for nature conservation and research personnel, anti-poaching units, other government bodies and in certain instances, handicapped people.

When travelling off-road, you should be aware of Fynbos vegetation in the mountainous areas of the Western Cape as well as inland rivers and wetlands, 100-year flood lines, sensitive biomes etc. and avoid them!

THE CONSUMER PROTECTION ACT

Lots of discussion has taken place about this Act since it has come into effect. There are numerous interpretations of this Act. We will touch on issues that are relevant to the purchase of a vehicle, accessories, and partaking in 4x4 events, etc. The consumer has a right to safe, good, quality goods (section 55 of this Act).

The broad implications of this legislation are:

- To promote and protect the economic interests of consumers
- To protect consumers from hazards to their own well-being and safety
- To promote consumer education
- To facilitate the freedom of consumers to associate and form groups to advocate and promote their common interests.
- To promote consumers participation in decision-making processes concerning the market place and the interest of consumers.



- Suppliers must provide a written record of transactions
- Pre-authorisation of repairs or maintenance is required
- The consumer has the right to demand service quality
- Issues such as 'defect', 'failure', 'hazard' and 'unsafe' are key in a dispute.

The product should be suitable for the intended purpose, of good quality, in good working order and free of defects. A consumer will have recourse if the purchase does not match up to the stated intended use.

The product must be usable and durable for a reasonable period of time.

OTHER POINTS OF INTEREST

Insurance On A 4X4 The insurance industry now provides specialist insurance for the 4x4 owner. It is essential that all 4x4 drivers ensure that their vehicles are insured. They should also check the extent of their cover, it should include damage, theft, vehicle repatriation for off-road use and medical repatriation for the driver and all occupants.

Drinking And Driving Drinking and driving is a serious issue that is covered by law. Some drivers think that once they leave the tar, road legislation does not apply. This perception is wrong and on many 4x4 outings it is noticed that drivers of 4x4s are not complying with this important rule. This is normal practice amongst responsible 4x4 drivers. Motorsport South Africa (the controlling body of motorsport in SA) has a zero tolerance policy.



Drivers and passengers must accept that no alcohol should be consumed in a vehicle until the trip or event is completed. Irresponsible behaviour damages the reputation of the 4x4 fraternity. Alcohol's involvement can often be seen when video goes viral.

Cross border accidents could become a nightmare should authorities find that alcohol was involved. Accidents that take place under the influence of alcohol will also negate any insurance claim.

AAWDCSA member clubs must ensure that the 'no drinking and driving' policy is enforced.

The legislation that affects 4x4 drivers is vast; this chapter has only highlighted some issues. Contact the AAWDCSA if you have questions.

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ENVIRONMENTAL CONSIDERATIONS

South Africans have many choices when enjoying the outdoors. Going off-road is a wonderful way to explore our natural heritage and get to inaccessible terrain. However, vehicles can severely damage sensitive ecosystems and as a responsible citizen, we owe it to future generations to be considerate and apply care when off-roading. The impression left behind should be one of a responsible off-roader that respects the environment.

Understand the ramifications of off-roading by attending a formal Unit Standard based training course that covers off-road technique, the environment and vehicle recovery.

Plan your trip and try to improve on the terrain: repack ruts with rocks, take your litter and any other rubbish you may find out with you and dispose of it responsibly.

Always engage 4x4 when leaving the tar, high range gearing for gravel roads and low range as you start trails and obstacles. This will immediately limit the impact of your passage.

Follow these guidelines:

- Travel in terrain that is suited to your vehicle.
- Stick to the designated route and avoid the temptation to create a new track unless absolutely necessary.



- Become aware of sensitive areas and avoid them at all cost.
- Stick to speed limits even in off-road situations — they are there for a reason.
- Respect the local population, fauna and flora.
- Practice safe convoy rules and avoid creating dust.
- Use eco friendly soaps and cleaners and do not dispose of toxic materials such as old oil etc.
- Use water with care and do not camp too close to water holes, as this may scare animals.
- Practice safe fire techniques, check for fire restrictions and do not make fires on the drip lines of trees as this will harm roots underground, or may even set it alight.
- Remove your litter and do not wash dishes or clothes in rivers or dams.
- Use the ‘cat-latrines’ technique for toilets.
- Obey all signs and close all gates when passing through.
- Practice safe recovery techniques and restore damaged tracks after stuck vehicles have been extricated.
- Always use tree protectors when winching to avoid ring-barking trees. Ensure minimal movement when winching as even with a tree protector one can chafe the delicate bark of a tree.
- Avoid excessive wheel spin as the flora and ground cover bind the topsoil, an open rut can start soil erosion in the rainy season.
- Never ride over young plants and saplings; they are the future shade and food for animals that live in the area.



- Remove trees that have fallen into the road if possible rather than simply driving around them as this will just create a new track which others will follow, causing more damage.
- When camping respect the rights of others, do not play loud music and moderate your drinking habits – we are all in the bush to enjoy the solitude, loud behaviour can spoil the experience for all!
- Avoid noise pollution.
- Ensure that you keep your vehicle mechanically sound and free of oil leaks, so as to not pollute the environment.

Driving on beaches has been prohibited for some time, but it is still possible to drive on beaches in neighbouring countries. All indications are that this may be stopped due to the bad behaviour of some South African 4x4 and quad bike owners and the lack of policing in these areas.

Where allowed, use the following guidelines:

- Use demarcated exit and entry points.
- Obtain the necessary permission or permits.
- Reduce tyre pressure as a softer tyre will cause less damage, the wider footprint gives better traction.
- Do not pollute in any way, be it leaking oil, fuel or simply litter!
- Drive on wet sand, below the high tide mark, but check local conditions; on the East Coast turtles breed above the high tide mark but in certain areas on the Western shores crustacean breeding populations exist below the high water (tide) mark – check with the local authorities.
- Never drive on beaches designated for swimming, always consider other people, vehicles and your passengers.

ENVIRONMENTAL TERMINOLOGY

Anthropogenic Changes brought about by humans to the environment.

Aquatic Organisms that grow, exist and are evident in water.

Aquifer Permeable rock able to store quantities of water.

Backshore This area is between the dunes and the high tide mark. It is here that turtles lay eggs and plants grow and regenerate. Plants, animals and birds are vulnerable in this area.

Basic Sanitation Minimum standard of services required for the safe, hygienic, and adequate collection, removal, disposal and resultant purification of domestic wastewater and sewage from households.

Biodiversity Diversity that may exist among living organisms from whatever source (land, sea, air and rivers) and the ecological areas where they exist. The term also includes diversity within species, between species and ecosystems.

Biodiversity Hotspot An area identified as a conservation priority because it contains a high number of endemic species and faces threat.

Carbon Dioxide (CO₂) A naturally occurring gas within the earth's atmosphere. Produced when animals exhale, vegetation rots, and when material containing carbon is burnt or broken down e.g. fossil fuels such as petrol and diesel.

Carbon Tax A tax on emissions implemented on new motor vehicles. Applied at the time of sale for every gram of CO₂ per kilometre the vehicle emits over 120g/km. The tax will apply to passenger cars first and eventually to commercial vehicles.

Carrying Capacity The maximum population of a given organism that a particular environment can sustain.

Catchment The area of land drained by a particular stream or river.

Coastal Zone The area of land and sea along a coast. It includes estuaries, onshore and offshore areas, wherever they form an integral part of the system.

Concessions Areas of land owned and managed communally, mainly by traditional peoples or landowners.

Conservation The maintenance of environmental quality and functioning.

Degradation The reduction or loss of the biological or ecological function within an area.

Dunes Situated adjacent to beaches, these are the vegetated sand ridges where plants and small animals live. The dunes are sensitive ecosystems and can be irreparably damaged by irresponsible driving.

Ecological Footprint The 'load' imposed by a population on nature. It is seen as the land area needed to sustain current levels of consumption of resources and the discharge of waste. The larger the footprint, the greater the impact.

Ecosystem The combination of animal, plant, and micro-organisms with their environment (soil, water, climate, and atmosphere) interacting as a unit.

Ecotourism Where the natural environment is the main tourist attraction. The resulting tourism benefits the environment.

Effluent Generally wastewater that flows out of a human generated system into a river or the sea.

Emission Sound, liquid or gaseous pollution discharged into the environment.

Endangered Species A species whose population has been reduced to a critical level or whose habitat has been encroached upon, causing a risk of extinction.

Endemic A species occurring in and restricted to a geographical region is said to be endemic to that region.

Environmental Degradation When the environment is no longer able to sustain social and ecological objectives.

Environmental Impact Assessment (EIA) A process undertaken to assess the impact of a planned activity on the environment. EIA Regulations require specific procedures and reports for activities that may have a detrimental effect on the environment.

Environmental Implementation Plan (EIP) A statutory instrument promoting co-operative governance for environmental management.



Environmental Management A multi-disciplinary process of managing environmental resources. Careful planning, preparation and administration need to be in place. The aim is to ensure that environmental concerns are included in all stages, the development is sustainable, and does not exceed the environment's carrying capacity.

Environmental Management System (EMS) Procedures drawn up in terms of a South African Bureau of Standards (SABS) code of practice. These are based on international standards and provide uniformity. They provide a framework for the development of an environmental management system and the supporting audit programme.

Fauna All the animal life within a region.

Flora All the plant species making up the vegetation within a region.

Floodplain The area adjacent to a river that is seasonally flooded if water levels rise.

Fynbos (Afrikaans) A fine-leaved bush, mainly found in the southern Cape.

Heritage Sites They are of artistic, cultural, geological, zoological, botanical, archaeological, scientific and historical importance.

Indigenous Species Plants, animals, or microbes native to a particular area.



Invasive Alien Species Species intentionally or unintentionally introduced to an area where they would not naturally occur. They reproduce and invade areas beyond those into which they were originally introduced. Good examples are Black Wattle, Blue-gum and Jacaranda trees.

Intertidal Zones This is the area between the low and high tide marks. Although relatively resilient, sloped zones suffer from erosion caused by 4x4 driving.

Legislation Statutory law are laws promulgated by a legislature or governing body (as opposed to common law). The term may refer to a single law or to the collective body of law. In South Africa, legislation must be confirmed by the executive branch of government before it enters into force as law. Under the Westminster system, an item of legislation is known as an Act of Parliament. Promulgation is the act of formally proclaiming new legislation to the public. This occurs when the law receives final formal approval.

Marine Protected Area (MPA) A marine or estuarine habitat where types of fish or plants are protected, or where an entire ecosystem is set aside as a park or conservation area.

National Park Land set aside for the protection of plants, animals, marine life and scenery.

Over-utilisation Overuse of resources which affects their future use and the environment.

Red Data List A catalogue of species in danger of extinction or already extinct, published by the International Union for the Conservation of Nature (IUCN).

Red Data Species All species appearing on the Red Data list.

Regulation The required conduct, standards and procedures which must be adhered to in order to comply with legislation or a ministerial order.

Salt Marshes Low lying areas that are situated at estuaries and alongside lagoons. They are the breeding place for crabs, shrimp, fish and birds as well as certain vegetation types.

Sand And Mud Flats Flat, unvegetated areas adjacent to the shores of estuaries and lagoons, regularly flooded by salt water. They are home to crustaceans such as mud prawns (often used for bait). Vehicle pressure can compact soil and kill all life.

Shell Middens Prehistoric people lived for extended periods along the coast and this is evidenced by the deposits they left behind. These shell deposits, some of which are 120 000 years old, are found in dune areas all along the western and eastern coastal areas and give valuable archaeological insights. Middens are identified when you find combinations of the following: bones and bone fragments, stone artefacts, ostrich shell fragments, beads, seashells, rounded burnt stones, charcoal and ash. One pass of an off-road vehicle can destroy an ancient site in minutes!

Soil Conservation An intervention to stop soil degradation or reverse it through physical structures (contours and terraces), or through biological means (inter-cropping, grass strips).

Soil Erosion The loss and movement of soil generally caused by running water, wind, and gravity.

Stakeholders People and organisations involved or interested in an area or an activity.

Sustainability Enabling an activity to meet the needs of present and future generations through responsible management.

Transfrontier Conservation Area (TFCA) Areas where international boundaries overlap, composed of multiple conservation areas. Fences may hinder free movement of animals.

Triple Bottom Line A theory of sustainable development that enabling a positive social, environmental and economic consequence (bottom line).

World Heritage Sites

The United Nations Educational, Scientific and Cultural Organisation known as UNESCO encourages the identification, protection and preservation of natural heritage sites around the world deemed to be of outstanding value to humanity. In South Africa these are;

- The Cradle of Humankind
- iSimangaliso Wetland Park (St Lucia)
- Robben Island
- uKhahlamba/Drakensberg Park
- Mapungubwe National Park
- Cape Floral Region-protected areas
- Vredefort Dome
- Richtersveld National Park

CODE OF CONDUCT OF THE 4x4 FRATERNITY

Responsibility is key to ensure the longevity of our pastime and good behaviour is critical. The Association of All Wheel Drive Clubs of Southern Africa's (AAWDCSA) members abide by the following code of conduct:

Laws And Regulations Respect the rules and regulations of the country, national parks, conservation and public areas. Keep to the laws and regulations that apply to four-wheel driving.

Fellow Human Beings Respect the right of privacy and peace of others. Obtain permission before driving on private land.

Fauna And Flora Preserve our fauna and flora. Never disturb animals as it might affect their survival. Obey fire restrictions and always extinguish camp fires. Bring out what you take in. Never bury litter.

Vehicle Perfection Keep your vehicle mechanically sound to reduce environmental impact. Carry sufficient tools, spares and recovery equipment.

Fellow Road Users Abide by the traffic rules. Drive defensively and set an example to others. Be friendly and courteous to fellow road users. Assist fellow four-wheel drivers in need.

Responsibility Take responsibility for your actions. Promote the safe and responsible use of four-wheel drive vehicles. Accept responsibility for your group. Do not drink and drive.

Clubs Support four-wheel driving as a responsible and legitimate recreational activity. Obey the constitution and rules of your club. If you do not belong to an organised group, consider it.

Responsible Off-Road Driving Keep to existing roads and tracks. Avoid sensitive eco systems. Travel in a group or with another vehicle in remote areas. Take adequate water, food, first aid and fuel. Pre-plan your trips carefully.

Abide By The Code Of Conduct The Code of Conduct supports responsible four-wheel drive recreation and is valuable only if you apply it.

As a 4x4 user, you are encouraged to personally adopt this code of conduct in your approach to the 4x4 pastime.

MECHANICS OF FOUR-WHEEL DRIVE VEHICLES

BASIC TWO WHEEL DRIVE SYSTEM

The mechanical operation is similar for off-road vehicles and this chapter covers the basics common to most 4x4 vehicles. For more details with regard to any specific make and model, please refer to your vehicle's operating and maintenance manuals.

The best way to describe the mechanics of a 4x4 is to start with the basics. In the illustration below, a basic 4x2 vehicle is illustrated. It is called a 4x2 because it has four wheels, but only two wheels drive the vehicle.

The vehicle consists of the following basic parts:

Engine Many types of engines are available, varying from small four cylinder engines to large capacity ten cylinder engines. One of the choices you have to make when you are buying a vehicle is whether to buy a diesel or petrol engine. There is no definite answer on which is the best as both fuel types have advantages and disadvantages.

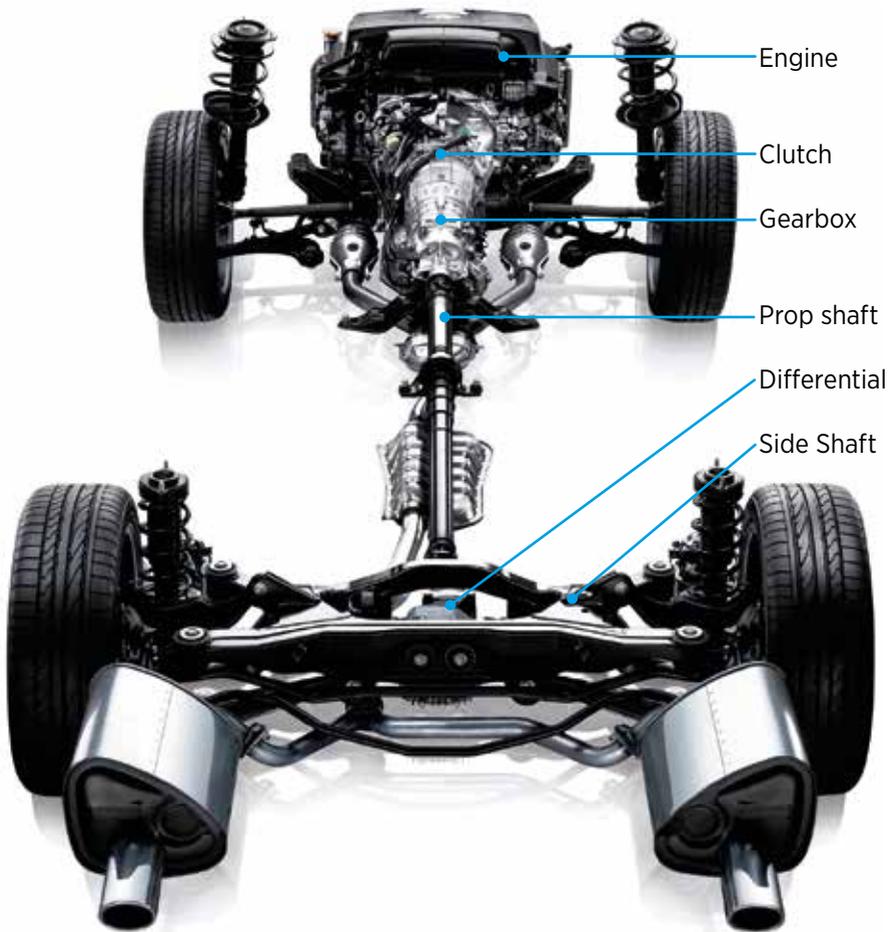
The Gearbox The gearbox allows the driver to select different 'gears'. In essence the gearbox allows the driver to select different ratios of speed between the engine and the wheels. Automatic gearboxes automatically select the appropriate power and speed ratio based on the amount of power generated by the engine, which is a result of the driver pressing the accelerator pedal.

Other transmission systems exist such as 'Tiptronic', or 'Selectronic'. For information on the operation of these systems please refer to the specific vehicle's manual.

Clutch The clutch engages or disengages the power transferred from the engine to the gearbox in vehicles fitted with a manual gearbox. In automatic vehicles the engine is connected to the gearbox by a torque converter.

The engine in a vehicle is always running while it is switched on, however, when stopping, the wheels of the vehicle do not turn and thus need to be disconnected from the engine. The clutch allows us to smoothly engage a spinning engine to a non-spinning transmission (gearbox) by controlling the slippage between them.

Propeller Shaft (Prop shaft) The prop shaft connects the gearbox with the differential to carry the power to the wheels. The gearbox and differential are, however, not in a straight line, which makes the rotation of a fixed shaft



impossible. A universal joint is therefore used at both ends of the prop shaft to allow rotation.

Differential Axles are fitted with differential gears that splits engine power between the left and right wheels on an axle. It allows differential rotation of the left and right wheels to accommodate the different distances that the left and right wheels must cover when going around a corner. This mechanism allows the wheels to rotate at different speeds, while still maintaining drive to the wheels. Such a device is essential in a vehicle to prevent axle 'wind-up' when using the vehicle on hard surfaces. Axle 'wind-up' is the torsional stress that builds up due to the rotational differences of the axle and the inability of the wheels to slip to release built-up torque. The axle differential is found inside the differential casing between the wheels of a driven axle.

Side Shaft The side shaft connects the differential to the hubs of the wheels; it therefore transfers power from the axle differential to the wheels.

A basic vehicle as described above has limited off-road capability. The differential will transfer all the power to one wheel when on uneven ground, effectively bringing the vehicle to a stop with the one wheel spinning. Traction is therefore completely lost. Traction is a wheel in steady rolling contact with the ground without slip, wheel-spin or slide (as with locked brakes) — i.e. the wheel is rotating at the same speed as the vehicle is travelling.

Transfer Case The transfer case is normally attached to the gearbox and houses a set of gears which transmit power to front and back in a 1:1 ratio. This permits power to be equally transmitted between the front and the rear axles. The transfer case also houses the reduction gears, which provide low range.

FOUR-WHEEL DRIVE SYSTEM

The problem can be overcome by applying power to all wheels instead of only two wheels, giving traction to all wheels, hence 4x4.

To achieve this, engine power must also be transferred to the front wheels. Another differential on the front axle is used. Side shafts connect the wheels to the front differential and a transfer case transmits the power through the front prop shaft.

Drive Train

Now we will focus on the types of drive train; moving from two wheel drive, we have:

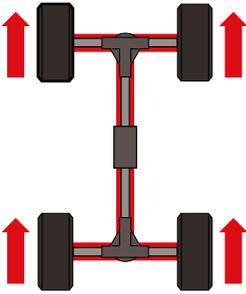
All Wheel Drive Typically available in 'soft roaders' and in some high performance sports cars. These vehicles turn all four wheels for better traction on slippery roads that are typically wet or have snow or ice.

Soft Roaders These are typically all wheel drive 'cross-over' vehicles between the all wheel drive and fully fledged four wheel drive. Some even employ a conventional centre differential with a lock, but they do not have a low-range, high ground clearance, or a 'crawl' gear (a first gear that is lower than a normal first gear for improved climbing). One of the best examples of this type of vehicle was the Volkswagen 'Syncro' Microbus.

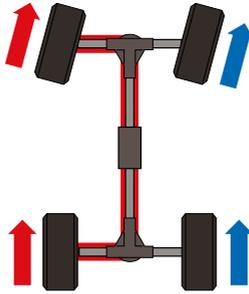
FOUR-WHEEL DRIVE WITH LOW-RANGE

Full-Time Four-wheel Drive with a Centre Differential These types of vehicles have a transfer case where power is transmitted to both front and rear axles at all times. However, to allow for different rotational speeds of the front and rear prop shafts during cornering, a centre differential is placed in the transfer

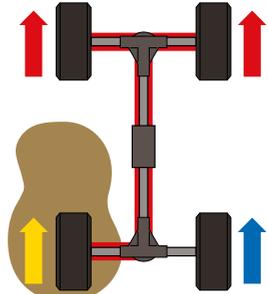
Standard Differential



4WD in a Straight Line

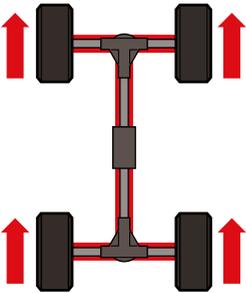


4WD Turning

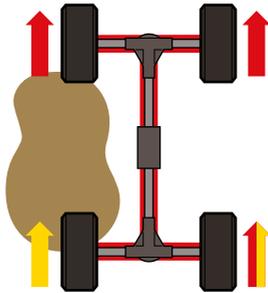


4WD on a Slippery Surface

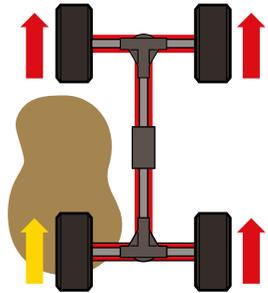
Locking Intervention



4WD in a Straight Line



Limited-Slip Differential



Differential Lock

 Power Transmission

 Driving

 Not-Driving

 Ineffective Driving

case to compensate for the difference in axle-speeds. The centre differential works similarly to the axle differentials, but controls the differential rotation of the front and rear axles. This is essential in a full-time or permanent four-wheel drive vehicle to prevent drive train wind-up when using the vehicle on hard surfaces. On loose ground wheel slip occurs releasing the built-up torque.

The drawback of this system is that a situation could result where all the power from the engine escapes through the central differential to the front or rear prop shaft and through the axle differential to just one wheel. Your 'four-wheel drive' vehicle becomes a one-wheel drive! In most four-wheel drive vehicles

the centre differential can be locked (transfer differential lock), forcing the front and rear prop shafts to rotate at the same speed.

An exception was the 'Selec-trac' part-time transmission found in several Jeep Cherokee models, which allowed 2-WD high (locked centre diff, front axle disengaged), 4-WD high part time (locked centre diff, front axle engaged), 4-WD high full time (open centre diff, front axle engaged) and 4-WD low part time (locked centre diff and front axle engaged).

Part Time Four-wheel Drive Part time four wheel drive vehicles with selectable four-wheel drive systems have transfer boxes where power is transmitted only to the rear wheels under normal conditions. Power will be transmitted to the front axle when four-wheel drive is selected. This is done by selection between 2-WD, 4-WD and 4-WD low, via the transfer box lever. In some vehicles the range selection lever is operated by a dial or push button.

Free-Wheeling Hubs Part time four-wheel drive vehicles had locking hubs (free-wheel hubs) on the front wheels to uncouple the hubs (wheels) from the side shafts. By unlocking (disengaging) the free-wheel hubs the unnecessary turning of the front differential and side shafts stopped and the resultant wasted energy eliminated. Unlocking free-wheeling hubs on road reduces wear and tear, improving fuel economy. Some vehicles are fitted with automatic locking hubs which engage once drive to the front wheels is selected.

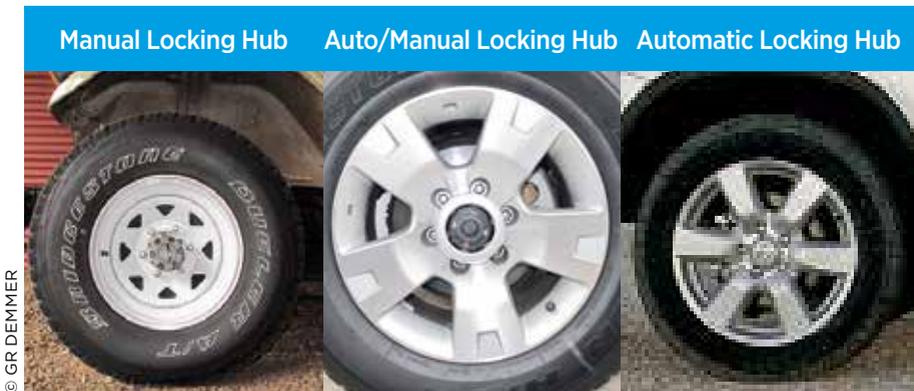
Low-Range Gear Ratios In off-road conditions even higher torque may be required due to the gradients and terrain traversed. On very steep inclines the first gear of a normal gearbox will not produce enough torque to put the vehicle in motion and even lower gear ratios are therefore required. It would not be practical to increase the size of the first gear due to the physical dimension of such a gear and the impracticality of such a low gear for normal on-road use.

Most four-wheel drive vehicles therefore have a transfer case selectable between 'high range' and 'low range'. High range will have ratios for normal on-road use whereas low range will bring a separate set of gears into play to reduce the ratios even further (typically between 2:1 and 4:1 ratio) and therefore increase the torque proportionally.

First gear is a gear that will produce high torque. The engine must make a number of revolutions before the gear will have made a single revolution. Fifth gear is a smaller gear which does not produce high torque, the engine usually makes one revolution for every revolution of the gear. The vehicle can therefore achieve high speed.

Differential Locking Systems And Other Traction Aids A vehicle may come to a standstill when one front wheel and one rear wheel lose traction. Power is directed to the spinning wheels because of the differential. Various systems are available on the market that allow the ‘wheel-spin’ to be stopped.

Depending the vehicle type, Diff-locks can either be fitted to the front or rear or both front and rear differentials. All four wheels of a 4x4 vehicle with a diff-lock engaged in the front and rear axles (and the centre diff-lock engage in full time 4x4) will turn at the exact same speed. However, it is most important that the axle differential locks are not used on hard surfaces, particularly if any turning is required, as damage will certainly result on the side shafts or even the differentials. Disengaging the vehicle’s particular system will result in the differential functioning normally.

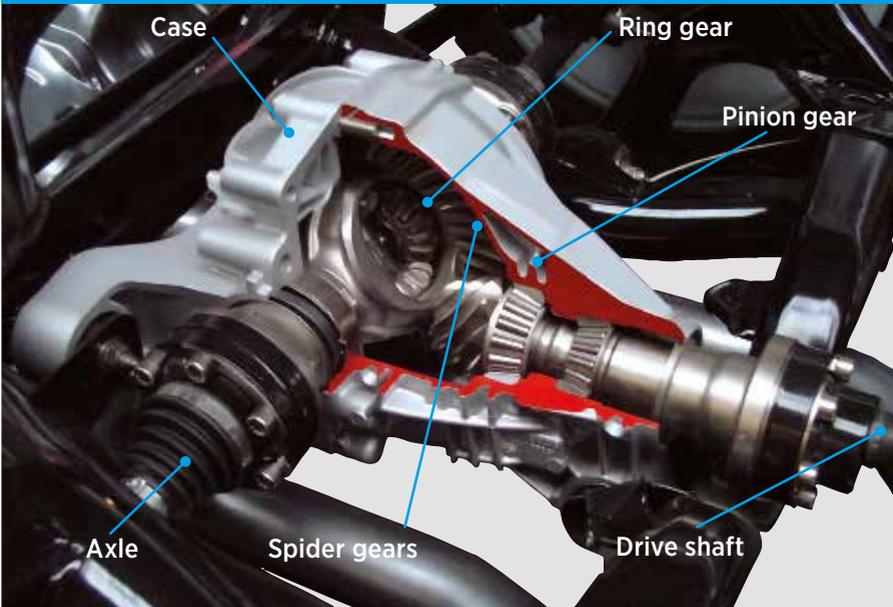


Mechanical Diff-Lock This will allow the driver to lock both side shafts of an axle together when needed, in order to ensure that both wheels turn at the same speed, overriding the differential’s function for extreme off-road conditions. This forces equal amounts of power to both wheels irrespective of traction to the wheels and results in considerable improvement in off-road ability under severe conditions.

Electro Pneumatic Diff-Locks This type of diff-lock typically relies on vacuum or compressed air to activate a mechanical lock mechanism inside the differential (normally the rear axle). By selecting the ‘diff-lock’ switch on the dashboard, the system is energised and the function of the differential (allowing differing wheel rotational speeds) is overridden. A typical after-market electro-pneumatic diff-lock is the ARB Air Locker.

Automatic Mechanical Lockers In essence, these type of lockers provide ‘locked drive’ whenever torque is present in the differential, an effect which

Conventional Differential



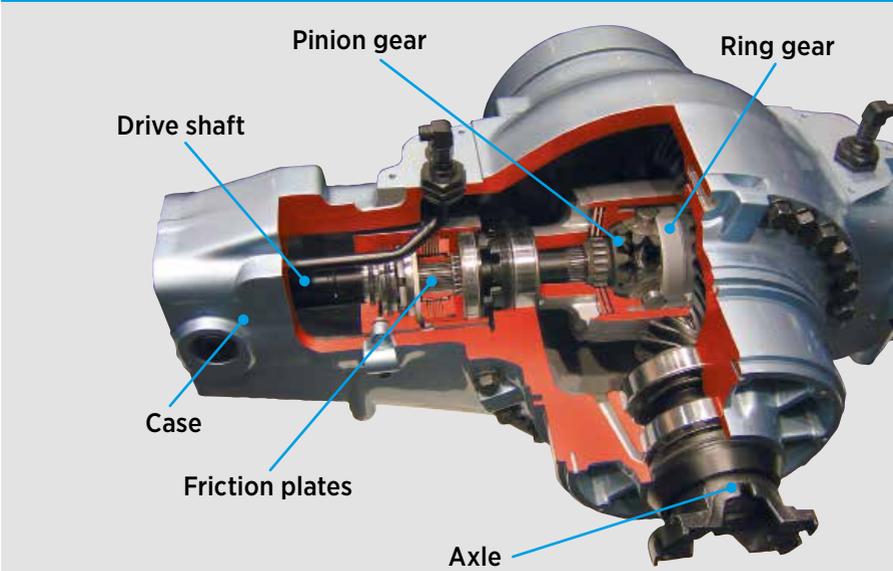
can be felt when turning on a hard surface — acceleration will cause the vehicle to turn wider (or under steer) on hard surfaces.

Very effective in off-road terrain, this type of locker can cause strange handling characteristics in two-wheel drive and while turning. In a permanent four-wheel drive vehicle the presence of this type of locker is less noticeable as the front wheels are assisting the vehicle by 'pulling' the vehicle around the corner.

Limited Slip Differential This is an arrangement somewhere between an open differential and a fully locked differential. A limited slip differential will not allow all power to be transferred to just one wheel, but will always ensure that a portion of the power is transmitted to the other wheel. The ratio of power transmitted to the wheels is determined by the design of the limited slip differential, using a series of clutches. A limited slip differential is less effective than a full diff-lock. It does, however, provide continuous on-road 'passive safety' in the event of a rear wheel slide.

Electronic Traction Control (ETC) ETC senses wheel-spin (normally using the ABS sensors) by monitoring the speed variance between the wheels on one axle. By applying the brake to the spinning wheel, it simulates traction and allows the transfer of torque to the stationary wheel, enhancing traction

Limited-Slip Differential



in slippery conditions. The wheel speed variance has to exceed a minimum speed before it will operate (normally 8–10 km/h). The function is de-activated at a set maximum speed (normally 50 km/h) when unintentional wheel spin is unlikely to occur. A light on the dashboard of the vehicle is normally provided to indicate to the driver when the system is operating.

Viscous Coupling Unit (VCU) This is a complex system that relies on the characteristics of the silicon fluid inside it. It can act as a differential, as a means to restrict wheel spin or both. Inside it are two sets of slotted metal plates — one connected to a front shaft, the other to a rear shaft. When there is a significant speed difference between the shafts, the silicon fluid heats up and expands thereby limiting the speed difference and slippage right-to-left or front-to-rear. In effect, it ‘locks’ the shafts together (although not mechanically, as in a locking differential). When there is little or no speed difference between the shafts, the viscous coupling does not work.

Automatic Locking Differential



POWER SOURCES

Diesel Diesel engines use a system known as compression ignition which is a closed system making it marginally more waterproof than a petrol engine. Starting is by means of a glow plug. They develop more torque at lower revs making them ideal for off-road use. They are more economical than petrol engines, but some have shorter service intervals and require low sulphur fuels that are not readily available. Modern diesel engines are quieter, cruise well on road and are well suited for towing. They sometimes suffer from a turbo-lag (delayed response to throttle at altitude).

Petrol Known as a spark ignition engine — a spark ignites the fuel in the combustion chamber. Petrol engines deliver their torque at higher revs and have longer service intervals. They are not as forgiving as diesel derivatives when off-road and require unleaded fuel which is not available across Africa. They cruise easily at all speeds and tow well.

Biodiesel And Liquid Petroleum Gas (LPG) LPG is very popular abroad. Performance is similar to petrol, it is cheaper and not taxed. Load space is lost as you have to fit an extra tank. Biodiesel contains vegetable matter. It's performance is similar to diesel. In future we may see these fuel types taking off in South Africa.

SUSPENSION SYSTEMS

The suspension absorbs and filters out high frequency inputs from the road to improve ride quality and to protect the vehicle, passengers and loads from high-energy road inputs.

The suspension on a four-wheel drive vehicle that is used off-road has to cope with much higher demands to enable the vehicle to keep traction. Suspension design on vehicles differs widely, with each having their own distinctive characteristics.

Articulation The ability of the wheels on an axle to follow the terrain and maintain contact (keep traction) with one wheel going up and the other down to their fullest extent.

Wheel travel is the distance a wheel is able to travel vertically, from its lowermost limit to its uppermost limit. The greater the wheel travel, the better the axle is able to articulate.

Springs (coil or blade) and torsion bars are the load carrying components and the shock absorbers provide the damping.

Live Suspension A live suspension refers to a system that permits movement of a wheel in conjunction with the opposite wheel on the same axle (solid axle). Generally considered to be preferable for off-road driving. Suspension is typically provided via coil springs/shock absorbers or leaf springs. This does give a slightly 'harder' ride and increases load carrying capacity.

Independent Suspension This is a suspension type that permits a wheel to move up and down without influence from the other wheel on the same axle. Common to the front axle of many four-wheel drives and most road vehicles, independent suspension typically comprises wishbones, A-arms and torsion bars. Independent suspension systems usually make use of coil springs.

Very often a combination of the above two systems is available, especially on light commercial vehicles, with independent front suspension (coil springs) and a solid axle with leaf springs at the rear. This gives a more comfortable ride.

Levelled Suspension (Self-Levelling Suspension) Eliminates sagging rear suspension when loaded. This is done by means of a hydraulic self-levelling unit between the chassis and the centre of the rear axle. This device can be found on coil sprung Range Rovers.



VEHICLE DYNAMICS

These are all the critical factors that will influence a vehicle in terms of on- and off-road performance and handling.

Centre of Gravity This is the point at which the vehicle will be in balance. Heavy loads on roof racks will negatively affect the vehicle's centre of gravity. A raised suspension has the same effect. The vehicle will tend to lean more during cornering and will have a much smaller roll over angle. It is advisable to load heavy items and equipment as low as possible in the vehicle. If a roof rack is used, load lighter equipment on the roof rack.



Roll-over angle (Lateral Lean Angle) This is the maximum angle at which a vehicle can negotiate a side slope without rolling over. The maximum roll-over angle is severely affected by heavy loads on a roof rack.

Approach Angle Is the angle formed by a straight line drawn from the front of the front tyres to the front of the vehicle (bumper or bull bar). The greater the angle the better the vehicle negotiates ditches and obstacles.

Departure Angle This is the angle between the rear contact point of the rear wheel and the lowest point of the vehicle behind the rear wheel (rear bumper).





The departure angle determines the angle at which a vehicle may leave an obstacle and represents the angle or reverse without striking the vehicle.

Break-Over Angle or Ramp Angle If the biggest ridge a vehicle can drive over is pictured as an equal-legged triangle, then the top angle of the triangle is called the break-over angle. The lesser the angle, the better will be the break-over on a ridge or ditch. It is obvious that a short wheelbase vehicle with large wheels will have the smallest break-over angle and best clearance.

Wading Depth This is the maximum depth of water through which a vehicle may safely drive, taking into account the position of air intakes. This is normally measured driving at a constant speed of 6 km/h through standing water.

Ground Clearance The ground clearance for a 4x4 is normally the clearance between the ground and the bottom of the differential casing(s).



VEHICLE CATEGORIES

It is important to understand that there are many different types of 4x4s with a variety of different capabilities. Manufacturer descriptions in terms of vehicle type are important from a training perspective as are the various power sources.



Light Commercial Vehicles (LCV) Single, extended and double cabs fit into this category known as LCVs. These vehicles have evolved to have various levels of specification and comfort. Single and extended cab derivatives can be utilitarian, being aimed at commercial use. Some recent entrants into the double-cab category have similar specification levels to expensive SUVs, having traction control, navigation, high-end sound systems etc.



Generally they feature a passenger car like ride due to the Independent Front Suspension with torsion bars, coupled to a live rear axle for load bearing capability.

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Sport Utility Vehicles — Station Wagon Bodies (SUV) Here we get the sub categories of small, medium and large SUVs as well as the so called **Cross-Over SUVs** or **Soft Road SUVs** – those without low-range gearing, these vehicles do not have much ground clearance but are competent in mud, sand and on gravel.





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The small SUV (SSUV) category is fairly limited with the bulk of sales falling within the medium SUV category (MSUV). Here one gets a mix of specification, generally with an independent front suspension coupled to a live rear axle – although there are units available with live axles front and rear.

Most vehicles in the **Large SUV category (LSUV)** are highly competent off-road due to a high level of specification, generally standard with live axles and coil/shock combinations. Priced at the top end yet very capable off-road.



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OFF-ROAD TYRES

Tyres are one of the most important aspects of a four-wheel drive vehicle, as they form the only contact the vehicle has with the terrain. The main purpose of tyres is depicted in the illustrations below:

Types of Tyres for Different Terrain Each kind of terrain demands its own specialised tyre to successfully traverse it.

Most vehicles are sold with 'standard' highway tyres as manufactures believe that the vehicles will spend most of their life on-road.

The terrain with the greatest design conflict is between the requirements of mud and sand. Muddy terrain requires a bold, angular tread and sandy conditions a gentler, subtler tread design.

A 'desert' tyre has to accommodate the different requirements of travel on rocks and sand, including very high temperatures. The side-wall of a desert tyre must also be able to resist rock damage, and at the same time flexible enough to accommodate the greatly reduced tyre pressures used in sandy conditions.

'All-terrain' tyres are a good all-round compromise tyre for on- and off-road use that also generates less road noise.



Highway



Mud/Snow



All Terrain

Different Tyre Types And Characteristics

Type	Characteristic	Advantage	Disadvantage
Highway	Close tread, optimised for road use.	Long lasting and quiet. Good road-holding in the wet.	Close tread will clog in muddy conditions.
Mud/Snow	More 'aggressive' than a highway tyre. Can have holes for fitting snow studs.	Quieter than other off-road tyres but with better off-road grip in the wet.	Tread will eventually clog in mud.
Mud	'Aggressive' open tread with wide grooves to allow easy self-cleaning.	Good off-road tyre for wet and muddy conditions.	Noisy on-road. Limited wet traction on-road.
All Terrain	Cross between road and mud tread design. The central area will be a closer tread for road use, the shoulder will have lugs for better grip off-road.	Good compromise between on-road and off-road.	Tread wears faster than road tyres and are noisier.
Sand	A wide flat tread, making 'floatation' easier.	Good for driving on sand and loose surfaces.	Poor grip on wet roads. Not suitable for mud.
Rock	Specialised tyre made for use on rock.	Harder side-walls, more resistant to punctures and damage.	Noisy on-road. Poor wet braking.

TRACTION

Traction is the single most important requirement of a tyre. Dry traction is a measure of the tyre's ability to deliver traction, or grip, under dry conditions. Dry traction is a function of the tackiness of the rubber compound.

Wet traction is the tyre's traction, or grip, under wet conditions. Wet traction is improved by the tread design's ability to channel water out of the tyre footprint and reduce hydroplaning.

TREAD PATTERN

Tread pattern and materials used in the tyre's construction are key to vehicle traction. The tread pattern has two main functions:

- To provide a path for water drainage to prevent aquaplaning
- To provide traction

Tread pattern influences the following:

- Noise level
- The ability to disperse heat
- The ability of the tyre to shed mud and small stones
- Tyre life
- Ride comfort
- Handling
- Aquaplaning

NARROW VS WIDE TYRES

Narrow tyres are best for mud and sharp rocks. Wide tyres are best in soft sand and for general traction.

LOW PROFILE VS HIGH PROFILE TYRES

Low profile tyres have the advantage in cornering on road. The only off-road situation where they have any advantage is on a side-slope. In this situation the tyre will not flex as much as a higher profile tyre. This will allow you to drive on a steeper side-slope. In all other situations, low profile tyres don't offer any benefits in off-road conditions.

TYRE STANDARDS AND REGULATIONS

The South African Bureau of Standards (SABS) is responsible for the creation of standards for the South African tyre industry. This ensures that the tyre conforms to the minimum safety standards. The newly formed National Regulator for Compulsory Specifications (NRCS) applies the compulsory standards through the regulation of all tyres manufactured and imported into South Africa.

Markings Required

- Proof of compliance to the compulsory specification: 'E' mark on the tyre and 'E' Certificate and/or
- US Department of Transport (DOT) mark supported by Economic Commission for Europe Regulation 30 or 54 test reports supplied by the manufacturer
- Verification that the manufacturer operates a quality management system certified by an accredited authority (copy of certificate)
- Size
- Tread Pattern
- Load/Speed Index

- Date of manufacture
- Radial/Bias
- Whether tubeless or not

TYRE TYPES AND SIZES

Side-wall Markings

Tyre's Commercial Name

Tyre Size Designation (ECE Form)

Load Index

Speed Symbol

Tubeless, If Applicable

Country Of Manufacture

Japanese Industrial
Standard Mark

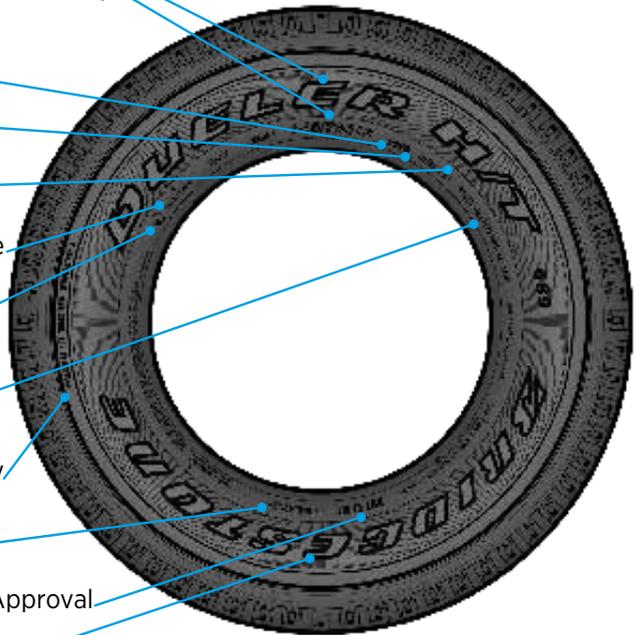
Tyre Construction

US Uniform Tyre Quality

Date Of Manufacture

US Dept. Of Transport Approval

Manufacturer's Name



TYRE SIDE-WALL MARKINGS

195/65 R 15 91 H

• Speed Rating

• Load Index

• Nominal Rim Diameter (Inch)

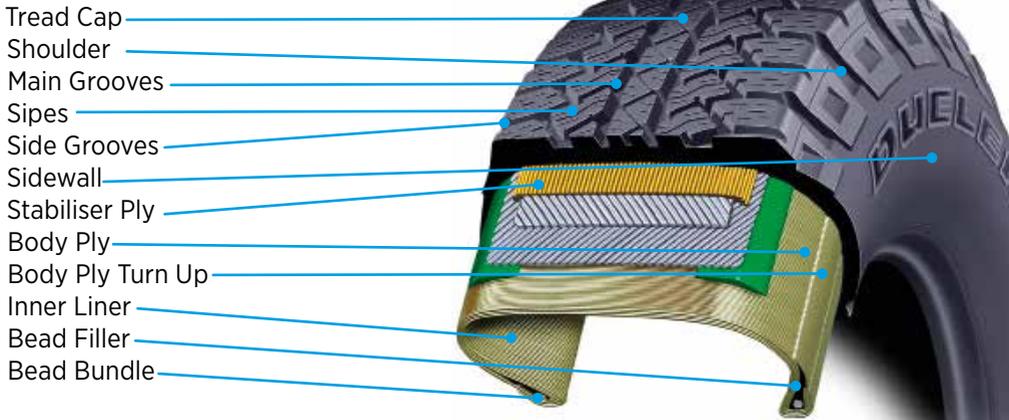
• Radial Construction

• Aspect Ratio (Series)

• Nominal Section Width (mm)

Side-wall Marking	Definition
Product Range	Tyre categorised in terms of product name.
Tyre Size	Sequence of symbols that contains the tyre section width, section height, construction and rim diameter for which the tyre has been designed
Load Index and Speed Symbol	Series of numbers that indicates the maximum load a tyre can carry at the maximum inflation pressure. The speed symbol is a letter which indicates the maximum speed capability of the tyre at its maximum load.
Tubeless	Indicates if the tyre is tubeless or if a tube should be fitted
Construction Type	Indicates the type of construction of the tyre
Product Type and Tread Pattern	Indicates the product type and tread pattern
Maximum Load and Inflation Pressure	Indicates the maximum load the tyre can carry in kilograms at the maximum inflation pressure of the tyre
Construction Information	Provides detailed information of the layers and the material used in the construction of the tyre
DOT Serial Number	Indicates that the tyre meets the international standards of the USDT
Tyre Brand	Indicates the brand name, i.e. Bridgestone
Safety Markings	This is a requirement of the USDT
UTQG Marking	The Department of Transport requires the manufacturer to grade the passenger car tyre based on three performance factors. (Tread wear/traction/temperature resistance)

TYRE COMPONENTS



Construction Term	Function of Each Component
Tread Cap	To provide friction to the road surface
Main Grooves	To channel air and liquids to allow maximum friction to take place
Side Grooves	To channel the compressed product for dispersion
Sipes	To assist in extra biting edges in tread area
Shoulder	To assist in stability when changing direction
Stabiliser Plies	To stabilize the tread area to the road surface while tyre in motion – providing the air pressure is correct for the load it is carrying
Cap Strip	To anchor the stabiliser plies at the point of cornering and high speed
Side-Wall	To join the tread area to the bead area. It displays all the side-wall information and protects the body ply and assists in the flexing of the casing
Body Ply	Gives the tyre shape and its strength under pressure
Body Ply Turn Up	Is the end of each body ply and this assists in the anchoring of the body ply around the bead
Bead Filler	Fills up the void between the body ply and the body ply turn up
Bead Bundle	Reinforced single strand wire, wound up on a drum to anchor the tyre to the wheel
Inner-Liner	To contain air under pressure for a period of time

Load Index

The load index indicates the maximum amount of kilograms a tyre can carry under the maximum pressure as indicated by the tyre manufacture.

The importance of these symbols should not be underestimated. If a tyre is loaded above its load index or fitted to a vehicle capable of higher speeds than indicated by the speed rating, and an accident occurs because of tyre malfunction, the owner of the vehicle will be responsible, irrespective of the cause of the malfunction.

Do not compromise on safety, fit the correct tyres to the vehicle and make sure the pressures are correct and look after your tyres at all times. Enquire from your local tyre dealer on Load Index (LI) symbols and relevance.

TYRE PROFILES

There are three types of tyre 'descriptions' on the side-wall of tyre:

- Imperial e.g. 7.50x16 – meaning a tyre 7.5 inches wide and for use on a 16 inch wheel.
- American e.g. 31/10.5x15 – meaning 31 inches in diameter, 10.5 inches wide and for use on a 15 inch wheel.
- Metric e.g. 205/75x16 – meaning 205 mm wide with an aspect ratio (side-wall height) of 75% of the width and for use on a 16 inch wheel.

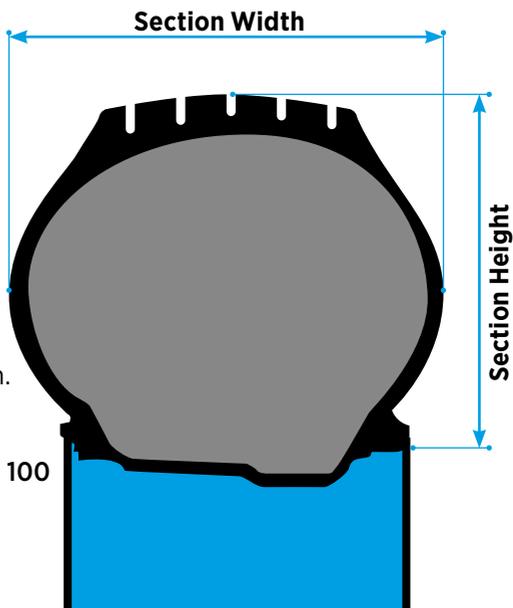
SECTION WIDTH 265/65R17

The section width is measured from sidewall to sidewall. Excluding any raised lettering, fitted to a rim, pressurised to the manufacturer's recommendation

ASPECT RATIO 265/65R17

The aspect ratio is expressed as a percentage of the section width.

$$\text{Aspect Ratio} = \frac{\text{Section Height}}{\text{Section Width}} \times 100$$



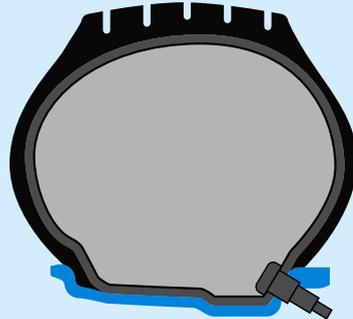
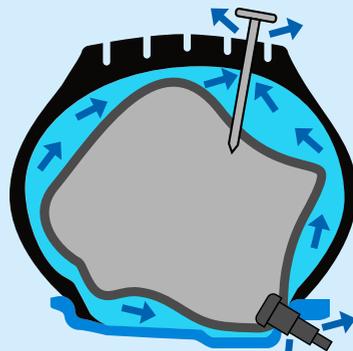
TUBE TYRES vs TUBELESS TYRES

Tube Tyre

With a tube type tyre, the air is enclosed inside the tube and the tube has the valve fitted to it.

Tubeless Tyre

With a tubeless type tyre, the tube is absent and the air is held between the wheel and the tyre and the valve is fixed to the wheel.

Tubeless	Tube type
<p>The inner tube is integral within the tyre, known as inner liner. The valve is permanently fixed to the wheel. The assembly is airtight</p> 	<p>The components are tyre, tube with valve and rim. The inner liner is not designed to retain air, therefore not airtight.</p> 
<p>In case of a puncture, loss of air is very slow, since air can escape only through the narrow gap made by the penetration of an object.</p> 	<p>Instant air leakage after getting puncture. The air under pressure finds a way between the tube, tyre and through the rim hole.</p> 

TYRE PRESSURES

The tyres on your 4x4 are the only contact that you have with the terrain and they determine the amount of traction provided to make your vehicle move. The area where the tyres make contact with the ground is called the footprint and reducing tyre pressure can increase the footprint, which then improves traction. Tyre pressure thus largely influences the way that an off-road vehicle traverses an obstacle.

Recommended tyre pressure for most four-wheel drive vehicles ranges from 200 to 250 kPa (Check manufacturer's recommended pressures, especially for loaded vehicles). At this pressure the footprint area, stiffness and handling properties are optimal for on-road conditions. When going off-road, optimal tyre pressures vary depending on the prevailing conditions and types of obstacles.

Tyre Deflection and Footprint

240 kPa 210 kPa 180 kPa

Over Inflated Correct Inflation Under Inflated

When tyre pressure is decreased, the footprint gets longer, not wider.

In rocky terrain there is no clear-cut recommended tyre pressure. Reducing tyre pressures in rocky terrain can improve traction but will expose the tyre side walls to possible damage. Increasing tyre pressure will protect the tyre but will compromise on traction. A rule of thumb will be to keep tyre pressures as recommended by the manufacturer.

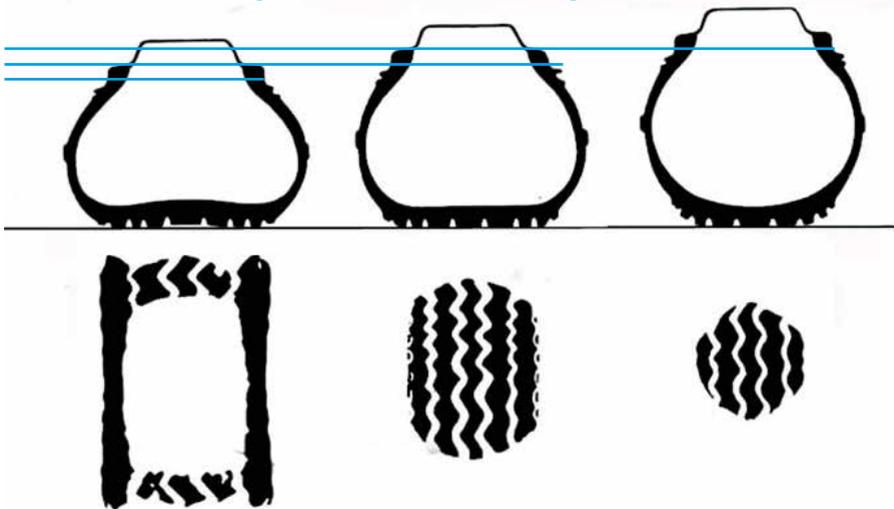
Reduce tyre pressure with approximately 20 – 30% from normal tyre pressure for driving over rocks with no sharp edges as this will improve traction and ride quality. However, for rocks with sharp edges, tyre pressures should remain at recommended on-road tyre pressures to prevent side-wall damage.

Negotiating mud with a solid foundation, tyre pressures should be at recommended on-road operating pressure to allow the tyre to cut through the mud to the solid base.

For sand and deep mud tyre pressures should be reduced to 40 – 60% of recommended on-road tyre pressures to increase the footprint and aid floatation. Do not reduce radial tyre pressures to less than 0,8bar and cross ply tyres to less than 1,2bar.

Sand, mud and rocks will tend to lodge between tyre and rim bead when operating at low tyre pressures and may result in total deflation. The rim could also spin within the tyre, possibly ripping the valve out of inner tubes.

NB: Note that the ground clearance changes as well.



TIP: Use ‘gasket maker’ to seal the tyre where it meets the rim. This helps to prevent sand from finding its way into the contact area (or rim bead). Silicon sealant tends not to be flexible enough for this purpose.

Guide To Inflation Pressure For 4X4 Tyres

Generic ‘Rule of Thumb’ for tyre deflation used in the industry:

Sealed Surfaces/Tar 100%

Gravel/Corrugations	-10-15%
Rock	-10-15%
Mud	-25%
Sand	-50%
Slippery Clay/Mud	-20%

Remember: When you do it, is important!

- Drive long distance, tyre air pressure increased (heat)
- A tyre takes two hours to cool down before resetting

Working in percentages is therefore recommended as the base value or pressure always remains constant in the situation you are in.

NOTE: The above table is just a guideline, it is rather suggested that if you are not sure about the inflation pressure, to rather inflate the tyre to the specification of the manufacturer of the vehicle.



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TYRE MAINTENANCE

One of the hazards of off-road adventure is tyre failure. You should always have at least one full-size inflated spare tyre at all times. Other essential items include a tyre plug, repair kit and an air source. Even so equipped, an unfortunate turn of events or extended backcountry travel can require some creativity and hard work to keep all tyres inflated.

However, regular 'maintenance' of your tyres is essential for longevity and safety. Before we address the emergency repairs and kits, take heed of the following important aspects.

Damaged Tyre Or Wheels

Driving on a damaged tyre or wheel can be dangerous. Always look for bulges, cracks, cuts, splits, penetrations, and abnormal tread wear. Damage can occur within the tyre body without being visible on the outside. A vibration or ride disturbance may be a sign of tyre damage. Any time you see any damage to your tyres or wheels, replace with spare at once and immediately repair the tyre, or see your tyre dealer to have the damaged tyre inspected and repaired, if possible.



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If, while driving, you notice a vibration or ride disturbance, and/or you suspect possible damage to the tyres or vehicle: immediately reduce your speed, drive with caution until you can safely pull off the road, stop, and inspect the tyres. If a tyre is damaged, deflate it, remove and replace the tyre and wheel with a spare. If you do not see any tyre damage and cannot determine the source of the vibration, have the vehicle towed to the nearest vehicle or tyre dealer for a thorough inspection.

Misalignment, under-inflation, overloading, impact damage, and/or separation within the tyre body may cause the vibration. Using a damaged tyre could result in sudden tyre destruction.

When inspecting your tyres, including the spare, check your air pressures. If your pressure check indicates that one of your tyres has lost pressure of two bar or more, look for signs of penetrations, valve leakage, or wheel damage.



All tyres wear out faster when subjected to high speeds as well as hard cornering, rapid starts, sudden stops, frequent driving on roads which are in poor condition, and off-road use. Roads with holes, rocks, or other objects can damage tyres and cause misalignment of your vehicle. When you drive on such roads, drive carefully and slowly. Before driving highway speeds, examine the tyres for damage, such as cuts or penetrations.

Wheel Alignment Wheel alignment and balancing are important for safety and maximum mileage from your tyres. Inspect your tyres regularly, at least once a month for signs of uneven wear.

Uneven wear may be caused by improper inflation pressure, misalignment, improper balance or suspension neglect. If not corrected, further tyre damage will occur. This will shorten the life of your tyres and may result in loss of vehicle control and serious injury.

If any of these problems exist, the cause may often be corrected at your tyre dealer or other service facility. Your tyres will last longer.

Tyre Rotation Proper tyre rotation is important. If you notice irregular or uneven tread wear, the tyres should be rotated to alleviate the problem. Remember: it is important to check your tyres and wheels for signs of possible



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damage (as previously discussed), and check your vehicle for any mechanical problems and correct if necessary.

You should follow the rotation pattern or procedure indicated in your vehicle owner's manual. The first rotation is the most important. Sometimes front and rear tyres on a vehicle use different inflation pressures. After rotation, adjust individual tyre air pressure to the figures recommended by the vehicle manufacturer for the new locations — front or rear — as shown on the tyre decal on the vehicle. Wheel alignment and balancing are important for safety and maximum comfort.

Tyre Mixing It is probably not necessary to make this obvious observation, especially to the 4x4 community, but tyre mixing can be dangerous! Mixing or matching of tyres on four-wheel drive vehicles requires special precautions. Always check vehicle manufacturer's manual for their recommendations.

Tyre Alterations It is probably not necessary to make this obvious observation, but tyre alterations are just as dangerous. Do not perform any alteration on your tyres. Alterations may prevent proper performance, leading to tyre damage, which can result in sudden tyre destruction. Tyres that have been altered are excluded from warranty coverage.

STORING TYRES

Tyres should be stored in a cool, dry place away from sources of sunlight, heat and ozone such as hot pipes and electric motors. Tyres should be stored so there is no danger of water collecting inside them. Be sure that surfaces on which tyres are stored are clean and free from grease, petrol/diesel or other substances which could deteriorate the rubber. Tyres exposed to these materials during storage or driving may be weakened and subject to sudden failure. Also, be sure to allow air to circulate around all sides of the tires, including underneath preventing moisture damage.

When storing tyres flat (one on top of the other), stack so that tyres on the bottom retain their shape.

If storing tyres outdoors, protect them with an opaque waterproof covering and elevate them from the ground. Do not store tyres on black asphalt, other heat-absorbent surfaces, snow-covered ground or sand.

TYRE REPAIR EQUIPMENT — ESSENTIALS

Tyre repair equipment is as essential as a snatch strap when four wheel driving.

Bead Breakers Bead Breakers are required to break the seal of the tyre from the rim (the bead). Internationally, there are three different types available, but not all are common in South Africa:

Tyre Pliers Tyre pliers are very quick to use. Ideal for use on all types of rims from 10" to 16" diameter. Operates on a lever principle.

Tyre Jaws Slower to use, but requires very little physical effort. They are suitable for all rims from 10" to 18" diameter, and are especially good for alloy rims, as the design limits the chance of marking or scratching the rim. Operates on a screw-thread action.

Bead Seater Suitable for use on any rim type and size, but may mark alloy rims. Operates on a combination of clamp/screw design. Once set up it is very quick and easy to use. Ideal for use where a large variety of tyre sizes and tyres will be used (i.e. Trucks and Tractors).

Tyre Levers Normally about 600mm in length and made from high tensile steel. These levers have curved and tapered ends to suit different shaped rims. Ideally two levers are required to be used with a bead breaker to successfully remove and refit the tyre to the rim.



Puncture Repair Kits There are various makes of repair kits available on the South African market, some imported, and some put together locally, for our conditions. The kits are also purchased according to tyre type (tubed or tubeless).

Basic Tube Kit These kits are designed for vehicles with tubes fitted inside the tyre. It provides a supply of basic tube & tyre patches, tools & glues. The tube & tyre must be removed from the rim for repair.



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Tubeless Kit These simple kits normally come in a plastic box or pouch, of a size suitable to place in the cubbyhole of your 4x4. They usually contain five string repairs and five rubber plug repairs, applicator, and glue. Most repairs can be performed without removing the tyre from the rim. Simply plug the hole and re-inflate the tyre.

Professional Kit These kits are comprehensive for both tubeless and tubed tyres. They have a large variety of various tyre and tube patches, tools, glues etc. This kit is designed for the four-wheel driver who is likely to encounter a wide variety of injuries to tyres.

Compressors When repairing any type of tyre, a heavy-duty compressor is essential. Portable or mounted compressors are available. You cannot afford to venture off-road without one.

Air Pressure Gauge Another essential part of your equipment is an air gauge. Various models are available, — buy a decent gauge as this is a very important aspect of off-road driving — correct tyre pressure.



PERIODIC VEHICLE MAINTENANCE IS NECESSARY

SILENCER

DETERIORATED

NEW

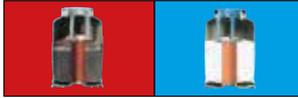


- Loud noise
- Discharge of toxic (smelly) gas
- Reduced engine performance

FUEL FILTER

DETERIORATED

NEW



- Sluggish acceleration
- Engine Stalls

WIPER BLADE

DETERIORATED

NEW



- Poor visibility in rain

If you continue to use worn out parts, phenomena in red may occur.

Parts shown should be replaced depending on distance travelled or year, whichever comes first (under normal conditions). As these may vary, please consult your warranty information and maintenance booklet for more detail.

BRAKE DISC/DRUM

DETERIORATED

NEW



- Brake pedal/steering wheel vibrates while braking

BRAKE PAD/SHOE

DETERIORATED

NEW

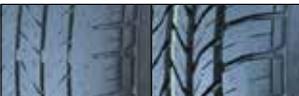


- Braking is very poor
- Worn brake pads will damage discs/drums

TYRES

DETERIORATED

NEW



- Poor ride comfort
- Tyres skid under various conditions

SHOCKABSORBER

DETERIORATED

NEW



- Poor ride comfort
- Vehicle is unstable at speed

DRIVESHAFT BOOT

DETERIORATED

NEW



- Abnormal noise/vibration

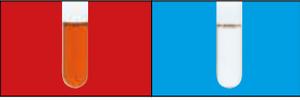


FOR YOUR SAFETY AND COMFORT.

BRAKE FLUID

DETERIORATED

NEW



- Brake pedal feeling becomes spongy when braking hard

BATTERY

DETERIORATED

NEW

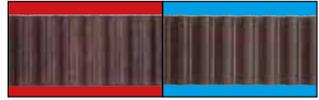


- Engine will not crank
- Dim headlights

TIMING BELT

DETERIORATED

NEW

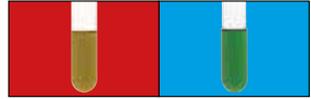


- Engine stalls
- Serious engine damage

ENGINE COOLANT

DETERIORATED

NEW



- Engine overheats
- Shortened engine life

SPARK PLUG

DETERIORATED

NEW

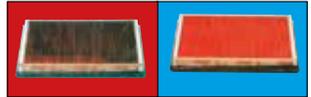


- Engine is hard to start
- Poor fuel economy, sluggish acceleration

AIR FILTER

DETERIORATED

NEW

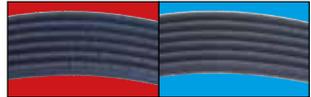


- Poor fuel economy, sluggish acceleration
- Shortened engine life

DRIVE BELT

DETERIORATED

NEW

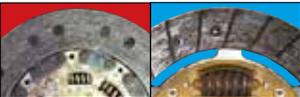


- Engine overheats and battery drains
- Air conditioning not working
- Steering is extremely stiff

CLUTCH PLATE

DETERIORATED

NEW

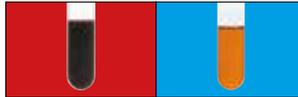


- Poor fuel economy, sluggish acceleration
- Unable to select a gear

ENGINE OIL

DETERIORATED

NEW



- Poor fuel economy, sluggish acceleration
- Shortened engine life

OIL FILTER

DETERIORATED

NEW



- Poor fuel economy, sluggish acceleration
- Shortened engine life



VEHICLE MAINTENANCE

Servicing Your Vehicle

Before going on any 4x4 trips or outings maintenance needs to be done. Remember that your dealership just does services according to the manufacturer's specifications. Prior to a trip, you will need to check various components.

Maintenance Before Trips

If the vehicle was serviced recently, establish exactly what was done. During a normal service the engine oil, fuel, oil and air filters are replaced.



© PS PRIMICH

As part of maintenance the following items must be checked:

Transmission (Gearbox) check for leaks, oil level and condition of oil, (replace if contaminated-oil and water do not mix well), contaminated oil has a milky appearance).

Transfer Case check for leaks, oil levels and condition (replace if contaminated).

Differentials check for leaks, oil levels and condition (replace if contaminated).

Suspension, Shock Absorbers, Coil or leaf springs check for leaks and that they are all secured properly.

Brake and Clutch check for leaks, fluid levels and condition, inspect all brake and clutch hydraulic pipes and fix or replace if necessary. Check brake pads and brake shoes where applicable. If the brake pads lining has 3mm or less remaining, it should be replaced.

Battery have the condition of the battery checked, top up electrolyte level if possible.

Power steering check for leaks, levels and condition, fix or replace if necessary. Hydraulic pipes and belts must also be inspected.

Radiator and Hoses check for leaks, levels and condition, fix or replace if necessary. (If the anti-freeze/water mixture ratio of the engine coolant is too high or too low it can damage the cooling system). See manufacturer's specifications.

V- And Flat Belts check for cracks and replace if necessary.

Charging System check alternators, pulleys and bearings, replace or repair if necessary.

Wheels check rims and tyres. Look for cracks, cuts or bubbles (both inner and outer sides). Check the spare tyre for condition and pressure. Ensure that the jack is rated for the vehicle's weight (with all your accessories and luggage) and in a good working condition.



Wheel Nuts, Studs or Bolts ensure that they are not worn and are properly tightened with a calibrated torque wrench. Make sure that the correct tool is in the vehicle for security nuts, if they are fitted. Ensure that you have the correct wheel spanner or sockets that fit all the wheel nuts.

Wheel Bearings check for play on wheel bearings, tighten if necessary. Bearing life is often much better when the bearing is kept clean and well lubricated.

Tow-Bar ensure that it is properly tightened with a calibrated torque wrench. Bolts and nuts must be of high tensile steel (grade 8.8 or higher). If the rear bumper is an integral part of the tow-bar system, it must also be secured with high tensile steel bolts and nuts.

U-Bolts And Drive Train make sure that they are fastened and secured. A motor vehicle's drive train consists of the parts of the power train excluding the engine and transmission. This includes the drive shafts, differentials, and the drive wheels.

Electrical System make sure that all components are in a working order. Check that you have replaced the battery in your spare key as you may need to use it.

The following should be done as part of maintenance:

- Lubricate all components of the steering, driveline and suspension.
- Differential Breathers — ensure that they are functioning correctly. Install extension pipes to differential breathers if not fitted, if extension pipes have already been installed check to ensure that they are not damaged or blocked.





MAINTENANCE AFTER TRIPS

After every 4x4 trip or outing vehicle maintenance must be done as discussed in the section. Doing this can save a lot of trouble, time and money.

MAINTENANCE ON A TRIP

While on a trip certain maintenance has to be done. If driving through long grass, it is recommended to stop regularly and remove the grass from the bottom of your vehicle. Grass can get clogged up between the exhaust and drive shafts and may result in your vehicle catching fire. This is due to heat generated by the catalytic converter.

Travelling through long grass without a seed net can result in the radiator becoming blocked with seeds and husks, which may result in engine overheating. Stop regularly and clear up seeds in the net and radiator.

Driving through deep muddy water can result in your vehicle's radiator getting clogged up as the mud particles will block the core. This may result in the engine overheating. Inspect your radiator and clear the mud.

After driving through water inspect the fluids in the gearbox and differentials for signs of water (oil turns milky). Should this be the case, change these fluids as soon as possible.

Mud can build up on the inside of your rims affecting the wheel balance.

DRIVING PRINCIPLES

SURFACED ROADS

4x4 Vehicle Dynamics

It is important to understand the difference between on-road handling of a 4x4 vehicle and that of a light passenger vehicle on a surfaced road. As most 4x4 vehicles are used mainly on surfaced roads one must understand the different driving dynamics.

Tyres Off-road tyres do not have the handling ability on the road as a HT rated tyre. This will have a direct influence on the traction available in dry and wet road conditions. Ensure that tyres are inflated to their normal on-road tyre pressures after off-road driving as this will allow the tyre to run cooler and influence traction and wear.

Centre of Gravity In general the centre of gravity of an off-road driving vehicle is considerably higher than that of a normal passenger vehicle. When going on extended trips, the centre of gravity may be even higher as a result of items that are taken along and are put on the roof-rack of the vehicle.

This has the effect of causing greater weight transfer during cornering. Corners need to be negotiated at lower speeds and with great caution. Looking far enough ahead, predicting and reacting to possible hazards well in advance can prevent sudden jerky movements with the steering wheel, thus improving safety and the possibility of losing control of the vehicle.



Acceleration Although usually bigger and more powerful engines are used in off-road vehicles, when loaded off-road vehicles have impaired acceleration abilities. When merging with traffic or overtaking this has to be taken into consideration.



Braking Various aspects influence braking distances, especially under emergency conditions. These need to be borne in mind. The important factors are:

- Speed
- Road surface
- Ability and condition of the vehicle
- Weight of the vehicle
- Condition of the driver



Therefore, speed should be adapted to the type of conditions that are present at that time and following distances should be increased to allow more time for the driver and the vehicle to react.

At 120km/h a vehicle is moving at approximately 36 metres per second. On average, the time a driver takes to identify a hazard, take the foot off the accelerator and onto the brake is one second. This means that by the time the driver starts to brake, the vehicle has already travelled 36 metres. For this reason, a following distance of at least three seconds should be maintained and even increased in adverse weather conditions.



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Correct Seating Position

For maximum control and safety when driving on and off-road, it is important to ensure that you are in the correct position when driving. Having the correct, upright seating position can also prevent a driver from becoming drowsy, especially driving on long trips.

When behind the steering wheel, make sure that the leg remains slightly bent, when the clutch pedal or, in the case of an automatic, the brake pedal, is depressed. As it is human nature to ‘brace’ your body for an impact by pushing your legs out straight, this reduces the possibility of major injury to your hips in the event of an accident.

The driver's arms should also have a slight bend when the hands are in a ten-to-two or quarter-to-three position on the steering wheel. Make sure that the thumbs are on the rim of the steering wheel for safety while driving off-road. The quarter to three position is the new standard as it allows for safe deployment of an air-bag in an emergency.

The head restraint should be as close as possible to the back of the driver's head and adjusted so that the top of the head restraint is in line with the top of the driver's ear. The mirrors should be adjusted while the vehicle is still stationary and not during driving.

The driver must also be able to see objects in both side and rear view mirror from this position, and if in a precarious situation, be able to adjust the mirrors, while strapped in, as a seat belt must be worn at all times (except during water crossings).



GRAVEL ROADS

Gravel roads are normally graded to allow water to drain quickly to the side of the road in order to prevent degradation. This rounded verge, however, could result in inexperienced drivers being caught in a slide towards the outer fringes of the road.

Loss of Traction The problem with gravel roads is that the available traction is far less than on tarred surfaces. Stopping distances are far greater on gravel roads and the ability to turn is also seriously reduced. Corrugations in the road surface makes the problem even worse as the wheels can actually skip from bump to bump so that traction is even further reduced from what it would be on a perfectly smooth surface. In general, gravel roads are more winding, have more blind rises and unexpected corners than tarred roads.

To cope with these changes and to ensure reaching your destination safely, your driving style on gravel roads has to be adjusted accordingly. Failing to do this can lead to loss of control and serious accidents. The use of the vehicles 4-WD(high range) is recommended on gravel roads to increase the traction of the vehicle to the maximum level possible.

Adjust Your Speed The first requirement for driving on gravel roads is the awareness that driving at the same speed as on tar roads is dangerous. If the road was to suddenly deteriorate or a corner appear or an animal stray onto the road, we need to be able to take the necessary avoiding action. It is a fact that on gravel roads the vehicle will start skidding quite easily during excessive driver inputs such as swerving or hard braking, leading to all kinds of control problems.

What to expect and how to rectify the situation when your vehicle starts skidding. The best still is not to get into trouble in the first place by correctly adjusting speed to the conditions!

Front-Wheel Skid This happens when we ask more of the front tyres than what the available traction allows and is also referred to as under-steer. The result of front wheels skidding is that the vehicle will slide in the direction of least resistance and not necessarily in the desired direction. The way of least resistance is towards the outside of a corner and that is probably the place you don't want to be!



Front wheel skids are caused either by turning the steering wheel too much or applying the brakes too hard, or more commonly, a combination of both. Remember that there is always a limited amount of traction available and this must be shared between your steering and braking efforts. You can either brake hard or steer hard but it is not possible to brake and steer hard at the same time, while maintaining traction.



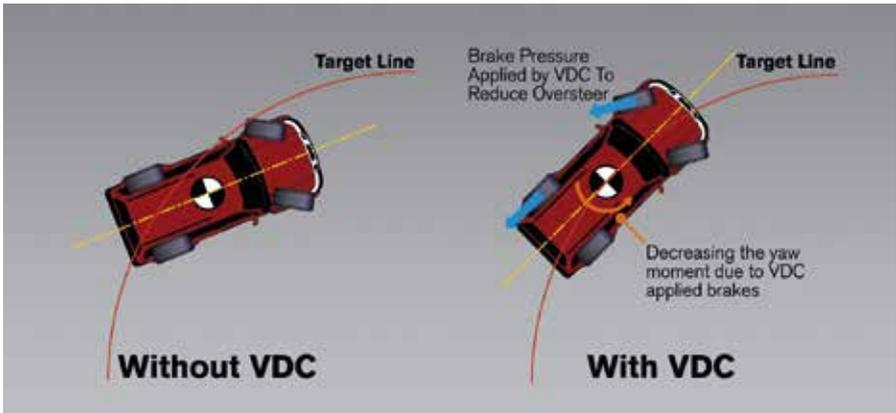
Rear Wheel Skid This is usually the result of trying to accelerate faster than the available traction allows and is also referred to as over-steer. As the rear wheels are not in rolling contact with the road, they will skid in the direction of least resistance, which is usually towards the outside of a corner we are trying to accelerate out of. The vehicle tends to broadside and if left unchecked will turn around completely.

A rear wheel skid can also be caused when the brakes are applied too harshly.

Four-Wheel Skid Things are now really out of hand because far too much is asked of the available traction. The vehicle is out of control and could head in any direction. Excessive braking or acceleration as well as steering input can cause the four-wheel skid.

The same remedy as above is prescribed namely, to establish rolling steer by steering into the skid and easing off on the accelerator.

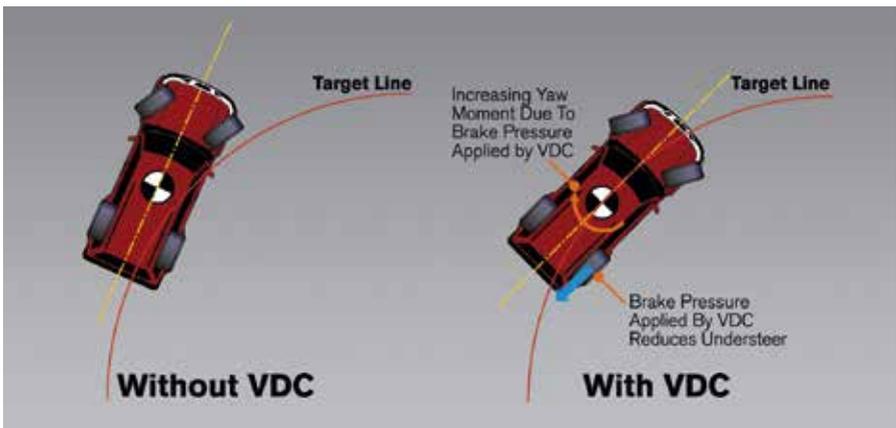
Braking in a Corner Never apply the brakes in a corner. Apply the brake ahead of the corner and accelerate slowly through the corner for optimum safety.



Braking in a corner increases the chances of the front wheels skidding and the associated loss of control. If we absolutely have to slow down in the corner to avoid catastrophe, cadence braking really delivers results. By repeatedly depressing the brake pedal hard for maximum braking and then letting go for a split second before applying the brakes again, will allow the wheels to remain momentarily in rolling contact with the road thus allowing control of the vehicle to be maintained.

Engine Braking Deceleration of a vehicle resulting from taking your foot off the throttle while the vehicle is in gear is called engine braking. Engine braking is especially effective in vehicles with manual transmissions, when placed in low gear or low-range in off-road conditions.

Momentum Momentum is a form of energy, defined as the product of the mass of the vehicle and the speed of the vehicle. (Momentum = Mass x Velocity). In simple terms, momentum is the tendency of the vehicle to continue travelling



once your foot is taken off the accelerator. This characteristic is valuable in traversing obstacles where traction may be at a premium.

Rolling Steer Continuous rolling contact is the description of a wheel in steady rolling contact with the ground without slip, wheel-spin or slide (as with locked brakes) — i.e. the wheel is rotating at the same speed and direction as the vehicle is travelling. This should be the aim at all times, both on and off road. Rolling steer is the proper method to control the direction the vehicle is headed.

Recovery from a Skid When the vehicle starts skidding you must turn the steering wheel into the skid and ease up on the brake pedal or the throttle to regain rolling steer for proper control. This goes against every living fibre in the untrained person because it seems to aggravate the dilemma. We are now steering in the direction of the peril we were trying to avoid in the first place. However, it is truly our best chance of getting out of the predicament. Once rolling steer has been re-established, steer yourself out of trouble by using the regained traction.

Wheel Spin Wheel-spin (a similar loss of continuous rolling contact) results from the application of excessive power for the conditions — to correct reduce the wheel speed by decelerating slightly until traction is regained.



Traction Traction is the concept of achieving grip between the tyres and the ground or road surface without slip or skid.

Anti-lock Braking System (ABS) prevents wheels locking under maximum braking conditions. It works on the principle of braking a wheel until it just

begins to skid, then releasing the brake pressure and re-applying the brakes. Wheel speed sensors identify the skid point and trigger a release in brake pressure. The cycle is repeated many times a second with an associated shudder feedback of the brake pedal to indicate you are in ABS mode. (see cadence breaking)

Drive Train Wind-up (Transmission wind-up) A 4x4 not fitted with a centre differential (i.e. part-time 4x4 with a transfer case) that is placed in 4-WD or a permanent 4-WD driven with the centre differential locked results in equal amounts of power being transmitted to the front and rear prop shafts. As this does not allow for the differences in wheel distance travelled (as when turning), it results in some wheel slip and skid, which on loose ground, occurs without any harm.

On hard surfaces however, the improved wheel grip makes it difficult for the wheels to slip (releasing the built-up torque), resulting in considerable torsional stress being built up in the transmission. This is known as transmission wind-up and can sometimes exert so much stress that the centre differential or transfer case gears will not disengage when de-selected. You will also sense very heavy steering. If this occurs due to your forgetting to disengage the centre differential lock/select 2-WD on the transfer case on hard ground (or at any other time) reverse the vehicle some distance until the 'diff-lock' or 4-WD warning light extinguishes or the transfer case lever moves.

Snagging

One of the most common problems encountered on tracks is snagging the underside of the vehicle. One should thus be aware of the clearance under the axles and avoid any obstacles that might snag them.

Always be aware that a smaller rock lying on top of the 'middelmannetjie' might be high enough to hit the axle. If the 'middelmannetjie' is quite high, it may help to drive with the one wheel on it to increase the clearance. If there is a big rock in the way that cannot be avoided altogether, driving over it with the wheels at low speed will let



it pass harmlessly under the vehicle. Know where the lowest point on your vehicle is, and also its position relative to the wheels so that you can avoid getting it snagged or damaged. If you are not good at judging heights, cut a length of wood to that size and use it as a guide.

Ditch At Speed Another common problem on tracks is the sudden encountering of a hole or ditch in the path while travelling at speed. If a hole, mound or ditch were to suddenly appear in the track and we were travelling too fast to reduce speed completely, brake as hard as is safe for as long as possible, then release the brakes completely just before the front wheels hit the obstacle. In this way the suspension is given time to recover from the weight transfer of the braking manoeuvre and is in a much better position to absorb the shock of the obstacle.

If the brakes are not released in time, the suspension would hit the obstacle still in a compressed state and would have very little travel left with which to absorb the impact. Many vehicles have been damaged due to ignorance of this simple yet very effective procedure.

Use of 4-WD

Although most rough tracks can be negotiated in two-wheel drive, it is advisable to select four-wheel drive in order to protect the environment, road



and tyres from damage due to unnecessary spinning and braking. It is even sometimes advisable to travel in low range on these tracks. Low range will enable you to travel up to about 60 km/h, which is quite sufficient for most tracks. Low range will aid getting down steep slopes with engine braking and also delivers higher torque to climb out of steep sections.

Steering Zero and Rutted Tracks

Be aware of the 'steering zero' position when driving in deeply rutted mud tracks or well used sand tracks. While travelling in ruts it can happen that the front wheels are not pointed straight ahead but are instead trying to climb up the side of the ruts. Should you hit a hard patch without ruts and the vehicle suddenly follows the sideward direction of the front wheels this can lead to roll-overs.

The general rule is to follow other tracks in muddy terrain because they would already be compacted by the previous vehicle.

Sandy Terrain Let the vehicle find the sand track and therefore the zero position by holding the steering wheel very lightly at the start of the deep sand tracks. Then you tighten the grip slightly and continuously move the steering wheel in small arcs through the zero point to keep you in the track.



Deep longitudinal gullies The best method when encountering deep longitudinal gullies or ruts is to straddle them. This entails driving with the wheels on either side of the gully.

ON ROAD CONVOY DRIVING

© GR DEMMER



Plan convoy driving in advance by taking the following into consideration:

- The use of a spread out convoy to allow other traffic to pass the convoy safely and quickly is much more practical for public roads.
- Plan the departure and arrival times as far as possible to be during daylight.
- All vehicles to drive with the lights on in the convoy.
- Take short breaks every 1, 5 to 2 hours. Make provision for regular stops with toilet facilities to accommodate people in the convoy.
- Remember that convoy driving takes longer than driving alone, thus plan additional time to cover the same distance.
- Place the slowest vehicle second in the convoy to allow the leader to set the convoy pace accordingly. Also consider the vehicle with the shortest fuel range when planning fuel stops.
- Stops at shopping facilities could prove to be a time consuming exercise if convoy members are not controlled. Stipulate the time allowed for each stop in advance, including lunch stops, and convoy members should adhere to these times. Also alert convoy to vehicle safety procedures, as this is an area where most convoys get targeted, amongst the excitement of the trip.
- The convoy leader must make sure that all convoy members have lined up

in the convoy before heading off. He should start with a slower speed for a short period before speeding up to the agreed convoy speed. He should not exceed this speed.

- Communicate the convoy rules to all members prior to departure.

Convoy members should adhere to the following basic rules while driving in convoy:

- Follow the instructions of the designated convoy leader. Driving in convoy with radio communication between the first and last or even all the vehicles in the convoy does simplify matters significantly.
- Be courteous to other road users and allow at least 100 meter gaps for faster moving traffic to pass. Where possible move to the left of the road to facilitate save overtaking by other traffic. The convoy must move slower than the posted speed limit.
- Do not let the vehicle behind you out of your sight. You are responsible for the vehicle behind you!
- Keep up with the vehicle in front of you. Do not let the gap increase to more than 200 to 300 meters on a paved road unless doing so would be positively dangerous. On gravel roads the gaps are to be increased to ensure save driving out of the dust of the vehicle in front. The lead vehicle will set the pace. Do not abuse the previous rule if the pace is not to your liking. (If the gap gets too large the driver in front will think you have a problem and will slow down, you will slow down and then he will). Maintain a safe following distance.
- If you do have a problem and need to stop, either flash your headlights, hoot or call on the radio to indicate to the vehicle in front of you that you have a



problem. Stop only at a place where it is safe for the convoy to do so. Should the vehicle stop at an unsafe location, the next vehicle should stop to assist and the rest of the convoy should continue driving to the first safe place to stop the convoy. Should you have radio communications, inform the convoy leader immediately of your problem and follow his instructions.

- Do not stop the entire convoy for non-essentials. Adhere to the pre-planned stops and ensure that children use the facilities at the designated stops.
- When encountering a gate the first vehicle opens the gate and the last vehicle closes the gate.
- When encountering a change in direction at a road crossing or a branching of the road or track, each vehicle waits until the following vehicle arrives before continuing to ensure that everybody takes the correct turn-off.
- When encountering an obstacle in convoy, it is very important that a vehicle does not enter the obstacle before the previous vehicle has completed the obstacle and is a safe distance away.
- Leave a safe distance between vehicles when the convoy comes to a halt.
- Driving in convoy on public roads can prove to be exhausting and nerve racking. City traffic, toll-gates, roadblocks, border posts, etc. can disrupt the convoy order and hamper progress. It is thus important to be patient and keep communication. Ensure the last vehicle never passes the second last vehicle!
- Stay in your position in the convoy and do not overtake other convoy members. Decide on convoy positions before departure.
- Obey the rules of the road, Traffic Acts and Regulations at all times.
- Stay alert; check your mirrors constantly for approaching, fast moving traffic and you will not be caught unawares. Indicate your intention to turn



or change lanes well in advance. Overtake slower vehicles only when it is safe and remember, your vehicle's overtaking acceleration capability may be slower under load.

TARGET FIXATION — A BIG ISSUE WHEN DRIVING OFF-ROAD OR ON GRAVEL ROADS

Wikipedia defines the term 'Target Fixation' as: "Target fixation is a process by which the brain is focused so intently on an observed object that awareness of other obstacles or hazards can diminish." Also, in an avoidance scenario, the observer can become so fixated on the target that they will forget to take the necessary action to avoid it, thus colliding with the object.

Our hands are trained from an early age to follow our eyes.



Target fixation is a negative response that can affect many day to day activities including golf, tennis, skiing, mountain bike riding and motorcycling — virtually any activity where the participant is penalised for a target.

Golfers are a good example as they are particularly susceptible to the vagaries of poor concentration and the penalties that arise from target fixation. The golfer stands on the tee, ready to drive the ball deep down the fairway. To the right is a large dam and the golfer knows that if his ball finds its way into to the water he will incur a penalty and may 'lose' the hole.

He becomes so fixated on the negative target and of not driving the ball into the dam, that his concentration on the positive target, the fairway, is virtually nil. The golfer is doomed from the start. His concentration, his target fixation on

the dam and his subconscious all conspire against him and as sure as certain he plonks the ball right in the middle of the water.

Target Fixation And Driving A Car The penalty for target fixation in golf is a lost ball. The penalty for drivers may be buckled vehicles and broken bones.

Many rear end collisions can be attributed to target fixation. The driver's eyes lock onto the red brake lights of the car in front, the driver panics, having never anticipated an escape route and slams into the car in front. Had the driver observed the whole line of forward traffic and anticipated interruptions to the flow then that driver may well have been on the brakes before the car in front.

Whether we drive in tight traffic, on long back roads or over rocky four wheel drive tracks the art of seeking out positive rather than negative targets will make us better drivers.

Reacting Normally Under Stress

Accidents and mishaps occur when we fail to react normally in stressful situations. They arise because we are unprepared for new developments in the driving environment

Highway drivers need to constantly scan the verges and sides of the road. The road is an ever changing scenario and the brain requires constant information updates so it can be prepared for arising developments.

Many people don't look far enough ahead when driving on highways. After the brain has absorbed the facts about the road surface and assimilated any information about potholes etc., it is time to see the bigger picture.

The bigger picture includes the bends and dips of the road all the way to the visual vanishing point. These bends and dips usually correspond to the surrounding countryside which is where most of the danger on African roads arises.

Animals wander on and off the road surface, especially around water. Being aware of this means being prepared.

Big trees on the side of the road or oncoming trucks are just obstacles that require a mental notation. The tree won't move so there is no need to focus on it once it has been locked into the mental picture of the driving environment.

The truck is a moving obstacle that we need to constantly monitor and recheck position, but only in the context of constantly updating our brain to our situation.

We certainly don't want to target fixate on the centre of his grill because that is where we may end up. This is especially important at night when our vision is greatly reduced and a set of headlights become the most available target.

Avoiding target fixation and consequently avoiding accidents is a matter of constant assessment of the driving environment and the constant notation of dangerous elements and the planning of escape routes.

Target Fixation and Four Wheel Driving

When we leave the tar and head out onto the gravel roads, sand tracks and rocky trails of southern Africa, the need to develop this constantly adaptive mental image of our environment is equally important – especially on gravel roads.

Vehicles lose traction and move around on the loose surface offered by gravel. Our need to be aware of our surroundings, the turns and camber (the way the road 'leans'), dips, potholes and washouts is vital.

It is counter-productive to concentrate on the mere 20 metres ahead (target fixation) that the vehicle is about to negotiate. We need to drive to a 'bigger picture' and see the whole road and it's surrounds as the target.

Once this ability is developed the journey becomes smoother and more relaxed. Anticipation and forward planning means we are able to make the necessary judgments to overcome surprises and compromising situations.



Of course this mental imagery happens in mere nano-seconds and is really a subconscious action. The fact that we may be covering ground at 80 kilometres per hour means our environment is in a state of constant change and our perceived route is also fluid and constantly altered.

Driving on difficult, rocky terrain presents much the same scenario. If we focus too much on each individual rock we have to negotiate, we are unable to develop a rhythm for the course and anticipate the best line of travel. We end up bouncing from one rock to the next.

It sounds tiring but in effect it is actually a more relaxing way to travel. Target fixation is stressful and focusses on negative imagery. By developing a keen sense of our route and environment we begin to understand and control it. We can relax our 'white knuckle' grip on the steering wheel, rid ourselves of 'white line fever' (target fixation) and enjoy the ride.



DRIVING PRINCIPLES – OFF-ROAD AND OBSTACLES

4X4 TRACK CLASSIFICATIONS

This issue is something that the four wheel drive fraternity in SA is still battling with. No legislation nor formal accepted guidelines exist, and very little agreement has been reached on how it should be classified and for a novice 4x4 driver (even some experienced drivers), it is not clear. This can be detrimental in some cases.

When looking for a 4x4 outing, it is essential to understand and know what the 4x4 track's classification is and if the vehicle that will be used to do the outing is capable. Not only is it dangerous to tackle a track that is difficult, but it could also be costly should the vehicle used, be damaged.

TRAIL GUIDELINE



Easy

This trail is suitable for 4x2s with diff lock, or novices in 4x4 soft-roaders.



Easy to moderate

Basic 4x4 driving experience principles and a 4x4 is necessary. Low range is recommended.



Moderate

4x4 driving experience and low range is essential.



Difficult

Challenging terrain, suitable for experienced drivers. Low range is essential. Recovery equipment and a diff lock or traction control strongly recommended/essential.



Extreme

This trail is suitable only for off-road experts with serious 4x4s and recovery back-up. It should not be undertaken on your own.

Some track owners will not want to share the fact that their track is difficult as this, in their minds, could scare 'clients' off. However, over the years, a common set of guidelines have unofficially appeared. In South Africa, many 4x4 writers, magazines and other industry specialists have 'classified' tracks and trails unofficially into five categories. Grade one being the easiest and grade five being the most difficult.

In broad terms the grade one track would be open to All Wheel Drive Vehicles with high range 4x4. The driver could be a novice. Ground clearance could be low.

The grade five grading would mean a low range 4x4 would be required, high ground clearance, normally a rear differential (diff) lock and an experienced driver to pilot the vehicle through the track.

The tracks are not all one or the other, so it could be found that sections of the track could be one (1) and change to 3, 4 or 5 as one proceeds. Normally the grade 5 section does have a slipway, an 'escape' route, or whatever the owner wants to call it. Weather and on the ground conditions at any specific point in time can also change the grading of any obstacle at that point in time, e.g. rain on rocks.



For simplicity sake, the Association of All Wheel Drive Clubs of Southern Africa (AAWDC) has adopted the Safari Centre 4x4 Group's standards as published on the internet.

GENERAL PRINCIPLES OF OFF-ROAD DRIVING

So with some idea of track and trail ratings, let's move on to the disciplines of off-road driving and the essential preparation thereof.



There are 4 basic disciplines that every off-road driver should adhere to, from the very beginning. These are:

- Assessing an Obstacle
- Preparing a vehicle externally before driving an obstacle
- Preparing a vehicle internally before driving an obstacle
- Driving the physical obstacle

A fifth dimension of course is failure in the obstacle, and the correct procedures to safely extricate the vehicle from this situation. These will all be dealt with in the following section.

Assessing An Obstacle (Reading The Line)

Although the driving technique required for the different types of obstacles may vary, the assessment of any obstacle remains the same. The following

steps should be followed prior to driving the obstacle:

- Make your vehicle safe, before proceeding to assess the obstacle. In layman's terms this means switch the vehicle off, ensure the hand brake is on, the vehicle is typically in 1st gear, low range, and the keys extracted, especially if there are still passengers in the vehicle.
- Identify the entry and exit points of the obstacle.
- Look for existing tracks between these two points. It is always easier to follow an existing track and it is more eco sensitive.
- Assess the entire obstacle by walking up on the left track and back towards the vehicle on the right wheel's track. Check 'middlemannetjies' where applicable (raised areas between tracks). Notice the differences in obstacle formation from the two different sides.
- Identify all possible problematic areas — holes, ruts, high points, etc. Check for loose rocks and objects that could flip up and damage the sides and underside of your vehicle.
- Determine traction surface quality — poor traction (loose stones, mud or deep sand) or good traction (stable ground).
- Assess the surface as well as the underlying material of the obstacle. Also try to assess the carrying capacity of the terrain by prodding it with a stick (soft mud, hard mud, soft sand etc.).
- Check the clearances on either side of the obstacle and, just as important, the available overhead clearance. Check for protruding objects such as rocks and tree roots that could cause damage to tyres.



- Plan your route or line through the complete obstacle, including the approach and exit sections. It is good practice to start your inspection at the desired exit point and trace back to your current point.
- Plan an escape route in the event of an unsuccessful attempt or failure, i.e. make provision for an alternate plan, Plan B. It is important to assess what will happen if something goes wrong, for example, if the engine dies, or a side shaft breaks, and to plan for such events in advance. Assess what will happen if the vehicle should roll over and how far it may roll.
- If necessary, avoid the obstacle (water and mud may be fun to drive, but may cause longer term damage).
- It is sometimes necessary to build a road by moving rocks, breaking away crests, etc. Assess the impact of your actions on the environment.
- Check the obstacle's required approach, break-over and departure angles. Also assess the side slope angles. Review all other vehicle dimensions for successful transition through obstacle.
- Check for external dangers such as wild animals, children playing, family photographer etc. Feel free to ask locals for advice.
- Finally, decide if a guide or spotter is required to assist a safe passage through the obstacle.

Prepare Vehicle Externally For Specific Obstacle

In order to successfully clear an obstacle, it is important to tackle it in the correct manner with the right tools. It is assumed that your 4x4 is well maintained



and mechanically sound. Your 4x4 vehicle should be prepared for the type of obstacle you will attempt and the following should take place:

- Select the correct tyre pressures most suited to the type of terrain.
- Make sure that the free wheel hubs (if fitted) are locked.
- Check if any load needs redistribution and act accordingly.
- Check dimensions affected (tuck in mirrors, remove bumper, remove tow-ball etc.)
- Make sure that all bystanders/spectators are standing well clear of the obstacle and that you have enough space available to negotiate and clear the obstacle. Also take Plan B into consideration when requesting spectators to move out of the way.
- If guide/spotter action is decided upon, confirm all signals and line to be driven. This is the last possible verbal communication opportunity.

Prepare Vehicle Internally For Specific Obstacle

Safety should be your first priority and the following should always be adhered to:

- Ensure that all loose items in the vehicle are either secured with appropriate tie down straps or placed under the seats. Loose items are very dangerous, as they may become flying objects if the vehicle is brought to sudden halt, or if the vehicle rolls over.
- Close or open windows completely as you could bump your head against a window which is half open. (A window that is opened a few millimetres does not break as easily as a window that is closed tightly.) In the case of water or



river crossings, it is advisable to open the windows completely to allow for a quick escape from a sinking vehicle should things go wrong. Also be aware of thorny branches that could injure your face through an open window. Adjust to three quarter or closed position in this case.

- Ensure you take up the correct seating position. Hands at 10 to 2, able to adjust mirrors within reach or electronically, seat upright, legs bent etc.
- Always wear safety belts (except for water crossings) as this will prevent you from falling out of the vehicle in the case of a vehicle roll over and it will keep you in the seat should the vehicle hit a solid object. Keep hands and other extremities inside the vehicle at all times.
- When negotiating dangerous obstacles, drive alone, let your passengers walk.
- Ensure that you have selected 4-wheel drive by engaging centre diff lock, high or low range.
- Select the most appropriate gear for the specific obstacle.
- When using the centre and axle differential lockers, one should take note that they may not always come into operation immediately, thus reverse and drive forward, before entering the obstacle until the light or other indicator shows that the lockers are properly engaged.
- Engage the centre differential lock – axle diff locks can also be engaged in loose rocky terrain and obstacles where there is a chance of losing traction. Remember that axle diff locks may cause the vehicle to go straight in muddy, very sandy terrain, ice and slippery conditions.





- In the case of an unsuccessful attempt at an obstacle, if there is even a slight chance of the vehicle falling over, immediately secure the vehicle to an anchor point such as another vehicle. The correct recovery methods as described elsewhere in this manual should then be followed to recover the vehicle.

Approach Obstacle

The following steps are applicable to most obstacles that will be encountered in off-road driving:

- Approach an obstacle at the correct angle.
- Select the appropriate line and gear.
- Keep your foot off the clutch pedal; carefully apply the brake and accelerator pedal on approaching the obstacle as required.
- When a navigator/marshal is assisting from outside the vehicle, make sure that you agree on the hand signals when you assess the obstacle and follow his/her directions carefully. Ensure that the agreed signals are distinct and unambiguous. Also make sure that he is aware of the line that you intend to follow.

Speed Through Obstacle

Plan your speed through an obstacle considering the following:

- Use the golden rule of off-road driving: 'as slow as possible and only as fast as necessary'. Rather do it over than over do it.

- Should the traction be good, minimum momentum will be required and 1st gear low range would probably be the correct gear selection.
- Should the traction be poor, momentum will be necessary and 2nd or 3rd gear low range should be considered.



Route Through Obstacle

Plan your route in advance, while assessing the obstacle. The following should be adhered to while driving through the obstacle:

- **SAPFAN** — Slow as Possible — as Fast as Necessary — the **golden rule** for all obstacles!
- Approach the obstacle as intended and where possible, as square as possible.
- Stay with route and lines as decided on when the obstacle was assessed.
- Keep a firm grip on the steering and for safety reasons remember to keep your thumbs on the rim of the steering wheel.
- Try to keep one hand on the same position on the steering wheel in order to know which direction the wheels are pointing at all times.
- Follow the guide/spotter instructions at all times, if one is in place.
- Follow general driving principles: Good traction — 1st gear, Low Range. Poor traction — 2nd or 3rd gear, Low Range.

The following section will now cover the most typical environments faced when driving off road trails or tracks. All of the above principles apply, with each obstacle type introducing specific nuances for the specific types of obstacles experienced.

DESCENTS



Assessing Descents

The following steps should be followed prior to driving the obstacle:

- Firstly assess the slope by walking it; also assess the approach and exit sections.
- Identify all possible problematic areas — holes, ruts, high points, etc. Take note of possible cross-axle areas where loss of traction could cause the wheels to lose traction and the vehicle not to run against engine compression.
- Determine traction capacity of the surface — poor traction due to loose stones, etc. or good traction on stable ground and rock.
- Plan your line through the entire obstacle including the approach and exit sections, considering the following:
 - It is important to find the line with the best traction.
 - Always try to drive directly down the slope.
 - The break-over angle should be considered on entering steep descents, as well as the departure angle when exiting the descent.
- Assess what could go wrong and consider the alternate plans.

Preparing Your Vehicle

Once the assessment of the obstacle has been completed, the following should be done prior to driving down the Descent:

- Adjust the tyre pressure according to the type of terrain and the traction anticipated.

- Line your vehicle up while still on the top of the descent so as to start the descent on the line selected during the assessment phase.
- Engage first gear, low range, and apply the centre differential lock (for permanent 4WDs) — let the engine do the work.
- If cross-axle situations are anticipated, engage the axle differential lockers if your vehicle is equipped with them.
- Adhere to the safety precautions as described above.

Driving Descents

To successfully and safely negotiate and complete the descent, the following aspects should be taken into account:

- Never use the clutch on a normal descent. If you want to stop the vehicle on the descent, use the brake pedal without using the clutch, the vehicle will then stall and the stall-starting procedure should be followed. If the clutch is used on a descent, the vehicle might run away as the engine compression will no longer be able to assist in slowing the vehicle down.
- To slow down a vehicle on a steep descent, use the feather braking technique known as cadence braking — Apply slight braking and releasing pressure on the brake pedal to reduce speed. Do not keep your foot on the brakes as this could cause the wheels to lock and then slide.
- If a vehicle starts to slide, in certain cases the accelerator can be applied gently to regain traction.
- A 4x4 equipped with an automatic gearbox should engage 1st gear in low range and it will be necessary to assist the engine to slow the vehicle down, by pressing the brake pedal slightly.
- Maintaining directional control (rolling steer) is most important above all else. If steering is lost, you may even have to accelerate a little until control is regained. The rear end of the vehicle will tend to 'come around'.
- In some cases it may be necessary to apply the foot brake. Make sure that the brake is applied gently, do not allow the wheels to lock up. Should the vehicle start sliding or skidding, release the brake momentarily and re-apply gently.

On very steep descents with good traction on all wheels the following technique can be used:

- In some cases, such as rock crawling, the 1st gear low range will still be too high or fast to allow proper control down a descent. In such cases only the brake will be used to 'walk' the vehicle down. The vehicle should engage 1st gear low range and the clutch pedal should be pressed in completely. Now using the brake, allow the vehicle to 'inch' forward smoothly in small steps of approximately 100mm at a time, until the bottom of the descent is reached. If the vehicle starts to slide down, release the clutch immediately to allow the engine to assist in slowing the vehicle down and to maintain rolling steer. Do not attempt this technique on slippery surfaces, as it will only work if



sufficient grip between the tyres and the surface is maintained.

Stall-Starting On A Descent

Stall starting a vehicle is a skill that should be mastered by all 4x4 drivers, before any difficult obstacle is attempted. Sometimes, possibly due to too hard braking while driving downhill, especially with inexperienced drivers, the engine may stall. This technique is carried out as follows:



- Do not depress the clutch.
- Ensure that the brake is applied hard and the vehicle does not run forward after stalling.
- Apply hand brake.
- Ascertain the cause of the stall, you may have hit a rock or driven into a rut.
- Give yourself time to regain your composure and think through the procedure.
- Depress the clutch, select the correct gear and make sure it is selected properly.

- Release the clutch slowly and remove your foot from the pedal.
- Confirm that the direction in which the front wheels are pointing is the direction you want to go.
- Release the hand brake slowly and then the foot brake. The vehicle will now be supported under engine compression.
- Start the engine by just flicking the key to the start position.
- The engine will start automatically and the vehicle will move forward, to control the speed, 'feather' your brakes.
- Avoid getting the vehicle sideways at all cost.
- Vehicles equipped with an automatic gearbox will not stall that easily, but it can occur. A different procedure is required for automatic gearbox vehicles.

1.2 ASCENTS

Assessing Ascents

The following steps should be followed prior to driving an ascent obstacle:

- Assess the ascent by walking it; also assess the approach and exit sections.
- Identify all possible problem areas — holes, ruts, high points, etc. Take note of possible cross-axle areas where loss of traction could result in wheel spin and cause the vehicle to stop moving forward.
- Determine the traction capacity of the surface — poor traction due to loose stones, etc. — or good traction on stable ground and rock.
- Plan your line through the entire obstacle including the approach and exit.
- It is important to find the line with the best traction.
- Select a line that is as straight up the slope as possible.
- Always try and drive directly (At 90°) up the slope.
- The approach angle should be considered for entering the ascent as well as the break-over angle on exiting steep ascents.
- Plan a course of action should the first ascent fail.
- Consider what will happen if the attempt fails, where will the vehicle go? Can it be turned around? Where are the recovery points to assist in a recovery?

Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be done before driving up the obstacle:

- Depending on the type of vehicle, load, obstacle and traction available — selection of the correct gear, low or high range, centre diff lock, axle diff locks and amount of momentum required.
- Line your vehicle up while still at the bottom in order to start the ascent along the line selected during the assessment phase.
- If cross-axle situations are anticipated, engage the axle differential lockers if your vehicle is equipped with them.
- Adhere to the safety precautions as described in the safety section.

Driving Ascents

To successfully and safely negotiate and complete the ascent, the following aspects should be taken into account:

- Follow the plan and lines decided on in the assessment phase.
- Build momentum on good traction areas before arriving at the bad areas with no or little traction with some momentum in reserve. Try to maintain steady speed.
- Should the vehicle's nose start sliding sideways and quick counter steering does not correct the situation, stop immediately. Follow the stall-starting procedure to abort and return to the bottom of the ascent or secure the vehicle and winch it up.
- Wheel spin is the first sign of loss of traction. If more power is applied it will result in further loss of traction. It is thus better to ease off the power to allow the wheels to regain traction.
- When the vehicle has lost traction and stopped moving forward, apply the brakes immediately without depressing the clutch. Follow the stall-starting procedure and take control of the vehicle as soon as possible, in a safe manner.
- After an unsuccessful ascent attempt, take some time to consider what went wrong. If necessary, get out of your vehicle and re-assess the obstacle. Take note of the line that you have just tried, and consider alternative lines.
- It is important to realise that different vehicles have different capabilities and that not all vehicles have the ability to climb extremely difficult ascents. It is thus wise to rather find a route around certain obstacles rather than causing damage to your vehicle that may require expensive repairs as a result of driving it beyond its' capabilities.



Stall-Starting On An Ascent

A driver should master the technique of stall-starting a vehicle on an ascent before a difficult obstacle is attempted. This is done as follows:

- Do **not** panic!
- Simply allow the engine to stall or force a stall by applying the brakes, but do not depress the clutch.
- Apply the brakes (the brakes may be applied and held before the stall occurs). When the vehicle is at a complete standstill, apply the hand brake as well.
- Once the vehicle has come to a complete halt, with the engine no longer running, give yourself time to regain your composure. You will probably tremble the first few times that you are in this position, especially on the more challenging ascents.
- Select reverse (while holding the brake, use the clutch to engage reverse, and then release the clutch) and make sure reverse is properly engaged. (A common mistake is that reverse is not engaged properly and the vehicle starts rolling as the vehicle is in neutral.)
- Verify the direction in which the front wheels are pointing and realign them with your planned route backwards.
- If a person is not available to guide you down, make use of the rear view mirrors to view the road behind or, alternatively, look over your left shoulder — **do not put your head out of the window.**
- Once ready, release the handbrake and then the foot brake slowly. The engine compression will in most cases hold the vehicle.
- Some vehicles will automatically start to roll backwards or even start. If this is not the case, while in reverse gear and without brakes, start the engine by just flicking the key.
- With one hand on the steering wheel at the 12h00 position drive the vehicle down the hill without applying brakes. (It should not be necessary to steer at all as you ascended in a straight line, drive down in a straight line.)
- Avoid getting the vehicle sideways at all costs.
- Once you are down, try again, with more momentum or a different line.

1.3 CAMBERS/SIDE SLOPES

Assessing Camber or Side Slopes

The following steps should be followed prior to driving the obstacle:

- Walk through the entire obstacle. Inspect the terrain. Look for slippery spots. The rule should be 'can this be avoided'.
- Asses the terrain below the obstacle in case you need to abort the obstacle.
- Check the track both on the upper and lower side. If there is a hole on the downside, the angle of the slope will be increased. If there is an extra obstacle, for example a rock, on the upper side the angle will also increase.
- A person's common sense will normally tell him/her that the vehicle is about

to fall over sideways long before the vehicle will really tilt over.

- The manufacturer's side slope specifications are based on a standard vehicle with no load and should only be used as an indication. Side slope ability is negatively affected by suspension-lift kits, additional weight of accessories fitted on the top half of the vehicle such as roof racks, roof top tents, tyre pressures, etc. The side slope ability is improved by fitting wheels with a wider wheel track, and increasing tyre pressures of 'downhill' side tyres.
- Take note of the Centre of Gravity and Roll-over Angle previously covered.



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Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be completed prior to driving the obstacle:

- Make sure that the vehicle is correctly packed and can cope with the angle. Remove heavy items from the roof rack and place them on the floor of the vehicle or as low as possible, or even remove them from the vehicle completely.
- Make sure the load is evenly distributed and secured. A load that slides from the topside to the bottom may cause your vehicle to roll over.
- Let passengers sit on the upper side to help with balancing if possible.

Driving the Side Slope

To successfully and safely negotiate and complete the obstacle, the following aspects should be taken into account:

- Follow the safety procedures previously explained.
- Select first gear low range and engage centre differential lock. Use the engine to control the speed and not the brake or clutch.
- Maintain a steady and even slow speed throughout the obstacle and do not change gears unnecessarily.
- To follow the desired path, a degree of steering wheel turn in the uphill direction may be required.
- If possible, anchor the vehicle to prevent a roll-over.
- Should the vehicle slide, turn into the slide and accelerate.
- Follow the appropriate recovery procedures as explained elsewhere in this manual in case of emergency.

1.4 ROCKS AND ROUGH TERRAIN

Assessing Rocky and Rough Terrain

The following steps should be followed prior to driving the obstacle:

- Walk the obstacle and inspect the route.
- Remember that the higher points of the trail can sometimes work to your advantage — these can be used to increase ground clearance by driving with the tyres over them, not around them.
- Pay attention to high points that exceed your vehicle's ground clearance.
- Look for loose rocks and objects that might turn over and damage your vehicle when you drive over them.
- Assess the height of high points you intend driving over to ensure clearance for the running boards and undercarriage.

Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be completed prior to driving the obstacle:

- Know where the vulnerable low points and lowest ground clearance areas of your vehicle are before driving over rocky terrain.
- Driving in rough terrain will bounce the occupants around and it can prove to be difficult to drive smoothly. If your vehicle is fitted with a hand throttle, it should definitely be used for this obstacle.

Driving Rocky and Rough Terrain

To successfully and safely negotiate and complete the obstacle, the following aspects should be taken into account:

- Select 1st gear low range.
- Take it very slowly, at idle speed. You may consider feathering the brakes to slow the vehicle further.
- Keep a firm grip on steering wheel.
- Have someone you trust guide you through to avoid damaging the chassis on

rocks or getting stuck on them.

- Confirm hand signals with your guide before starting.
- When driving over uneven terrain, it is uncomfortable for you and the passengers. It is definitely also demanding on your vehicle and it is recommended that you slow down to a crawl speed.



1.5 CROSSING WATER

Assessing Water Crossings

The following steps should be followed prior to driving the water obstacle:

- Fast running water usually has a clear surface and relatively firm base. Slow moving water usually has a muddy base.
- Never wade unless you have absolutely no other choice! Water can be ‘sucked’ into engine air intakes, differentials and gearboxes and can cause damage. Check water depth in correlation to the vehicle’s wading depth specifications.
- Always walk the water crossing. Walk on the left track and back on the vehicle right hand side track. Feel for holes and rocks. Feel for the ‘middlemannetje’.
- Be aware of surroundings and potentially dangerous/wild animals.
- If the water is flowing too strongly to walk through – it’s flowing too strongly to drive through! If flowing water cannot flow through beneath vehicle, do not drive through.
- Mark the holes or rocks with sticks; you can even use passengers to do this if

it is safe to do so.

- Check the slope of the entry and exit points remembering that the vehicle will wet the exit, reducing traction. This is important with convoys.
- Select a point on the other side of the river in line with the preferred route as a target to drive towards.



- Check the height of the water, is it rising or falling? Water in a river may rise quickly after flash storms.
- Ask local inhabitants about the condition of the crossing. Check it though — it remains your responsibility.

Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be done prior to driving the obstacle:

- Know the safe wading depth of your vehicle and that it is properly prepared for the crossing.
- Know where the air intake of your vehicle is. Allowing water to be sucked into the air intake could result in expensive damage.
- Check the height of fuel filler caps, they must be secure and above the water level, especially when water could build up against the side of the vehicle.
- If your vehicle is fitted with a bell-housing and/or timing housing wading plug, make sure it is securely fitted.
- Protect the radiator and engine by fitting a wading sheet. This will reduce water entering the engine compartment while the vehicle is moving. A bin bag and duct tape can suffice in an emergency.
- You can waterproof petrol engines by adding silicone under the distributor

- cap or spraying a water displacement fluid on wiring and connectors.
- If your vehicle does not have a fan de-coupling system or viscous coupling, remove or slacken the fan belt to ensure that it slips when submerged. A jacket or towel can be used to temporarily jam a viscous coupling fan, preventing the fan from damaging the radiator and/or spraying water over the top of the engine.
- If the terrain under the water is soft or sandy, reduce tyre pressures. Use the same pressures as recommended for mud or sand (see tyre chapter).
- Have recovery equipment ready and pull straps should be attached to the vehicle before entering the water.

Driving Water Crossings

To successfully and safely negotiate and complete the obstacle, the following aspects should be taken into account:

- First or second gear – low range, lock the centre differential and engage axle diff locks. Select the gear decided on during the assessment phase and try not to use the clutch while in the water.
- Entering water – water must not go over the bonnet.
- If the vehicle stalls in water and there is even the slightest chance that water may be sucked into the air intake – do not attempt to restart it.
- If the exhaust will be submerged significantly, make sure that the engine is kept running. If it should stall, restart the engine as soon as possible.
- Avoid wheel spin when driving through water – tyres are more susceptible to damage from cuts when wet.



- Do not use your safety belt during wading.
- The general rule is to keep windows open.
- While crossing the river, drive towards the target point selected in the assessment phase.
- Always stay/drive behind the natural bow wave formed.



What do you do when the vehicle gets stuck?

- If possible, engage reverse and go back along your own tracks, in the process compressing the surface. Move back only a meter or two. Then try again with a bit more momentum. Never spin the wheels!
- Before using your winch, let the passengers just give a little push. This is normally all that is needed.
- If for some reason your vehicle starts to float, do not panic, simply open the doors to fill the vehicle and re-gain traction. It is easier to dry the carpets than to collect your vehicle downstream. Note that some vehicles have electronics situated under the front seats, water damage here could cause severe problems. Rather ensure your assessment is correct the first time.

What to do when you leave the water

- Remove obstacles in front of the radiator and under the bonnet. Refit any belts removed or re-tighten.
- Check lights etc. for water ingress.
- Check for debris under vehicle.
- Apply foot brakes gently while driving slowly to dry and clean them.
- Remove the wading plugs if fitted.

If you drive through water often

- Check differential and gearbox oil for water on a regular basis. Oil mixed with water will become thick and grey in colour.
- Re-grease the vehicle regularly.
- Check electrical connections. You may notice a white residue on copper/brass parts, which must be removed. Refit with a spray of water displacement fluid to prevent re-occurrence.

1.6 MUD

Assessing Mud Obstacles

The following steps should be followed prior to driving mud obstacles:

- Inspect the obstacle and the type of mud. Try to avoid mud as far as possible.
- In some instances mud might have a hard coarse surface, but as soon as the surface is broken thick, deep mud may be underneath.
- Soft mud must be inspected and usually has a hard bottom underneath the muddy surface.
- Always try to stay in the tracks of the vehicle in front as this vehicle may already have compacted the mud.
- Usually when faced with the situation where there is mud and water on the track, the side with the water could be a better option, as the surface there is often too hard to absorb the water.

Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be completed prior to driving the obstacle:

- Mud usually has a firm base underneath. The trick is to let the tyres 'cut' through the mud to get traction on the base underneath. Narrower tyres and high tyre pressures will normally be better than wide tyres that are deflated. If the mud consists of a crust and 'bottomless' mud underneath, flotation is important – tyre pressures should be lowered to reduce contact pressure.
- Select the correct gear for the mud, usually 2nd gear low-range with centre diff locks engaged – be aware that the use of an axle diff lock will cause the vehicle to be unresponsive to steering inputs on slippery surfaces.
- If there is a chance that you might not complete the obstacle, secure the tow-rope to the vehicle in advance, as this could save you from digging in the mud to attach the tow-rope after you get stuck.

Driving in Mud

To successfully and safely negotiate and complete the obstacle, the following aspects should be taken into account:

- In most cases, driving technique through mud requires momentum. While the speed should be high enough to maintain momentum, safety should be of



equal value, as excessive speed could result in a vehicle going out of control and sliding in the mud at will, or even rolling over.

- High speed driving through mud that has not been checked by walking the obstacle could result in the vehicle hitting a hole or rock, causing serious damage and even injuries.
- Do not hold the steering too tightly – feel the feedback from the tyres on the steering wheel and move with it rather than fight it. The idea here is to allow the vehicle to follow the path of least resistance in cases where direction of travel is not of crucial importance.
- Do not spin the wheels excessively, but a degree of wheel spin may have the desired result. Mud tyres require a quick wheel spin to throw the mud out of the grooves.
- Wheel spin indicates a of loss of traction. Ease off the power to allow the tyres to regain traction.
- To improve traction, swing steering wheel very gently left to right and back to use grip from tyre edges. This technique is more effective in combination with aggressive tyre patterns. Remember that turning the wheels could increase the amount of resistance to the point where momentum is lost.
- If you are stuck, reverse until a pull away is assured and try again.
- ‘Rocking’ the vehicle may also help.
- If the vehicle is stuck and rocking the vehicle using alternately forward and reverse gear does not show any signs of moving the vehicle, stop and initiate the recovery process. Any further attempts will merely dig the vehicle in deeper and will thus make the recovery more difficult.



- Use a kinetic-rope (snatch) or winch for recovery. See the correct recovery procedures in the Recovery Chapter for kinetic-rope (snatch) usage.
- Mud is able to penetrate oil seals, brake drums, differentials, etc. and should be removed as soon as possible. Some types of mud can also have a high salt and acid content, which could cause rust and leave marks on the paint of the vehicle. Your 4x4 should be cleaned and serviced as soon as possible after driving in the mud.

Tip: A fresh coat of good quality automotive polish and even ‘Spray-and-Cook’ applied to painted areas around the worst affected areas, prior to the vehicle driving in mud will aid the cleaning process.

1.7 SAND DRIVING

Assessing Sand Obstacles

The following points should be considered prior to driving sand obstacles:

- To ensure minimum environmental impact, stay on the existing sand tracks as far as possible.
- Do not drive over vegetation in sand, as this will cause ecological damage.
- Assess the type of sand that you will be driving on. Different sand types will require different driving and preparation skills.
- Driving on sand at midday is more difficult than in the morning or late afternoon as the heat dries the sand causing it to displace easily.
- Damp sand will compact better than dry sand and will thus be easier to drive



on. However, wet patches in dry sand may be an indication of trouble as they may be caused by water just under the surface.

- Patches of quicksand are found in wet sand.
- Inspect as much of the area as possible and look for the hard and soft patches.
- Driving uphill will prove much more difficult than driving downhill on the same type of sand and will require momentum.
- Fine sand found on pans and salt flats could hide soft, deep mud. The rule here is to stay on existing tracks as they have been compacted by the vehicles that have used them before. If you have to stop without using the brakes, roll



to a stop on the track. Frequently check the surface around the wheels for signs of the surface breaking up due to the weight of the vehicle.

Preparing your Vehicle

Once the assessment of the obstacle has been completed, the following should be completed prior to driving the obstacle:

- Sand driving requires good flotation and lowering tyre pressure increases the tyre footprint, improving flotation and reducing rolling resistance. Adjust tyre pressure according to the type of sand.

Tyre pressure:

- Rolling resistance in sand is the factor that has the biggest influence on stopping the vehicle. Wider tyres can give an advantage in sand. They have lower rolling resistance as they 'float' on top of the surface.
- Deflate tyres ($\pm 50\%$ of normal operating pressure; not less than 0,8kpa in extreme circumstances). Extreme deflation may de-bead a tyre, especially when moving from a soft surface to a hard surface or when wheel spin occurs.

- Choose correct gear before entering thick sand (3rd low range/1st high).

Driving in Sand

To successfully and safely negotiate and complete the obstacle, the following aspects should be taken into account:

- Try to stay in the existing tracks or the tracks of the lead vehicle, as the sand will be more compacted in these areas. Making new tracks may increase the environmental damage in sensitive areas.
- Thick sand requires momentum to allow tyres to float on top of the sand. Always keep moving.
- If you need to stop in sand, don't use your brakes — roll to a halt. Applying brakes will cause a wall of sand to build up in front of the wheels which will make restarting in the sand difficult. Applying brakes may also dig the vehicle into the sand resulting in a much faster stop than anticipated.
- After stopping reverse approximately two to three meters. Reverse until the front wheels cross the ridge made by the rear wheels — as this will allow you to pull away on the tracks that you have just compacted. Stop on a downhill facing as close to 90° down as possible.
- Use a higher gear, 2nd or 3rd low-range, to pull away. It will still provide enough torque but lessen the chance of spinning the wheels.
- If stopped or stuck in soft sand, reverse on own track until a firm surface is found and try again.



- Know where the front wheels are pointing and keep them in the direction of travel. Periodically check that the front wheels are not turned in, particularly when driving in deep existing tracks, as the vehicle may suddenly climb out of the tracks at a time when it is least expected.
- Do not speed in existing tracks as a loaded vehicle may unexpectedly start swinging and roll over before you can take preventative action.
- Don't fight the steering. Let the vehicle guide the steering, especially when there are existing tracks.
- If the vehicle gets stuck, do not allow the tyres to dig into the sand as it makes recovery more difficult. Place ladders, branches, carpets, etc. under the wheels for more traction. Clear away the sand in front of the tyres to form a gentle slope out of the hole.
- Try to glide on the sand, do not plough through it!
- Once in existing tracks it will be difficult to escape from them. The following driving technique will work best when attempting to escape from the tracks:
 - Reduce your speed;
 - Ensure that the front wheels are pointing straight ahead;
 - Turn the steering wheel gently in the desired direction of travel; Do not over-steer if the vehicle does not want to leave the tracks immediately. Gently jerk the steering to the opposite direction and then back to the original direction. Slight over steer could be necessary. If not successful the first time, try again, possibly using a bit more momentum;
 - Alternatively, turn the steering wheel in the desired direction and decrease power for an instant allowing the vehicles weight to press the front tyres into the sand, making the steering more effective.
 - If still not successful, apply both of the above techniques simultaneously;
 - Correct the steering immediately to straight ahead when leaving the tracks to prevent a potential roll over;
 - Be careful not to over-steer and do not speed when applying these techniques.

1.8 BEACH DRIVING

The South African Environmental Act prohibits driving on South African beaches. It is only allowed under certain circumstances as specified by the Act. However, driving on beaches is still allowed in certain areas in other countries in Africa and is thus dealt with in this manual.

The following should be considered prior to driving on beaches:

- Familiarise yourself with the law pertaining to the area you are travelling in.
- Take note of the driving on sand techniques previously covered.
- Always consider anglers, children, other persons and wildlife on the beach. Drive at responsible speeds.
- Use demarcated entry and exit points only.
- Drive only below the high tide and above the low tide watermarks. Do not

drive three hours before or after high tide. Know the tide actions by obtaining a tide timetable.

- Sea sand consisting of broken seashells can be very difficult to drive on and should be avoided if possible. Avoid beach areas covered with pebbles or shells. They can be treacherous.
- Do not drive on beach or dune vegetation
- Do not drive on the beach at night.
- Do not drive on the dunes.
- Do not drive in demarcated 'no go' zones.
- Avoid wet patches and seawater at all times as it causes corrosion.



- Do not drive between stationary vehicles and the sea; bathers, fisherman and especially children are bound to cross this space without looking.
- Pay attention to sand that could break away causing side slopes that could result in roll-overs.
- Do not turn quickly as this could also result in roll-overs.
- Get a permit, if required.
- Wash your vehicle's undercarriage to remove corrosive salts after driving on the beach.

Preparing your vehicle for beach driving is the same as for sand driving as described above.

1.9 DRIVING ON DUNES

Dunes are encountered in sandy areas. All the assessment, vehicle preparation and driving techniques for sand as describe above should be taken into account when driving dunes. The additional factors as described below should also be taken into account.

Assessing Dune Obstacles

The following points should be considered prior to driving dunes:

- See sand driving above.
- Always walk the dune. The wind can change the dune's shape in a few hours. There may be a new, vertical cliff on the other side.
- Obey signs demarcating 'no-go' zones.

Driving Dunes

To successfully and safely drive dunes, the following aspects should be taken into account:

- Always ascend or descend in a perpendicular line (Straight up or straight down).
- Wind dunes are created by the wind moving loose sand and consist of deep sand. Traction is almost non-existent on a dune. A mix of momentum and flotation allow the vehicle to drive to the top of the dune.



- Build up speed on the run-up to the dune and drive to the top in 2nd or 3rd gear, then release power as you reach the crest of the dune. Speeding over the top will send the vehicle flying over the crest while with too little momentum the vehicle will stop just short of the crest.
- Follow the stall start technique for ascents to safely reverse down the dune after an unsuccessful or aborted attempt. Avoid sliding down the dune by gently accelerating while reversing down. Do not attempt to turn around at the top of the dune!
- Driving down the dune may require the crest to be dug away. Engage low-range to descend, gently accelerate to avoid sliding down the dune and to maintain steering. Avoid using the brakes.

- The trailing edge of dunes is angled at approximately 43°. Care should be taken not to roll-over head-over-heals. Build just enough momentum on the leading edge to go across the crest (at 90°), then 'ride' the sand on the trailing edge. Use the momentum of the vehicle to accelerate away from the rolling sand near the bottom of the dune.

Note: Dunes and deserts are highly sensitive ecological systems and should be avoided if possible.

1.10 DITCHES AND DONGAS

Driving through Ditches and Dongas

To successfully and safely negotiate ditches and dongas, the following aspects should be taken into account:

- Approach and enter smaller ditches and dongas at an angle so that only one wheel crosses the obstacle at any given time. This will leave the other three wheels on the ground with traction. Use the axle differential locks, if your vehicle is fitted with them.
- Always enter slowly in order to avoid damaging the vehicle.
- Should the vehicle get stuck, try again with a little more momentum.
- For larger ditches and dongas that cannot be crossed one wheel at a time, the right angled approach (90°) should be considered. Approach, break over and departure angles are limiting factors.
- Avoid getting both wheels on one side of the vehicle in deep ruts as recovering a vehicle from this situation could prove difficult.



- Use the driving skills attained as described in descents and ascents and apply them to large dongas.
- Logs, rocks or sand ladders can be used to build a temporary 'track' or bridge over narrow, deep ditches and dongas.

1.11 DRIVING THROUGH GRASSLAND

There are a few aspects to consider when driving through tall grass:

- There may be hidden obstacles such as rocks and ruts that you may encounter.
- Seeds from the grass may block your radiator, adversely affecting cooling — prior to travelling through grass it is advisable to fit a seed net.
- Check around the catalytic converter and prop shaft regularly, grass that catches in those areas can ignite — with disastrous consequences.
- Every vehicle should have a fire extinguisher readily accessible when travelling through stretches of grass.



1.12 DRIVING THROUGH SNOW AND ON ICE

The advantage you will enjoy under these conditions over a passenger car, is the fact that you have double the traction, giving more grip. Braking is similar, except that the vehicle is heavier so stopping distance will be greater. That means that you have to watch your speed.

- Select 1st gear high range.
- Engage centre diff lock if vehicle is a full time 4x4.
- Pull away slowly and brake carefully (cadence fashion) to avoid lock up.
- Be aware of hidden obstacles under snow.
- Avoid creating a wall of snow in front of your vehicle.
- Fit snow chains.
- Ensure that you have recovery equipment, recovery points and a shovel.
- In light snow your tyres will break through the surface and compact it, but be wary of ice underneath.
- If others have driven the route before you, be careful of sticking to their tracks as they may be slippery. Move out of them onto fresh snow.
- Driving in snow off-road is safer as there is more traction, as the surface is not tarred.
- An on foot inspection by your passenger is still needed, probing the snow in much the same way as in water.
- Wheel hub height is a safe depth to tackle.



RECOVERY OF A 4x4



Purpose Of Recovery

The purpose of 4x4 Recovery is firstly to introduce the 4x4 owner to the different types of recovery equipment available, and secondly, how to use the equipment safely in practice.

The main objective of this chapter is to teach the 4x4 owner how to assess a recovery exercise, to confirm an approach, then to decide on the equipment and best technique to use, much like choosing the correct tool from a tool box. The emphasis throughout this chapter is on the 'Safety and the Prevention of Damage', to the vehicle, equipment, environment and any bystanders.

It is important that the 4x4 owner realises his responsibility towards the occupants of his vehicle, as well as to the environment. In so doing uses the equipment and his vehicle in a correct and safe manner.

It is extremely important to appoint only one person to be in charge of a recovery operation. The rest of the group should retreat to a safe position, but should be available to help if needed. The appointed person in charge firstly has to relax and secondly, think the recovery process through, before starting half-cocked.

RECOVERY EQUIPMENT

A wide range of recovery equipment is available on the South African market, which is distributed and fitted by the original manufacturers or at specialised 4x4 centres. It is, therefore, important as well as cost effective in the long term to purchase the correct equipment and to have it fitted by specialised personnel. This will ensure that the equipment is guaranteed and professionally fitted to ensure trouble free service for as long as possible.



Gloves Always use a good pair of leather gloves when winching or doing any recovery. They protect your hands from all dangerous elements. Good gloves are also useful around the camp for a variety of different applications. Ensure that every person assisting with the recovery also wears gloves.



Strong, welded Drag chain A rated, welded steel linked chain between 1-metre and 3-metres with grab hooks on both ends. Can be used on vehicles with no proper tow hooks, and around sharp objects such as rocks for anchor points.



Shackles There are mainly two types of shackles available in the market, namely the Alloy rated Bow Shackle and the D-Shackle. Both types are available in a variety of sizes. All shackles used must be rated with a minimum work load limit (WLL) of 3,25 tons. Avoid the cheaper commercial shackles. A commercial shackle's body and pin are the same diameter.



The large loop on the Bow Shackle is designed to accommodate more than one strap attachment, without crushing or damaging the straps and provide a large radius for angled connections. Straps should be positioned within the bow side of the shackle during operation. The pin on these shackles is noticeably thicker in diameter than the body of the shackle. The ratings will appear in raised letters on the body.

Hand-tighten the pin, then slack off by half a turn to prevent the pin from binding due to the stress generated during the recovery.

Straps and Ropes Should be purchased only if the manufacturers label is stitched to the strap with the following details:

- Manufacturers name
- Type of material
- Pull strength
- Length
- Type of application
- Work load Limit (WLL)
- Date of manufacture
- Minimum breaking strength (MBS)
- Ensure that the strap/rope selected matches your vehicle in terms of mass.



Tree protector As the name explains it is used to protect trees from ring barking when used as an anchor. The strap must be at least 2-metres long and a minimum of 90mm wide. It is a multi-purpose strap and can be used for many applications.



Kinetic Strap or Rope The recovery strap/rope is also called a 'snatch' or 'kinetic' strap/rope, which gives a better understanding of exactly what it is. Kinetic Energy is energy generated by momentum and mass and this energy is transferred through the strap/rope from the towing vehicle, which is moving (momentum and mass), to the vehicle being recovered. As soon as the strap/rope tightens, this energy is transferred through the strap/rope to the recovered vehicle.



Pull-Strap A pull strap, unlike a kinetic strap, cannot generate kinetic energy. The purpose of the pull strap is to pull another vehicle. Make sure that the pull strap is secured to proper recovery points on the vehicle using the correct shackles.



Recovery Bridle This is used when a vehicle has two anchor points to distribute the pulling power evenly on the chassis. It can be used in tow, kinetic pulling or winching exercises. It is important though, to ensure the rating on the bridle is sufficient for the application.



SAFETY EQUIPMENT

Recovery Lanyard The main aim is to increase the safety of kinetic straps/ropes for recovery. The lanyard must be used on both ends of the strap/rope.

In the event of a failure the lanyard will 'choke' the rope or strap used.



Recovery Link If the tow vehicle cannot get close enough to the stuck vehicle, the kinetic strap/rope can be lengthened by joining it to the second strap/rope (only of the same type – rope to rope/strap to strap). Join the two with a Recovery Link (traditionally a strong piece of wood was and can still be used). Place this between the loops as illustrated. This will stop the eyes of the strap/rope from binding under severe tension. **Never** use shackles to join a strap or a rope.



Recovery Blanket Used when winching to dampen cable flail. Can be used with kinetic strap/ropes as well. A proper recovery blanket may be purchased.



The object of the blanket is to dampen cable or ropes when snapping, they will whip through the air if a blanket is not used, and this will prevent injuries. Other items such as straps, jackets and normal blankets can be used as long as they are heavy enough to keep down and contain flailing cables.

NB: This is very important and must always be employed as basic safety.

WINCHING EQUIPMENT FOR RECOVERY

Length of Cable It is handy to have a length of 5 – 20m of certified soft cable. It must be the same dimension as your winch cable, $\pm 10\text{mm}$ with eyes on both ends. Used to lengthen or extend your winch cable. Handy when using the hi-lift jack as a winch (discussed later).



NB: Do not use to tow a vehicle.

Snatch Block The snatch block has two main purposes, firstly to double the pulling power of the winch and secondly to change the direction of the pull.

Under normal circumstances one snatch block will be sufficient but it is handy to have two. Ensure that you have a good quality snatch block and service it frequently.



WINCH

Winches are designed for different applications with varying capabilities, so it is important to get the correct winch and have it fitted to your vehicle by a reputable dealer. If you intend fitting the winch yourself, keep in mind a few thousand kg of pulling power that will be applied to the mounting points and ensure the use of high tensile bolts (grade 12) and the correct mounting plates and brackets suited for the specific vehicle.

Electrical Winches The power supply to this type of winch is from the vehicle's electrical system. In all modern 4x4 vehicles, the electrical system is under great strain due to all electrical power supply being directed from the alternator and the fitted battery. The battery supplies power to the headlights, starter, ignition system, fuel injection system, air-conditioner, ventilation system, instrumentation, wipers and various other systems on the vehicle. It not unusual to fit an additional battery to the vehicle during the installation of an electrical winch, since the power and ability of the winch is dependent on the supply of current to the winch motor. The vehicle's alternator charges both batteries while driving.



Mechanical Winch This type of winch is mechanically driven by the vehicle's engine via the gearbox or crankshaft. For this purpose a 'mechanical drive' (Power take-off) must be fitted with a mechanical drive shaft to the winch. This type of winch is not readily available for the normal recreational types of 4x4 vehicles, but is normally used on bigger vehicles such as the Unimog.

Hydraulic Winch Is driven by the hydraulic system of the vehicle, for example, the power steering system. The hydraulic pressure from the steering system is then supplied via hydraulic pipes to the winch. On vehicles without a power steering system, an additional hydraulic pump can also be fitted.

Manual Winch These types of winches, commonly called 'Tirfors' (available locally as the 'Donsa' winch) have been in use in the mining, agricultural and forestry industries for a number of years.

The Tirfor is a portable winch, supplied with cable that can be used for recovery from any secure recovery point on a vehicle. This type of winch is manually operated via a handle, and can be operated in either direction (to winch 'in' or to winch 'out').

Winching With A High-Lift Jack

If your vehicle is not fitted with an electric winch, another method will be to use your Hi-Lift jack as a winch. This method is very time consuming and requires some effort but is none the less very effective. For the exercise you need a length of chain, shackles and non-stretch ropes. You will only be able to winch in increments. After the jack has reached it's maximum point, anchor the vehicle. Reset the jack to the bottom and repeat the process until the vehicle is recovered. Remember to apply all the safety principles.



THE DIFFERENT RECOVERY PROCESSES

Kinetic Recovery

- After the strap/rope has been attached, lay the strap/rope down in a 'S' shape $\pm \frac{1}{3}$ the length of the strap/ropes length.
- Get bystanders at least twice the length of the strap/rope away from the vehicle.
- Both drivers must wear seat belts and both vehicles their engines running and in gear.
- The recovery unit pulls away rigorously in a straight line away from the casualty vehicle, normally in 2nd gear and in low-range.
- This 'jerk' will release the kinetic energy and should free the casualty vehicle.
- If unsuccessful, the process can only be repeated after the strap/rope has been 'rested' (generally 24-hours) or using a new strap/rope.

- Should the second attempt also fail, re-assess the recovery process, and consider different recovery methods.
- Kinetic straps/ropes have limited life spans depending on the type of materials. If the strap/rope does not return to the manufacturer's specified length, it has lost the kinetic capability and may now only be used as a tow strap.
- Never drive over the strap/rope.
- After the strap/rope has been stretched to its maximum capacity, the strap/rope should be allowed to rest and return to its original state – (generally 24-hours).

Safety of Kinetic Recovery Whilst very effective and quick to use, the kinetic rope/strap can potentially be dangerous.

- **Warning** never use a kinetic rope/strap attached to an ordinary tow ball. These are not designed for vehicle to vehicle recovery and often fail. When they do, the ball acts like a missile hurtling towards the other vehicle.
- Proper recovery points are a non-negotiable pre-requisite – no sharp edges anywhere near the recovery points.
- Keep bystanders away from the recovery operation
- Don't use a kinetic strap/rope as an extension to a winch cable.
- Don't join snatch straps/ropes using shackles. To join them feed the one end through the eye of the other and place a recovery link through the eye.
- The recovery vehicle must be of equal weight or heavier than the casualty vehicle.
- Make sure that the strap/rope will not snag on any obstacle (rocks, trees etc.) at any time during the recovery process.



Hand Signals

Below are the recognised hand signals for Winching as published by WARN.

In some situations, recovery could involve two people. One driving and controlling the winch, while the other provides navigation instructions and ensures the wire rope is winding properly. You and your helper must establish clear and precise hand signals and review so everyone clearly understands. It should also be understood that if the driver controlling the winch cannot see both hands of the assistant, the winch should not be activated. Suggested signals:



DIRECTION OF STEERING

Hold your arms out with thumbs up and tilt your hands in the direction you advise the driver to steer.



POWER IN THE WIRE ROPE

Hold your forefinger in the air above your shoulder height and draw small circles in the air to indicate to wind the winch.



POWER OUT THE WIRE ROPE

Hold your forefinger pointing down and draw circles in the air at about waist height to indicate feeding more wire from the winch.



PULSE WIND THE WIRE ROPE

Tells the driver to wind the winch in short, quick bursts. Open and close the two fingertips until you want the winch to stop.



STOP THE WINCH

Clinch fist, palm to driver, held high enough for driver to see and other arm straight out at shoulder height is the sign to stop the winch.



BRAKING

Cross your palms together to tell the driver to apply the foot brake.



Drive assist

Tells driver to give the tyres more drive force to assist the winching process.

WINCH RECOVERY

Golden Rules Of Winch Recovery

- Always wear thick, protective leather gloves.
- Safety must always be your first priority.
- Plan the recovery to have the least impact on the environment.
- Keep spectators at a safe distance (rule of thumb, twice the length of the played out cable).
- Always use a recovery blanket or similar item as a damper over the cable. As a rule of thumb one recovery blanket per 5 metres of cable, when winching in, watch the blankets to ensure that they do not foul in the fair-lead rollers.
- Do not step over the cable once it is attached as it is now considered live.
- The last step before winching commences is to plug in the winch control.
- Take up cable slack, assess equipment, anchor points, safety and then continue.
- Do not leave the winch control plugged in if not attended.
- Keep winching equipment in good condition through regular maintenance.
- If more than one person is involved in the recovery, it is very important to appoint one person to take charge of the winching process, giving loud, clear and understandable instructions, either verbally or via hand signals, as this will eliminate confusion.
- Remember, the less cable on the winch drum, the greater the pulling power but never leave less than 6 turns of cable on the drum.



- Never lead the cable around an object and back onto it as this will cause cable damage.
- It is impossible to wind the cable neatly when under extreme tension so after the exercise and in a safe place, the cable can be unwound and rewound back neatly (light tension is an aid in this case. Use a cable guide when reloading the winch cable onto the drum).
- Try to avoid winching at an angle as this will create drag and damage to the cable and fair-lead rollers. Get the vehicle in-line or use a snatch block to get the correct angle.
- Always have the winching vehicle's engine running at least at 1 500 rpm to keep the battery charged. The winch draws at least 100 amps under load.
- Ensure your vehicle has a good battery and high amperage alternator.
- While winching, keep both hands at least a meter away from the fair-lead rollers.
- Do not slide the cable through your hands; use the hand-over-hand method.
- Don't let cables twist over each other.
- Do not use the winch as a tow rope.
- Avoid 'jerky' actions as this could damage the winch gears.
- When your winch cable gets damaged, replace it to avoid accidents.
- Keep your equipment on one central spot like the car mat or canvas sheet.
- If possible, use a snatch block to double the pulling capacity as this puts less strain on the winch motor. It will reduce the line speed.

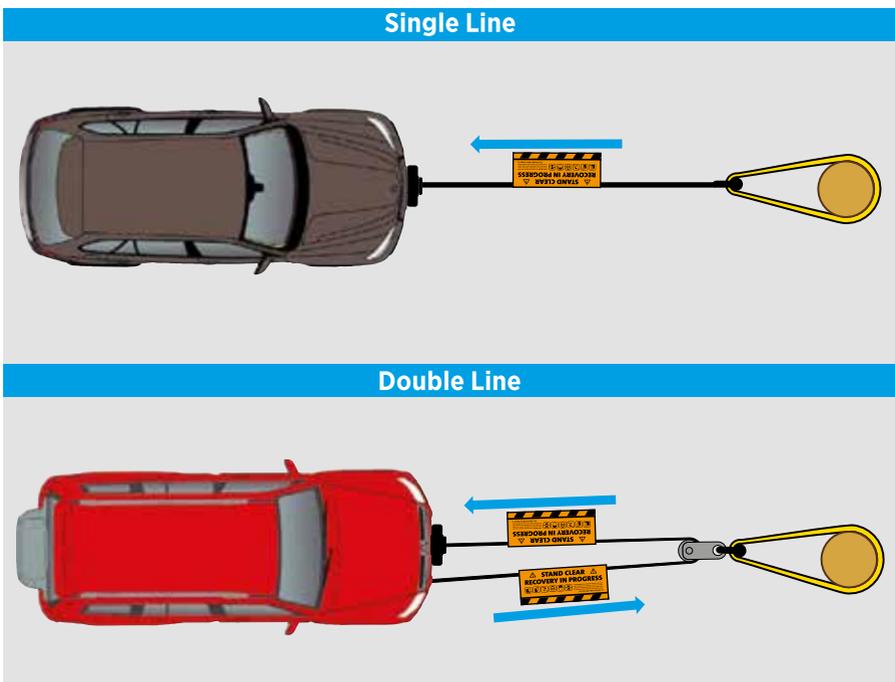
Capacity Winch capacity must be selected according to the weight and requirements of the vehicle and application.



- Assess the situation (surroundings and environment).
- Plan your recovery – recovery line and anchor points.
- Execute the plan using all available recovery equipment.
- Ensure that all the **golden rules** are adhered to.
- The stuck vehicle may gently assist the winching vehicle if the driver is experienced, jerking movements are counter productive.
- If windings becomes messy/spooled to one side:
 - Stop
 - Secure vehicle
 - Unwind and rewind neatly
 - Then continue winching
 - Never drive over the cable
 - Steer the casualty vehicle to ensure even alignment of the cable on the winch

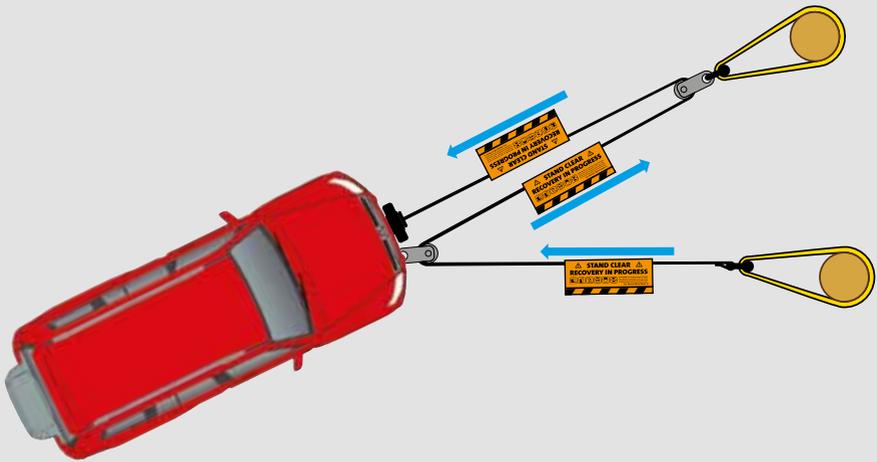
Self Recovery With A Winch And Snatch Block

In the case of self-recovery (using your own winch to recover your vehicle), a snatch block can be fixed at the anchor point (tree, rock, etc.). This will result in doubling or tripling the pulling power, with slower line speed. Always keep the cables parallel to obtain maximum pulling power.

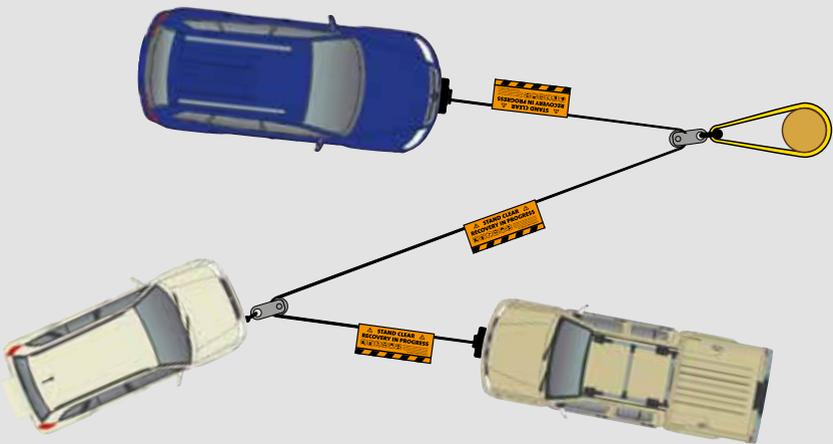


Recovery Of Casualty Vehicle

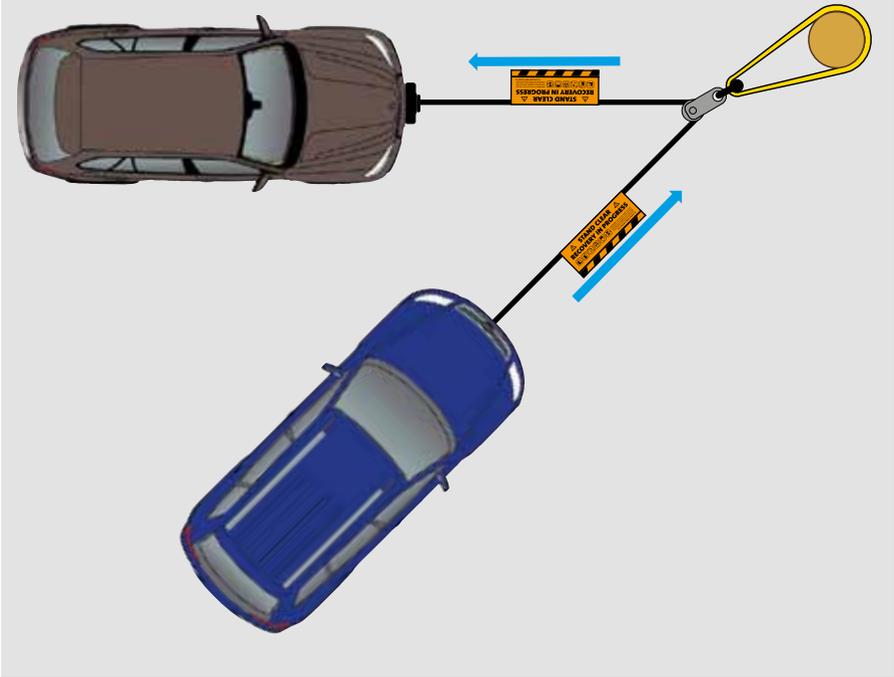
Triple Line



Triple Lining Using Other Vehicles



Winching At An Angle



Winching Over An Obstacle

It is critical to ensure that rocks and hard ridges do not damage the cable; a stout branch under the cable generally does the trick.



Hi-Lift Jacks

This is a versatile part of your recovery arsenal and much cheaper than a winch. There are many cheap imitations available on the market but should you be serious about safety, you will choose the 'Hi-lift' trade mark (made in USA). With this product your safety is guaranteed and backup service and spares are available.



Different lengths of shafts are available. Choose one suitable for your application. The jack is very rugged and can withstand most of the abuse thrown at it. The one very important aspect of jack maintenance is to keep the moving parts well lubricated and dust free, especially the two pins. This will ensure you get many years of service from it. Purchase a jack bag to keep it clean and operational.

Always mount your jack in an easily accessible place. To ensure that a jack can be used on your vehicle, 'jacking points' must be fitted. Without proper points, the jack could be dangerous and ineffective.

There are many accessories available for the jack.

General rules for usage:

- Always wear your leather gloves
- Replace the main shaft should it become bent.
- When the jack is used frequently, turn the main shaft around so that the pins move from the opposing side.
- Follow the operating instructions.
- Always remember the safety aspect. This is a simple piece of equipment but can be very dangerous if handled incorrectly. Keep your face clear of the handle.
- Always hold the jack arm firmly when jacking up or lowering. When jack is unattended, keep the arm in the upright position.
- Never work under a vehicle that is supported by a jack only, as it is dangerous.
- If using the jack on soft surfaces, use a base plate to increase the footprint.



Air Jack The air jack is a large PVC bag that is placed under the vehicle and then filled with exhaust gas to lift the vehicle. It is able to lift around 4-tons. Air jacks are extremely useful but care must be taken for safe operation. The jack can easily be punctured by protruding and sharp objects. To prevent this, rubber car mats or protective gear must be placed over the top of the jack.

The jack must be kept clear of the exhaust and soft and flexible items like side steps and fuel tanks that could not bear the weight of the vehicle. Inflate the jack until the vehicle starts lifting then stop and check if all is in order before you proceed to inflate to the required height, or the jack has reached full potential. Tracks can now be filled with rocks, branches, etc. To deflate, turn the bayonet attachment to release air slowly or remove completely for fast deflation. Take care when the jack is inflated as the vehicle will be unstable.

When inflated, the vehicle may be pushed to the side to get it out of the tracks. Take care to avoid objects that may damage the jack. The nozzle and bayonet fitting must be kept clean to ensure proper operation. Always deflate the air jack completely before you pack it back into the vehicle as there may still be toxic exhaust gas in the bag. Keep safety in mind.

Spade and Shovels Spades are a standard piece of equipment and size vary depending on the requirements of the owner and vehicle. Normally used for recovery, digging cat latrines or moving hot coals.



Sand Ladders and Bog Mats Ladders are a traction aid, generally a rigid or semi rigid platform used under the front or rear wheels when a vehicle is stuck. The solid steel sand ladders are still used, but are also available in a lighter material such as aluminium and more recently woven rubber or plastic. They are sold in pairs and are generally one or two meters long. The flexible sand ladders are in many ways more effective than the solid ladders. They are light weight and can be conveniently packed. Solid ladders can be used to build a short bridge but they are bulky to transport.

Tip Attach lengths of brightly coloured rope or webbing to the ladders, to make their location visible after they have been buried in sand or mud, to facilitate easy retrieval of the ladders.

Water Displacement Fluid There are many brands of this product available and the main purpose is water displacement and lubrication. On petrol engines where water can disrupt engine performance, the fluid should be sprayed on electrical components to displace water and maintain current prior to wading. Should this not have been done, it will be part of the recovery procedure to get a stalled vehicle restarted. It is an ideal lubricant for Hi-Lift jacks, any moving parts or as a rust preventative. It is a must for any 4x4 vehicle, it is cheap and very user friendly.



CARING FOR RECOVERY EQUIPMENT

Maintenance and Care of Recovery Straps and Ropes

- Any strap/rope requires good maintenance. Avoid dirt getting trapped inside the fibres, as this will cause minute fibre abrasions during operation, shortening the lifespan of the strap/rope. Protect your straps from direct sunlight over long periods by storing them in a bag designed for this purpose.
- Straps/ropes can be washed with mild detergents. Drying should take place in the shade. All straps/ropes should be inspected and not used if damaged.

Maintenance and Care of a Winch

- Modern winches are sealed and require the minimum maintenance on the winch itself. The following items need to be checked and repaired if necessary:
- Winch cable must be inspected for any broken strands, kinks or wear.
- Winch electrical cables must be inspected and all contact bolts must be tightened.
- Winch mounting bolts must be inspected and tightened.
- Fair-lead rollers must be inspected for excessive wear.
- Battery condition must be checked, preferably with a load tester to ensure it's effectiveness.
- Battery connectors must be cleaned and re-tightened.
- After every recovery the winch cable must be cleaned with fresh water and rewound neatly under tension.
- Winch control unit must be cleaned and tested.
- Engage/Disengage lever must be checked to ensure effective free spooling.
- The winch should be serviced and repaired by an accredited service centre.
- The bonnets of both vehicles should be open to protect drivers in the case of a failure, observers should be a safe distance away, the engine of the recovering vehicle should be running so as to provide power to the brakes and winch. After protracted periods if the winch heats up the process should be stopped to allow the motor to cool down.



ACCESSORIES FOR YOUR 4x4

When deciding to do any after-market fitments to a vehicle, care must be taken that manufacturer's warranties do not become void in the process. Enquiries must be directed to appropriate manufacturer to determine if said accessories are approved by the manufacturer.

Bull Bars (Bumper Replacements)

Most vehicles can be fitted with bull bars, nudge bars or replacement bumpers (front or rear), which increase the approach or departure angle of the vehicle. These bars also protect the vehicle in minor frontal impact collisions. Therefore it is important that you purchase a replacement bumper that is:

- Air bag compatible
- Compatible with crumple zones
- Correctly deforms on impact



It is also a good idea to purchase such a replacement bumper (front or rear), that has integrated recovery points as well as high lift jacking points as part of the construction.

After-Market Jacking Points

Fitting after-market jacking points is critical if you wish to use recovery equipment such as a Hi-Lift Jack.

After-Market Recovery Points

Fitting after-market recovery points is key if your vehicle is not fitted with appropriate recovery points in its standard configuration.



After-Market Suspension

Fitting an after-market suspension to a 4-WD vehicle increases its performance in off-road situations. In most instances these items provide for a firmer ride. You get extra body lift and better compression/rebound strokes and improved articulation on your wheels by fitting a new suspension. Off-road shock absorbers, coils, extra blades or a replacement set of leaf springs will affect total off-road dynamics, load carrying capacity and handling characteristics under load.

Lights

Apart from the vehicle's OEM lights, a range of lights can be fitted. They include:

- Driving lights
- Spot lights
- Fog lights
- Extra braking lights
- Extra reversing lights
- Floodlights
- Internal (fluorescent) tubes and LED strips
- Yellow 'Dust' Light at rear (standard fog light)

Always buy good quality waterproof lights as they are less prone to bulb failure. Try not to position spotlights in front of the radiator, as they will reduce airflow through the radiator and consequently cooling ability. Positioning of lights on top of the roof is illegal in South Africa.

Spotlights may also not be positioned above the centre line of the main beam unless the vehicle has been homologated with roof lights.

A floodlight can be useful for various tasks after sunset. Extra lights will place greater demand on your electrical system. Fit a relay in line to take care of the extra electrical load. It is a good idea to fit covers over the light lenses to prevent damage from flying stones and branches.

South African law states that no spotlight may be placed higher than one metre (normally bonnet height) on a vehicle, and also that there is a maximum of three lights per side, i.e. six lights, on the vehicle. This thus limits most vehicles with the integrated lights (two per side), to one additional spotlight.

Spotlights must also be connected to the High Beam switch of the vehicle.

Roof Rack A fully laden roof rack will negatively impact on the centre of gravity and can cause a roll-over. Do not stack heavy items on the roof rack. Rather put them inside the vehicle as low down as possible. Remember that a roof rack does not increase the permitted axle and Gross Vehicle Mass (GVM).

Be careful not to overload the vehicle on either axle. (Consult manufacturer's specifications) The structure of the roof of a vehicle is not designed to take



excessive loads, make sure the roof rack is mounted at strong points on the vehicle, so as not to overload the roof structure.

A roof rack also creates wind resistance, which affects the performance, fuel consumption and handling of the vehicle.

Running Boards Running boards are fitted mainly for cosmetic reasons. They may impair off-road ability. Replacements for running boards are known as Rock Sliders, which are manufactured per individual vehicle, they are designed to protect the vehicle from side sill damage, and increase ramp over angle.

Branch Deflectors These can be fitted easily if a roof rack is fitted. They consist of steel cables that run down from the top of the roof on both front sides of the vehicle to the front tips of the bonnet. They prevent branches from damaging your windscreen. Keep the windows rolled up to above eye level, as deflected branches will be released from the deflectors with some force.

Snorkels Snorkels are designed to allow the engine of the vehicle to breathe the clean, cool air in dusty conditions. Although this raised air intake could provide advantages in wading situations it should not be deemed to be its main function.

Dual Battery System Unless you are an electrical specialist, have your vehicle's 2nd or 3rd battery installed by a reputable company. Make sure you spend your money on good equipment. If you have a winch, the system should offer the ability to connect the batteries in parallel during winching, to offer the best possible power source for the winch. This will maximise the life of both the winch and batteries.

- Do not — Connect the batteries with under-rated electrical wire as the regulator will not charge the second battery to full capacity.
- To connect the second battery, use proper 10mm diameter battery cable.
- Use a custom designed split-charging unit.

GPS For navigational purposes, a paper map may be the purchase of a GPS unit. More detailed on this topic can be accessed under the Navigation section of this manual.

TOOLS AND EMERGENCY REPAIR KIT

Essential equipment for any vehicle is a fire extinguisher, first aid kit and a tow rope. Then you can add in tools and spares dependent on your destination.

- Spade
- Fire extinguisher
- Torch or other light with its own batteries

- Basic tool set
- Spares (fan belt, fuses, water repellent, jumper cables, etc.)
- Drinking water. The quantity will depend on where you plan to go
- Functional full size spare wheel, peripheral equipment and repair kit
- Good quality tyre pump and pressure gauge
- Keys (extra set)
- Pocket knife
- Triangles
- Axe
- First Aid Kit

Fire Extinguishers A fire extinguisher should always be within arm's reach of the driver. It is recommended that extinguishers be serviced every six months. A minimum fire extinguisher of 2,5kg is recommended, but a >4 kg extinguisher with a nozzle, is more suited. Most people find the size a limitation factor for storage though. However, it holds a better capacity for the unknown incident. See the section on Fire Fighting.

Trailers and Caravans When choosing a trailer, make sure the track width is the same as your vehicle. Good trailers have shock absorbers. Many manufactures do not include this in the design, but this is essential.

The trailer must comply with the Gross Combined Mass of the vehicle when it is loaded.

A packed trailer that exceeds 750kg (when packed) must have an over-run brake system. A swivel head attachment is also recommended. A trailer must be packed with even more care than your vehicle, as it will take more strain and be shaken about more than your vehicle.

A good practice is to have the rims and tyres on the trailer interchangeable with the towing vehicle. In this way you can reduce the number of spare wheels to be carried.

Fit stone guards to your vehicle to protect both the vehicle and trailer. Stones can hit the trailer and then bounce back onto your vehicle.

When towing, adjust your speed and turning circle to accommodate the trailer. Remember that the trailer never follows the exact tracks of the towing vehicle. Make sure the planned route can be managed with a trailer, before departing.

Do not overload the trailer. The suspension of trailers does not handle weight that easily. It's important to keep this in mind while adding those last few

luxuries such as the garden furniture and whatever might be needed.

Plan ahead; make sure of your line through an obstacle before entering it. It is very difficult to reverse with a loaded vehicle and trailer in an obstacle.

Remember — your trailer also has an approach and departure angle to be considered and there is a second break over angle between the vehicle and trailer.

Warning: In thick sand and mud a trailer becomes an anchor. Many off-roaders have experienced difficulty in crossing such areas. In some cases trailers have been abandoned as the owners found it impossible to get through, or even had the suspension ripped from the chassis of the trailer. In such terrain it is best to carry everything in or on the vehicle.

First Aid Kit

It is always advisable to carry a basic first aid kit in any motor vehicle. For the 4x4 adventurer it could mean saving a life when venturing off-road. It is important that one purchases a kit in line with your own usage requirements, and that one is well versed in the use of the contents therein. Note that it is not permissible for unqualified people to dispense medication in any form.



OFF-ROAD COMMUNICATION

Off Road Radios

Both VHF FM and 29MHz AM radios are available for the 4x4 fraternity to make use of. Check what your fellow club members are using as this will help you decide what type of radio you will need to buy to communicate with members and friends.

29MHz radios are relatively cheap, safe, reliable, and a number of clubs and groups still choose to use 29MHz sets over the newer high powered VHF sets. The number of suppliers of these sets has declined in recent years, but they are still available. 29MHz sets are also less of a problem in our neighbouring countries as they are usually defined as CB radios and are easier to get licenses for and use as a visitor.

VHF radios do have benefits including higher transmission power and good immunity to atmospheric and man made electrical noise, but their installation and setup is a bit more complicated and needs to be done correctly to ensure safe operation. VHF radios are also more expensive than 29MHz sets.

Antennas

When buying an antenna for your vehicle it is important to purchase one that is specifically designed to operate on the frequency of operation that you intend to use. The type of antenna and the mounting configuration need to be considered at the time of purchase.

Stick to reputable brand names when it comes to antennas and you will not have a problem finding a suitable one for your application.

For best results and effective transmission and reception, an antenna needs to be mounted as high up on the vehicle as possible. However, this is somewhat of a contradiction for us off-road types as it is also vulnerable to damage in the bush. As a result mounting location is usually a compromise between performance and practicality.

As commercial antennas are all made for a range of operating frequencies, any antenna needs to be trimmed and tuned for the required operating frequencies as part of its initial installation.

Radio Installation

There are some basic principles that need to be adhered to when installing a two way radio inside a vehicle.

The mounting location must be safe and away from the driver's area of movement during normal driving operations and not interfere with any of the driver controls. It must not interfere with the deployment of any air bags within the vehicle and it must be secure to prevent the radio from flying around in the vehicle during off-road driving or in the case of an accident.

Finally, the power supply leads need to be connected directly to the vehicle battery and secured safely to ensure safe, sufficient, and reliable electrical power to the radio. These leads must be fused for safety as well.

Radio Operations

The radio frequencies we use are allocated to us on a shared basis with other users around the country. We do not have exclusive use of these frequencies and it is perfectly normal to find other users on all our allocated frequencies. This statement is valid for both 29 MHz and VHF operations.

As these are shared frequencies we need to uphold a high level of correct voice procedure and professionalism when using our radios. Good voice procedure ensures efficient use of the frequency or channel in getting your message across. It also ensures that the communication takes place in an orderly, respectful, and professional way. Good voice procedures also allow others to know who is on the channel.

Voice procedures include all of the following points:

- Use your call sign on a regular basis to allow yourself to be identified.
- Wait and listen first before you talk, only one person can talk at a time, unlike a telephone or cellphone.



- Speak in a slow and clear voice across the microphone face and not directly into it.
- Do not hold the microphone too close to your mouth; this will cause distortion in the transmitted audio.
- Keep your transmission short and to the point.
- From time to time pause before replying in a conversation to give others the opportunity to join the conversation.
- No foul, derogatory, blasphemous, or insulting language is allowed to be used on the air. No prejudice on the ground of race, religion, sexual orientation, political affiliations, or cultural grouping is allowed during radio transmissions.

FREQUENCIES AND CHANNELS

AM (29 MHz):

Three legal channels have been allocated to the 4x4 industry in the 29 MHz band, and all licensed radio transmitters must operate on these frequencies, unless another channel is legally licensed to the owner, e.g. a Marine channel.

These channels are:

Channel 14	29.8725 MHz
Channel 15	29.8850 MHz
Channel 16	29.8975 MHz

VHF FM

Our VHF frequencies are all in the high band VHF section of the spectrum (approx. 146 MHz-174 MHz).

We have been granted three distinct frequencies to be utilized by licensed radio users. These frequencies are issued as standard with CTCSS tones on each frequency to help protect the channel from outside interference. Two of the frequencies are in close proximity to each other in the 160+ range, and these are the adopted communication channels to be used. The third frequency is in the low 150+ range, and is being reserved for emergency and logistical usage at organised events, and is not used as a common communication channel.

A new revised programming configuration for radios that will result in a new set of predefined channel numbers has been rolled out to all users in the recreational 4x4 fraternity. This new configuration includes CTCSS tones on all the channels to allow reduced levels of interference and irritation from outsiders.

It is important to note that the use of these CTCSS tones is purely a 'comfort and convenience' feature. It does not offer confidential or private radio channels.

Anyone listening in on a radio with no tones set up will hear everything being broadcast by everybody on that channel.

So, be careful what you say, and follow proper voice procedures!

Administration And Legal

The management of radio transceivers in the organized South African 4x4 Club fraternity is currently managed by the Off-Road Radio Association (ORRA), an independent management body under the auspices of the Association of All Wheel Drive Clubs of South Africa (AAWDC).

Only paid up club members, whose clubs are also paid up members of the AAWDC, may apply for 29 MHz and VHF Radio Licenses usage rights, through ORRA. This is not a public facility.

Together with a selection of ORRA approved suppliers and installers who have agreed to our code of conduct and legal requirements, ORRA manages and co-ordinates this activity for the membership at large on behalf of the Independent Communications Authority of South Africa (ICASA).

Due to the legal requirements of radio transmitter ownership as laid down by ICASA, there are very specific procedures to be followed before a radio can be purchased for use, and also before a radio can be sold or disposed of.

These procedures are explained in detail in the ORRA brochure as well as on the ORRA website. The procedures need to be followed to ensure correct and legal ownership and use of your radio equipment.

Currently licenses are renewed in March each year.

Other

Further details and additional technical information is available from:
Off Road Radio Association Administrator

Tel 012 379 1715
Fax 012 329 4296
Email orra@aawdc.org.za
www.orra.co.za



OFF-ROAD NAVIGATION

Introduction

Navigation is the art of monitoring and controlling movement from one place to another in unfamiliar or unknown terrain. The word navigation comes from the Latin, NAVIS or boat and AGIRE, guide. Generally, meaning the art of steering a boat from one point (on the earth) to another. A GPS does comply with all the above points in the definition

The elements of navigation are:

- Distance
- Direction
- Time

A GPS can be used to determine all of the above. (Distance travelled and time span/distance to one's destination.

The basics of navigation are:

- Know where you are
- Know where you are going
- Know where you have come from
- Keep orientated (always be aware of your surroundings) and
- have a alternative plan (a backup)

A GPS does comply with all the points above.

What is a GPS?

The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides a reliable location (generally three to



five metres) and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. (Wikipedia Free Encyclopaedia)

The concepts and principles of navigation (position, distance, direction and time) remain whether at sea, in the air, or on land.

Does The GPS Replace A Map?

Traditional navigation before GPS was with a map and a compass. The map gives a picture of the terrain and infrastructure, creating an idea of what to expect, while the compass gives direction. The map being the main role player during navigation, as one could do without a compass if necessary. In an emergency, one could apply nature's navigation aids such as the stars, the sun, moss or lichen, trees, insects, birds etc. to find direction if you had to and knew what to look for. However, these other navigation aids are not always available in the dark of night, during bad weather conditions or in a desert.

A GPS or navigation device does the above. It uses technology that can fail. The most common being that the batteries go flat or the device is dropped and breaks. It can also become temperamental, as do most modern computer technologies. If we allow a GPS to be our only navigation tool, we would be forgetting the basics of navigation and become lazy.

What Is Off-Road Navigation?

Navigation is the art of monitoring and controlling movement from one place to another on unfamiliar or unknown terrain.

What Is A Map?

A map is a graphic representation or partial graphic representation of the natural and man-made features on the earth's surface, to scale and according to a projection.

What Is GPS?

GPS is a radio navigation system that allows one to navigate on land, at sea or in the air, knowing ones location, 24-hours a day, in all weather conditions, anywhere in the world.

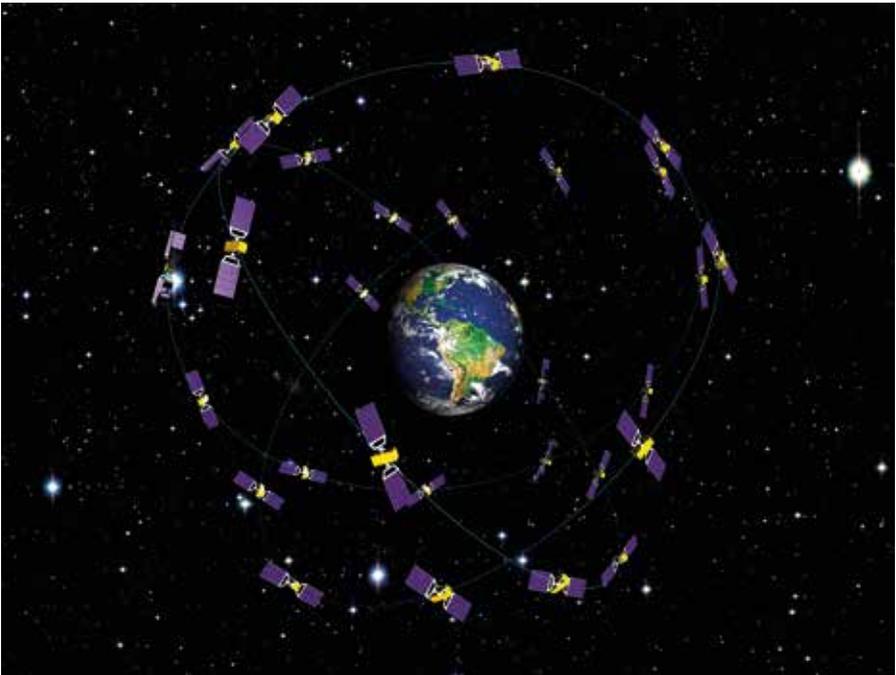
Therefore it can be said that Satellite Navigation is the subject and a GPS and map the navigation tools. These tools complement each other to give a navigation solution in today's modern world.

How satellite navigation works

The Navigation Satellite with Timing and Ranging Global Positioning System

(NAVSTARGPS or commonly known as GPS) (an American military system) is a satellite navigation network of satellites in outer space, orbiting above the earth at approximately 20 000km, transmitting radio signals. Generally one will receive, at any given time, not less than five (and generally eight) satellites in Southern Africa. The number of signals could, however, vary according to location of the receiver where a masking effect could block the signal path.

Each satellite transmits data to earth that enables the GPS unit to determine it's position accurately. The data that is transmitted is based on time and triangulation of these radio signals. The signal transmitted by the satellites is a very low power radio signal allowing coverage of nearly half of the earth simultaneously. There are as many as 30 operational satellites at any one time.



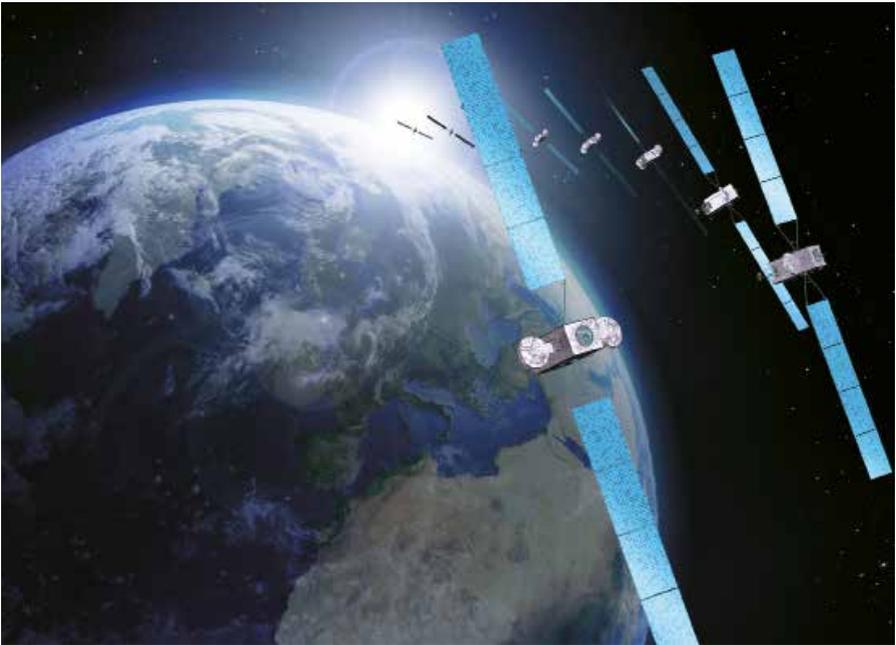
As of 2011 the Russian GLONASS system is also now operational, with Galileo (the European Union system) and COMPASS (the Chinese system) in the developmental stages. Therefore, referring to a satellite navigation system as a GPS is technically incorrect, as GPS is the American system.

How to select a device for your needs

How would I go about selecting a new satellite navigation device? What would you want to achieve with the device and what would you want to get out of

the device? Below are a few categories to assist in selecting the correct device for your application:

- What do I need?
- What do I want?
- Features that are 'nice to have'
- Features not needed
- Features I don't want
- How much usage will be Off-road
- Affordability



What I need: Features essential for successful navigation

- A satellite navigation device that will give a position (latitude, longitude, height above sea level and time).
- A navigation device that will allow one to navigate in the bush, on the open roads and in the cities (Street Navigation) from point A to point B without getting lost, knowing where you are at all stages of my trip.
- Needs to be able to take way-points, 'Favourites' preselected points (coordinates) that you have chosen and loaded into your device.
- And most important 'up-to-date maps' for the area you would be travelling in (in the city or remote areas) quantity/coverage area, is not always quality mapping).
- A Track Log, also known as a breadcrumb, to see where you have come from

and the history of the trip with the date time and speed recording.

- The device screen needs to have a high definition screen, broad viewing angle and be readable outdoors.

What I want: Features helpful when navigating

- A device with voice guidance navigation.
- The biggest screen possible.
- A satellite configuration screen (so that you can see what satellites you are receiving signal from and the quality of that signal).
- Have the capability of configuring the device to your requirement according to your activity (profile) and changing the navigation information on the different screens.
- The navigation device should have a compass to show the bearing to your destination.
- The map screen needs to have the option to be set North Up like a paper map or Track Up orientated for the direction that you are travelling in.
- The device needs to have a good battery life.
- The internal memory of the device must be of such that you can load your required mapping, a minimum of at least 1 GB is adequate at present for Africa (but this could change shortly). An additional expandable memory by means of a SD or micro SD is important.



Features in the nice to have category

- Speed limit of the road that you are travelling on at that particular time.
- For street navigation, Lane Assist showing you in which lane you should be travelling in.
- Map life upgrades are a nice feature.
- Live traffic reporting and traffic congestion.
- The speed camera alerts.
- A new feature of some devices is that of a landscape or portrait screen orientation.
- Junction view: a realistic graphic representation of the intersection of major traffic intersections is really nice.
- A feature on the outdoor devices that can add value to your navigation experience is the Sunrise and Sunset time. In addition some devices give the



phases of the moon daily.

- The elevation plot is nice to have.
- Some of the newer Street navigators allow for a Google selection of different places like an airport where you can check on flight delays etc.

Features that are not needed

- The Bluetooth feature on a GPS may be needed for city navigation but not in the field.
- Voice recognition is not always necessary especially in the field.

Unnecessary Features

- To be able to change and add extra voices for voice navigation.
- A Picture viewer, storing jpeg images (photos).
- Customisable icons.

Remember that the most expensive unit may not meet your needs.

The success of any satellite navigation device is not so much the device itself but the maps. Most street navigators come standard with mapping preloaded but the outdoor devices you have a selection to choose from. Do not always listen to the salesman but rather speak to your friends or well known outdoor enthusiasts about the best mapping for your applications and the area into which you will venture and they will be able to advise you.

Today most satellite navigation devices are purchased ready to use. However they could be set for other parts of the world and therefore it is essential to pre-check their settings before heading off into the unknown. The most important are:

Display set the screen back-light intensity, to that which best suits you. Some devices allow you to also set the back-screen display colour.

Map this is one of the most important settings in a satellite navigation device, to have the maps displayed according to your requirement. This is where you would select the setting North Up or Track Up, the configuration of your map screen display with the necessary information according to your preference. Which map set you would want displayed depends on your application/adventure, text size, zoom levels etc.

Routing street navigation/shortest or fastest. Normally choose 'fastest' in South Africa to avoid the back roads and 'off road' (as the crow flies), for the bush if there is no intelligent mapping of the area (rout-able maps). Please note that the 'off road' setting is not necessarily dirt roads or 4x4 tracks.

Units this would be the units of measurement, kilometres or millibars for the barometer if the device has such a capability etc.

Time ensure that is set for your part of the world and not in a different time zone.

Position Format these settings could be the most important settings on your satellite navigation device and where things could go wrong.

The first setting would be your datum (in broad terms the theoretical centre of the earth). Before 1999, in South Africa, we used the Cape datum based on a point near Port Elizabeth, but as of January 1999 the new datum in South Africa (and the International standard) is WGS84. The difference between these two datum formats in Pretoria is approximately 300m. If you are supplying co-ordinates, include the datum format to prevent any errors.

The second setting under this heading would be your Position Format (which co-ordinate system would you like to use). Below are some of the formats used in Southern Africa. The accuracy difference between the different formats is between 2 and 3m which are within the accuracy tolerance of the navigation devices.

- Hddd mm ss.s The old school format and navigation standard (degrees minutes and seconds).
- Hddd mm.mmm The newer thinking and is easier for some people (degrees, minutes and decimals of minutes).
- Hddd.ddddd The preferred format of some GIS systems (degrees and decimals of degrees).
- SA Grid (Gauss or the LO co-ordinate system) Not recommended for navigation. Be warned.

- UTM The new military format but also the format used in our neighbouring countries.
- MGRS The old 6 figure co-ordinate format used by the military.

Which one? Your choice! Whichever you find best suited for you navigation experience.

Calibrate the magnetic compass. If you have this feature (not necessary for the digital compass based on your positioning) this needs to be done every time you change the devices batteries.

The positioning of your satellite navigation device will have a direct influence on the quality of satellite signal received by the device and therefore the ideal situation would be in the middle of your dash board, as low as possible. In the middle of the dash to discourage 'smash and grabs' and also to be out of the way of your vehicles air bags (so that the GPS device does not become an uncontrolled missile during an accident. Be careful – some vehicles do have tinted windows with a metal content that does not allow radio signal to penetrate the window and therefore the devices will not get good signal (not giving you accurate positioning to navigate).

FIRE FIGHTING

All fires can be very dangerous and life threatening. Your safety should always be your primary concern when attempting to fight a fire. Any sort of fire will produce some amount of carbon monoxide, the most deadly gas produced by a fire.

Materials like wool, silk, nylon and some plastics can produce other highly toxic gases such as carbon dioxide, hydrogen cyanide, or hydrogen chloride. Beware — all of these can be fatal.

Smoke inhalation or exposure to fire itself can be life threatening so get educated about the basics in Fire Fighting, CPR and burn treatment.

Classes of Fire

- Class A** Involves wood, cloth, paper, rubber, plastic and other ordinary combustibles
- Class B** Involves flammable liquids, such as petrol/diesel, oil, thinners, paint and oil/petroleum based products
- Class C** Involves energised electrical equipment, such as wiring, fuse boxes, circuit breakers, appliances and distribution boxes/panels
- Class D** Involves combustible materials such as magnesium, potassium and sodium, which burn at high temperatures. Their combustion is self-sustaining as they evolve oxygen. There is no designator for Class D extinguishers as they are in a specialist category.
- Class E** Involves flammable gasses such as methane, propane and natural gas
- Class F** Involves commercial cooking oils.

Fires most likely to be encountered fall into classes A, B, AC, BC, or ABC, of which the last three represent combinations

Before deciding to fight a fire, be certain that:

- The fire is small and not spreading. (A fire can double in size within two or three minutes.)
- That you have the proper fire extinguisher for the type of fire.
- The fire won't block your exit if you cannot control it. A good way to ensure this is to keep the exit to your rear.
- That you know how your fire extinguisher works.
- Inspect extinguishers once a month for dents, leaks or other signs of damage.
- Ensure the pressure is at the recommended level — on extinguishers equipped with a gauge, the needle should be in the green zone — not too high and not too low.

- That you service it annually.
- That you know how to use your fire extinguisher (see PASS below).

If a fire occurs, you certainly do not have the time to read your instruction manual. You need to ensure that you already know how to use your extinguisher. Although there are many different types of fire extinguishers, all of them operate in a similar manner.

Never fight a fire if:

- The fire is spreading rapidly. Only use a fire extinguisher when the fire is in its early stages.
- If the fire is already spreading quickly, evacuate and call for assistance and the fire department.
- You don't know what is burning. Unless you know what is burning, you won't know what type of fire extinguisher to use. Even if you have an ABC extinguisher, there could be something that could explode or produce highly toxic vapours.
- You don't have the proper fire extinguisher. The wrong type of extinguisher can be dangerous or life threatening.
- There is too much smoke or you are at risk of inhaling smoke. Seven out of ten fire-related deaths occur from breathing poisonous gases produced by the fire.

Vehicle Fires

- Most vehicle fires are caused by electrical faults or fuel leaks on to heated exhaust systems. Grass can also be set alight due to the intense heat of a catalytic converter when a vehicle is stationary.
- Vehicle fires can be extinguished by means of an extinguisher in the early stages.
- Once extinguished the battery should be disconnected immediately.
- If unable to extinguish evacuate the area to at least 15 meters as rupturing fuel tanks will intensify the fire.
- Ensure that all electrical installations and accessories in vehicles are properly insulated and fused.

Fuel Storage

- Store fuels in suitable, approved containers.
- Keep away from open fires.
- Do not overfill containers.
- Decant fuel in a safe well vented area.
- Be cautious when opening containers that have been standing in the sun.

'Jerry Cans' are colour coded and must only be utilised as such:

- Red for Petrol (or Green/Black).
- Yellow for Diesel.
- Blue for Water.

Bush Fires Bush fires occur mostly in dry bush areas in winter and are responsible for widespread damage and deaths if not contained quickly. Bush fires can be a threat to campers and hikers. The smoke can be dangerous when driving as it limits vision.

Camp site selection and making of cooking fires are criteria to be considered when camping out.

LPG (Liquefied Petroleum Gas) Gas is used extensively in the outdoor environment and is safe and efficient. All gas equipment must be checked before each excursion and repaired immediately if found to be defective.

- Use in well ventilated areas.
- Do not leave unattended when in use.
- Most gas fires can be extinguished by closing-off the cylinder.
- If the valve cannot be shut-off evacuate the area to at least 50 meters.
- Flame impingement of the cylinder is the greatest risk.

Fire Blankets Fire blankets are made of asbestos free woven fibreglass material able to withstand temperatures of up to 550°C. Draped over a fire such as a pot of burning cooking oil these blankets smother the fire by starving the fire of oxygen. They may be used to wrap around a person whose clothes are on fire. Fire blankets are far more effective than a wet towel or blanket.

Types of Extinguishers

- Dry Chemical powder – DCP
- Carbon Dioxide – CO₂
- Foam, Water and specialist extinguishers

PASS Pull — Aim — Squeeze — Sweep

Use this acronym as a quick reference (it is a good idea to print this reference on a sticker and attach it to your fire extinguisher):

- **Pull** the Pin at the top of the extinguisher. The pin releases a locking mechanism and will allow you to discharge the extinguisher.
- **Aim** at the base of the fire, not the flames. This is important – in order to put out the fire.
- **Squeeze** the lever slowly. This will release the extinguishing agent in the extinguisher. If the handle is released, the discharge will stop.

- **Sweep** from side to side. Using a gentle sweeping motion, move the fire extinguisher nozzle back and forth until the fire is completely out.

Operate the extinguisher from a safe distance, and then move towards the fire once it starts to diminish.

Be sure to read the instructions on your fire extinguisher — different fire extinguishers recommend operating them from different distances.

Remember: Aim at the base of the fire, not at the flames!

BASIC FIRST AID

DUTY OF CARE AND THE LAW

Disclaimer: because of the generalisations made in this section, it should be taken only as guidance. For further information, consult the necessary legislative authorities, or a legal expert in South Africa.

One of the most common questions asked by trainees on First Aid courses are: ‘Will I get sued if I give first aid to a person, and something goes wrong?’

This is a reasonable question given the increasingly litigious world we find ourselves in today. South Africa is certainly following suit. The following section provides some of the important factors that must be considered to protect both yourself and the person in need. It is HIGHLY RECOMMENDED that all 4x4 enthusiasts attend a Unit Standard based Level 1 or Level 2 First Aid Course, as a rule.

TERMINOLOGY

Duty of Care is a legal obligation set on an individual requiring that they conform to a standard of reasonable care while performing any acts that could foreseeably harm others. It is the first element that must be established to proceed with an action in negligence.

Reasonable care – or the actions of a reasonable person – is a legal basis of Common Law representing an objective standard against which any individual’s conduct can be measured. It is used to determine if a breach of the standard of care has occurred, provided a duty of care can be proven.

What is important to remember is that one’s actions would be judged against those of a reasonable person of the same standing in a similar situation; the actions of a First Aider would therefore only be judged against those of someone of similar training and experience, not against the actions or decisions of a paramedic or doctor.

Negligence exists when a person breaches their duty of care owed to another through an act or omission which results in an injury or a loss. This is not the same as carelessness, because someone might be exercising as much care as they are capable of, yet still fall below the level of competence expected of them.

Common Law also known as case law or precedent, is law developed through previous cases by judges and through decisions of courts and similar tribunals rather than through legislative statutes.

Statutory Law Statute law is written law set down by a legislature, as opposed to Common Law.

Duty of Care and the First Aider For a First Aider nominated in the workplace the situation may be different from those who are simply bystanders as it could be argued that they have assumed a heightened duty of care. Under the Health and Safety Act, an employer is under a statutory duty to provide first-aiders in the workplace for the benefit of their employees. These first-aiders must undergo training to an approved standard in a specified list of competencies. As such, an individual who takes on this role as part of his job description could be argued to owe a duty of care to his fellow employees to render first aid.

However, a person, whether a healthcare professional or a member of the public, who witnesses a situation 'in the street' (or in our case, the bush) where life-saving First Aid might be required, is under no obligation to assist, provided the situation was not caused by him.

However, if that person does choose voluntarily to intervene to render assistance they will assume a duty of care towards the individual concerned. By starting treatment you are accepting a responsibility to the care of that person.

Rule 1 – Only treat if you are willing and able to do so.

Can I choose to do nothing?

Whilst there is no law that forces anyone to treat a casualty this does not mean that one can simply leave a casualty who you know is in danger. To do so may make you liable through your omission to act. If you are not happy to provide First Aid treatment in the 'classic' sense there are several things you can and should do including (but not limited to):

- Inform someone else, such as a recognised emergency number, if it is an emergency.
- Make the area around the casualty safe for yourself, others and the casualty.
- Monitor the casualty and/or find out what happened.
- Comfort the casualty.

These are examples of simple but important actions that can be done without 'getting your hands dirty'.

What if I injure the casualty?

A person who administers First Aid will only be liable for damages if negligent intervention directly causes injury which would not otherwise have occurred, or if it exacerbates an injury.

If First Aid is administered inappropriately or negligently and a consequential injury can be proved to have arisen from that procedure, a First Aider may be held liable for substantial damages if the standard of care he employed fell below that which could be expected of him in the given circumstances. This applies whether they are a healthcare professional, a non-professional volunteer first-aider, or simply an unskilled member of the general public.

For example, if a person inappropriately administered chest compressions where a casualty was not in cardiac arrest, which caused damage to the chest wall or underlying organs, they would be causing damage which would not otherwise have been suffered and, given that the casualty was not in need of emergency resuscitation, would by his intervention be leaving them in a worse position.

If Cardio Pulmonary Resuscitation is performed on a casualty in cardiac arrest, it is difficult to see how a person's intervention could leave someone worse off since a victim would, without immediate resuscitation, certainly die.

Furthermore, if an Automated External Defibrillator is being used, it will only permit shock when it detects a shockable rhythm and, since patients in this state are clinically dead, it is unlikely that any intervention with this device could make the situation worse.

Attending an accredited First Aid training course not only provides you with life saving skills but skills, knowledge and understanding of current best practice. A First Aid certificate is not a 'licence to treat' but it demonstrates that the candidate, at the time of the course, was able to perform tasks to a nationally recognised standard. By treating a casualty to these standards you are protecting yourself against a claim of negligence.

To treat a casualty in a way that goes against the training you have received or to treat a casualty using techniques you have not been trained in but have 'seen it on the telly' exposes you to a claim for negligence.

Rule 2 – Only treat in the manner you have been trained.

But what if the casualty does not want to be treated?

This situation is not as strange as it may seem; there are several reasons why a casualty, even with serious injuries may not want you to treat them.

- It may be that they don't want you to treat them, but they might want someone else.
- Is there personal history between you and the casualty?
- Is there a gender issue?

- Is the casualty suffering with a personal or embarrassing issue?
- Is there a lack of trust? Could this be how you presented yourself?
- Is the injury or condition self-inflicted and the casualty is refusing treatment from anyone?

Under UK law any form of physical touch without consent could be interpreted as common assault. (Although is more accurately described as ‘battery’ in England and Wales or ‘wrongful interference with the person’ in Scotland). Practically this is unlikely to lead to a conviction if — for example — a First Aider were to hold the hand of a casualty to reassure them, without first gaining consent. A conviction could be made if the First Aider were to use any form of force against the casualty to administer treatment.

How do I know if they have the mental capacity to make a decision?

The criteria set out by the Act for a casualty to consent/reuse treatment is that they can:

- Understand the information relevant to the decision
- Retain the information long enough to make a decision
- Weigh the information and make a decision
- Communicate the decision

In an emergency situation it could be argued that the First Aider could not be in a position to ascertain this information and make a decision and should therefore not be held liable provided all other actions were in line with those of this article.

What if they are unconscious?

If a casualty is unconscious and therefore unable to consent — or indeed they had refused consent and then became unconscious — you are permitted to undertake treatment that is only required for the purpose of saving life. You are not permitted to undertake non-life threatening treatment, such as treating minor injuries.

Section 5 of the Act applies in connection with the care or treatment of another person. If a casualty is found unconscious — and therefore their mental capacity cannot be assessed nor can the casualty express refusal of treatment — it is suggested that a First Aider who administers life saving actions should not incur any liability in relation to their actions (that he would not have incurred if the casualty had capacity to consent and had consented to treatment) providing that:

- 1 Before performing a procedure the First Aider takes reasonable steps to establish whether the casualty lacks capacity in relation to the matter in question and

- 2 When performing the act reasonably believes that the casualty lacks capacity in relation to the matter and
- 3 That it will be in the casualty's best interests for the act to be performed

The best interest of the casualty is usually doing as little as you need to, rather than as much as you can. This is true whether the casualty accepts or refuses your treatment.

Rule 3 — Act in the best interest of the casualty.

Can someone refuse treatment on behalf of someone else?

No one can refuse Life-Saving treatment on behalf of a capable adult or child over 16.

What is a 'Living Will'?

A Living Will or, more accurately, an Advanced Decision allows a person over 18 years to refuse specified medical treatment for a time in the future when they might not have the mental capacity to consent or refuse to that treatment.

Advanced Notices are commonly used where a patient with a known or predicted medical condition sets out their wishes — while they have the capacity to do so — regarding future treatment. Typically this may be that an patient with a degenerative health problem may request that should they suffer a cardiac arrest, they are not resuscitated.



- For a patient to refuse life sustaining treatment, the Advance Notice must be:
- Be in writing (it can be written by someone else or recorded in healthcare notes);
 - Be signed and witnessed; and
 - State clearly that the decision applies even if life is at risk.

In terms of a First Aider responding to a life threatening situation it is unreasonable to assume they would be aware of this written document. It may be that a person known to the casualty attempts to prevent the treatment of First Aid if the casualty has made an Advanced Notice. Again, it is difficult and unreasonable for the First Aider to make a judgment about the validity of this claim.

Should any bystander attempt to prevent life-saving treatment of the casualty, the emergency services should be called as paramedics and other healthcare professionals can – in certain circumstances – provide life saving treatment without or against consent.

Children

In the ordinary course of events, a the parents' of a child (a person under 16 years) would refuse or consent to treatment of a child. If a child required life-saving First Aid and the parents were there and refused consent, it would be difficult to assume implied consent. Doctors and healthcare professionals are, again, afforded the ability to make decisions regarding life-saving treatment against the wishes of the casualty on the basis of necessity. Whether this is afforded to a First Aider is legally unclear.

Summary

Rule 1 Only treat if you are willing and able to do so

Rule 2 Only treat in the manner in which you have been trained

Rule 3 Act in the best interest of the casualty

What would happen if I am sued?

To begin with seek professional legal advice from your solicitor and/or your Union representative as each case is examined individually it is not possible to provide definitive guidance here.

The great benefit of the legal system in this country is that ones actions are measured against 'those of a reasonable person of the same standing'. This means your actions would be compared against those of a First Aider in the same situation. You would not be expected to perform in the same way, or be measured against the actions of a paramedic or a doctor.

If the casualty has experienced damage or loss (i.e. an injury) they may attempt to make a claim against you. If the casualty dies, the claim may come from their family.

Two common situations are often questioned:

1 Do I move an unconscious casualty, who isn't breathing if they have a suspected spinal injury?

This dilemma is frequently seen on TV when a person screams 'Don't move them! They might have a neck injury!'

Remember these Rules

- If you are willing to treat the casualty, being aware of the seriousness of the situation and confident in your abilities, then proceed.
- Opening the airway in the manner in which you have been trained limits the potential damage to a spinal injury.
- This is a life saving procedure which is in the best interest of the casualty.

It may be that the casualty has a spinal injury and you might make it worse by opening the airway but an unconscious casualty — especially if on their back — cannot maintain their own breathing. If their airway is blocked they will not be able to breathe and this takes priority over any other injury. If you have treated the casualty in line with your training it is therefore unlikely a claim will be made against you.

2 Am I liable if I break someone's ribs when performing CPR?

Remember these Rules

- If you are willing to treat the casualty, being aware of the seriousness of the situation and confident in your abilities, then proceed.
- Performing CPR is a skill which needs to be taught to be effective. Performing CPR as you have been trained will protect you to a greater extent than violently or haphazardly 'jumping on someone's chest'.
- A broken rib is undesirable, for a casualty who is not breathing. It is certainly possible that a rib can be broken whilst performing CPR, even if trained and practised to the best standards. A broken rib is not a priority of a casualty in this situation. Because of these factors it is unlikely that a claim would be brought against you.

ADMINISTERING MEDICATION

Note that it is illegal in South Africa to at any time administer or give anybody any medication. Rather advise them where to find it, and let them, if they are capable, to access it and administer it, themselves.

SCENE MANAGEMENT

When approaching an accident scene, park your vehicle, beyond the accident scene and make sure your vehicle is locked. This also allows you to drive past an accident scene and survey the area for your own safety. If assisting once stop, follow the HAZARD/HELLO/HELP methodology. This is taught on all Level 1 First Aid courses.



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FIRST AID KITS

The following lists are suggestions only as it is impossible to plan for all eventualities. Some items, for example, emergency contraception, condoms, etc. may not be needed for your group.

Items can be replaced with generics as recommended by a qualified pharmacist. The most common brand names are mentioned — generic substitutes are usually cheaper. The medicines are for adults. If children or infants are going along, they may require different medicines (i.e. syrups). Consult with your Doctor and ensure that you have copies of the necessary prescriptions if taking medicine across borders.

ARV treatment starter kits are carried by some groups who are concerned about the possibility of rape. Malaria treatment is only needed if a trip is longer than 7 days, in a malaria infected area.

LIST A should be carried by all persons going on a 4x4 trip.

LIST B should be considered by all who are going into the wilderness, where medical care is hard to find. List B must be ADDED to list A

LIST C should be considered by all who are going into the wilderness, where medical care more than 24 hours away. List C must be ADDED to list A and B.

LIST D should be considered where no medical facilities are available, or where no sterile equipment can be guaranteed. List D must be ADDED to list A, B and C.

For larger groups, List A should be double the content for every 4 persons, List C double the content for every 8 persons.

LIST A (Should be part of all first aid kits for 4x4 trips) Consult your local Medical Doctor/Pharmacist for the best products, based on your and your family's personal situation (price, allergies, space etc.)

DESCRIPTION	QUANTITY	COMMENT/NOTES/PRODUCT
Bandages, etc		
Conforming bandage	4	
Conforming bandage	4	
Cotton wool (splint padding)	2	
Disinfectant solution	100ml	
Elastic adhesive strips	20	
Elastic adhesive bandage roll		
Latex gloves	4	
Latex gloves	4	
Gauze	100	
Gauze — sterile	5 x 2	
Hypo allergenic adhesive bandage	1	
Resuscitation mouth piece	2	
Safety pins	12	
Scissor	1	
Splints — interlocking	3	
First Aid Dressing No 3	4	
First Aid Dressing No 5	4	
Triangular bandage	4	
Tweezers	1	

DESCRIPTION	QUANTITY	COMMENT/NOTES/PRODUCT
Ear buds	10	
Ice/heat pack	1	
Burnshield	2	
Antiseptic cream	1 tube	
Mercurochrome	1	
Eye pad and shield	1	
Eye bath	1	
Magnifying glass	1	
Space blanket	1	
First Aid Book		
Medicines		
Painkiller	1 packet	
Painkiller	1 packet	
Anti-inflammatory	50	
Anti-inflammatory	1 tube	
Nausea	20	
Nausea	5	
Abdominal cramps	20	
Diarrhoea	6	
Diarrhoea	10	
Antihistamine	20	
Antihistamine cream	1 tube	
Antacid	1 packet	
Colds and flus	1 packet	
Sore throat	1 packet	
Cough syrup		
Eye drops	1 bottle	
Eye drops	1 packet	
Antibiotic cream	1 tube	
Torch	1	

LIST B (IN THE WILDERNESS) (less than 24 hours from doctor) (Add to List A)

DESCRIPTION	QUANTITY	COMMENT/NOTES/PRODUCT
Allergies	1	
Allergies	20	
Wound closure	1	
Electrolyte powder	5	
Ointment for piles	1 tube	
Cervical collar		
Surgical blades		
Burn ointment		
V treatment starter pack	1 packet	
Emergency contraception	1 packet	
Fever thermometer	1	
Water purification tablets	50	

LIST C (IN THE WILDERNESS) (more than 24 hours from doctor) (Add to Lists A and B)

DESCRIPTION	QUANTITY	COMMENT/NOTES/PRODUCT
Allergies	1	
Antibiotics	1 course	
Antibiotics	20	
Malaria treatment	24	
Antibiotic eye ointment	1 tube	
Anti fungus ointment	1 tube	
Pain killers strong	10	
Pain killers strong	5	
Vomiting	5	
Convulsions	2	
Antihistamine injection.	2	
Nose spray	1	
Cortisone injections	2	
Malaria test kit	2	
Syringes	3	
Syringes	3	
Injection needles	10	

Alcohol wipes	5	
Blood sugar test	1	
Urine Test Kit	1	
Asthma	1	
Ear drops	1 bottle	
Cortisone ointment	1 tube	

LIST D (IN THE WILDERNESS) (no medical centre in vicinity) (Add to Lists A, B and C)

DESCRIPTION	QUANTITY	COMMENT/NOTES/PRODUCT
Infusion needles	4	
Drip set	1	
Vaculiters	1	
Vaculiters	1	
Dextrose 50% ampoules	2	
Sutures	2	
Needle holder	1	
Local anaesthetic	5	
Dental syringe and needles	5	
Blood collection tubes	5	
Eye drops anaesthetic	1 bottle	
Flourescine drops	2 single dose units	

OTHER MEDICAL RELATED PERSONAL ITEMS:

- All personal and prescription medications
- Sunblock lotion
- Insect repellent
- Lip ice
- Tampons
- Condoms
- Swiss Army knife
- Mirror
- Spare glasses/screws and screwdriver
- Prescription for glasses
- Contact telephone number of your doctor
- Telephone number and policy number of medical insurance
- Yellow fever vaccination cards

Useful telephone Numbers

SOUTH AFRICA

Tygerberg Hospital Poison Centre	021 931 6129
National Government Emergency	10177
Netcare Ambulance Service	082 911
ER24 Ambulance Service	084 124

BOTSWANA

From a cell phone	991
International Cellular Emergency Number – not medically qualified:	112 (Toll Free)

Overland Travel/Cross Border Protocol

One of the most rewarding experiences any 4x4 owner can have is travelling to neighbouring countries with your family and friends. The objective of this chapter is to provide pointers to enable you to be more prepared and make the experience even better. If some of the items seem very generic, that is the purpose as every country has different rules and regulations and these must all be taken into account.

The following issues are important for overland travelling: Behaviour

It is important to remember that we are visitors in the countries we travel through and just as we would not appreciate bombastic behaviour, the local populations will appreciate a more humble approach. In preparing for a trip, use all resources available to you and research the local customs and try to avoid the no-no's of the culture you are visiting. These can be in the form of understanding religious practices, or to simply leave the gate in the position you found it, when you pass through a farmer's lands.

Probably the most important of all, is to remember that you are dealing with people, and people normally appreciate common courtesy and respect;

- Be polite at all times and remember that the customs official facing you has probably spent the day in the hot sun, and on this continent, has most likely not had the luxury of air conditioning.
- In many cases these people are just doing as instructed, they cannot change the rules, so when an official asks you to fill in an entry card, do so with grace.
- Before taking a photo of a person (or place for that matter) ask permission. In some cultures it is 'stealing the person's soul' to take a photo of them.
- Be especially careful when attempting to take photos of military or government buildings, bridges, vehicles and staff as you can be arrested as a spy, none of us would like to spend time in an African jail.
- A strong tip would be to ask questions politely when you don't know, show no emotion except a friendly greeting when arriving and leaving, and for the rest, keep quiet.
- Do not talk in another language, remove caps/sunglasses and control children.
- If arriving in a large convoy, send the group leader in to advise them of the numbers and how they would like to deal with it – overcrowding causes anxiety!
- When passing as a group through customs, it is advisable to move away from the post when cleared. Re group some distance away from the post as to avoid attracting attention from the officials.

Dealing With Officials

This is always a challenge and the more prepared you are the better.

- As a rule, make sure before you depart, what the traffic and other rules in the countries you will visit are. A good source of information other than the internet is the Automobile Association of SA.
- Irrespective of country, type of road surface, area or location, in Africa, if there is a STOP sign, then stop. This is irrespective of an official who waves you on just before you arrive at the sign. It is a legendary scam to fine foreigners and locals. Wait for the official to gesture you to move forward before doing so — after you have stopped behind the line.
- The attitude of officials differs vastly with countries like Mozambique displaying a high degree of animosity towards ZA registered vehicles, while Botswana officials are normally very helpful and generally pleasant to deal with. Just remember, they are 'in charge'.
- In most cases, a cool head and good manners generally gets the best results. The less you speak the better.
- If you are stopped for an 'infringement' your best defence is to keep your wits about you. Relax, remain calm and avoid the temptation of paying a bribe. Do not become aggressive or confrontational with the official!
- Try to co-operate, but keep an eye open for 'ambushers' on the other side of the vehicle.
- Always keep doors locked and windows closed when you are not in your vehicle.
- Other vehicles in the convoy can assist by keeping their eyes peeled while the vehicle in front or behind is being examined.
- Try not to let them separate you from your group, a technique often encountered when the next step is going to be trying to extract bribes.
- When approaching a roadblock or official checkpoint or border post, all vehicles (when fitted with radios) must maintain radio silence, unless there is an emergency. What you don't need is someone making an inappropriate joke or comment on the radio within earshot of the officials. On approaching such a point, the lead vehicle should warn the convoy that they are 'going silent'. When the last person leaves such a point, he may then declare the radio open again.
- When you see the locals being treated differently to you, just keep your cool, you remain a visitor.
- When faced by an official carrying a gun with menacing intent, be very careful to keep your head about you, your life could depend on it.
- When traveling in the group where you are the 'leader' or guide vehicle, if an official wants you to get out and listen to a safety talk, as is the case in Botswana, the officer will generally ask all the vehicles behind you to participate. Inform the officer who is in your convoy and ask him if you can arrange over the radio for the rest of group to park behind you in a safe place.

- When speaking over the radio in front of the officer, speak in English which will normally be the language of communication, so that they can understand what you are saying.
- When you talk to your passenger or navigator asking for any official documentation which an official is requesting, speak English.
- Never offer any form of bribe as this may be a trap.

Country Specific Restrictions

There are many restrictions that apply when visiting other countries, and again, prior research is critical. Some items we have encountered on our travels include:

- Restrictions can exist regarding transporting certain foodstuffs like meat and animal products that can carry foot and mouth disease. When travelling into areas where this is a problem, be aware that you will not be able to carry fresh meat across the 'veterinary' fences. They are normally well marked and the gates are manned. We have encountered these in Namibia, Botswana and Swaziland, but check before you depart.
- Even meat purchased in countries like Botswana and Namibia can be transported from South to North over the 'red' line but you are not allowed to take any meat back from North to South. When taking meat from South to North in Botswana you have to declare the meat at a veterinary point. If you do not declare the meat it will be confiscated! When the meat is confiscated do not argue with the officer as you are in the wrong. You may be able to negotiate with the official to go back to the correct point to declare it.
- Taking foodstuff into some neighbouring countries such as Lesotho may be taxed. Produce the necessarily receipt, and pay the taxes. Entering into a dispute with an official could end your journey.
- Road restrictions could make a chapter by themselves, but in most cases the main differences are that many 4x4 vehicles are considered light trucks, so they need to be fitted with reflective tape in some countries. This is normally white reflective tape in front with either red or yellow facing the rear. Ensure you understand these requirements before departure, and remember to get the correct size that is required by the country you are visiting. The AA is a good source for the tape (blocks) and information too.
- Of course a ZA sticker is required for all South African registered vehicles crossing out of our borders.
- Trailers may require their own reflective tape in some countries and in Mozambique a yellow triangle on a blue background is required on the front of the tow vehicle as well as on the rear of the trailer. Trailers require a red on silver 'T' in Zimbabwe
- A fairly new requirement in Mozambique is the need for warning triangles and reflective vests to be used in case of a breakdown, although the locals just drag a bush onto the road!

- Speed restrictions need to be adhered to, and local rules apply, so make sure you know what they are and adhere to them.
- A common practice is customs officials charging ‘import duty’ on fuel carried in jerry cans. Whether this is legal or not is debatable, but it is a better idea to fit extra tanks to your vehicle as far as possible rather than to use jerry cans. This can also apply to fuel being brought back into South Africa from neighbouring countries.

Documents

The following documents are required for most cross border trips, this list is not exhaustive and you are advised to contact the consulate of the country you intend to visit. It is a good idea to make at least 3 sets of all your critical documents and have them certified by the SAPS as opposed to a normal Commissioner of Oaths. Store these in separate places in your vehicle. This will assist you greatly in the case of loss/theft of original documents. If theft does take place, get to the nearest SA Embassy as quickly as possible.

Tip: have a file for all documentation neatly sorted with certified copies handy at border points. Any information that is requested is then immediately available, also giving the official the peace of mind that your paperwork is in order.

Tip: attempt to have border permits that need to be completed at border points filled in prior to your arrival at a border point. This saves time and confusion when at the border.

Tip: pre-print a small card which you laminate, and affix to a string/lanyard, for each one of your passengers, to hang around their necks when doing cross border administration. On this card, list:

- **Each person in your vehicle’s passport number, date of birth and passport expiry date**
- **List each person’s place of birth if not generally known (as per passport)**
- **The Vehicle Registration details**
- **The vehicle’s VIN and Chassis Numbers**
- **The trailer/caravan’s details as per above**
- **Driver’s licence number**

Have a black pen handy for each passport holder.

Passports

- Get valid passports for all travellers, they must not expire for at least 3 months after your travel schedule ends.
- Small children may travel on parent’s passports, but it is recommended that

all children have their own passports.

- Make sure the passport is in good condition, not full, and that there are at least three pages available for stamps.
- Recently, holders of temporary South African passports have experienced problems in some African countries, so avoid using temporary passports.
- Protect passports at all costs, keep them in the vehicle safe if fitted and only use them when needed.
- Ensure that when you pass through a border post that your passport is stamped and that it is stamped correctly. When passports are not stamped or stamped with the exit stamp (or visa versa), a great deal of confusion, time delay and unnecessary focus on oneself can be experienced.

Personal Medical Papers

- Vaccination certificates are required for some countries and this can vary, so check before you go as you do not want the border medical facility to give you injections with *used* needles.
- Some vaccinations have a lead time of a few days or even weeks, so make arrangements in time.
- Make sure the doctor gives you a proper certificate, stamped and signed legibly.
- Visit the National Institute for Communicable Diseases website for up to date information on vaccinations, most countries have websites that provide this information.
- If one of your group is using prescription medication, keep a copy of the Doctor's prescription in the vehicle to prove that they need the medication as you may be accused of smuggling drugs. Also ensure that the person who is using the medication is named on the medication and prescription.
- Get a letter from your medical aid confirming that you are covered across borders for medical emergencies. Keep this letter handy in case of need.

Vehicle Papers

- The license disk must be valid for the period of travel and affixed as per the road traffic act.
- Don't forget the trailer's license! It must be easily accessible even in the dark.
- The vehicle's original licence papers (not the renewal slip which contains the license disk) is a prerequisite.
- Make sure that the engine number and chassis and VIN number match those on the registration papers perfectly as well as the registration plate. It has occurred that two digits or numbers have been transposed.
- If the vehicle has had an engine change, the engine number on the manufacturer's plate and the number on the engine will no longer be the same. Make sure that in addition to the revised license papers (showing the new engine number) you have the revised papers and copy of a Police

clearance with you. Also make sure that the engine is clean in the area where the engine number is located and use white chalk rubbed into the numbers to make them easier to read.

- The owner's name reflected on the papers must be the same as that on the owner's passport.
- If this is not the case, and the names differ, an sworn affidavit giving one of the group permission to use the vehicle must accompany the vehicle.
- If the vehicle is financed, a letter must be obtained from the finance house, giving permission to cross the border stipulating the countries you intend to visit.
- If the vehicle is in the name of a company, ensure you have a letter on a company letterhead, stamped by the police, to state you are allowed to take the vehicle across the border. The same applies if the vehicle is registered in another person's name (such as your spouse) and that person is not travelling with you.
- This applies to all vehicles, including trailers, and motorcycles.
- Some countries require clearance papers stating the vehicle belongs to you and is not stolen. Other countries require a *Carnet du Passage or triptyque* from the AA.

Tax Forms

- Goods being imported into a country with the intent to export them back to the country of origin are required to be listed on the SARS Form 'DA 65 — Registration of Goods for Re-Importation'. You are advised to check the new process currently being piloted by SARS at Botswana border posts.
- The DA 65 form is available for download from the SARS website under 'All Forms>Importers'. It is also available from some customs offices such as at major Airports or some SARS offices. Some of the major Border Posts have the form, but do not count on it, especially at smaller Border Posts.
- The form should be completed before departing from home, and all high value moveable items such as cameras, cell phones (if more than 1 per person), satellite phones, radios, fridges, GPSs and laptops must be listed on the form, with the description, make and model and serial number.
- It is a good idea to draw up your own list (and keep a few copies handy) of all such goods that need to be listed. This makes for ease of declaration at the Border Posts. Sometimes it is an accepted practice to attach this list to the SARS declaration form without having to re-write all goods listed.
- Before exiting SA, have the form stamped by the SA Customs Officials at the exit point. The form can also be stamped at your local Police station. Ensure that you follow the correct procedure at the border post, to facilitate a smooth return!

Drivers Licences

- In all cases the original of the SA Drivers license card must be carried.
- Temporary licences may not be accepted in some countries, it is best to check first
- SA Learners licences are only valid within the borders of SA, a SA learner driver may not drive in the neighbouring countries at all.
- Even though it is seldom a prerequisite in the SADC Countries, always carry an International Driver's license, obtainable from the AA of SA for a minimal amount . This document can be produced in lieu of your SA Drivers license.

Document Copies

Here are some good ideas on how to manage your documents on long trips.

- Make two good colour copies of all your documents and laminate them. Have them certified by all means, but make sure they are good, full colour copies.
- Keep the sets separate, one at hand in the vehicle.
- Lock away your originals in the vehicle's safe if fitted and only produce them when under duress and then only at an official place.
- Only certify documentation at a SAP police station, some countries will only accept police certification as in this is practice in their country.

Medical Aid

- Most medical aids will provide assistance in medical emergencies, but remember to let them know and get authorisation before you go. In some cases there could be a *top up* charge.
- Make sure what you are covered for and what telephone numbers are necessary for you to call in an emergency.
- Cross border evacuation of patients is very expensive and not always covered in basic policies. Make sure what your medical aid's policy is in this regard.
- It is recommended that at least one person in the group have basic First Aid training and that someone in the group carries a comprehensive medical kit.
- Note: certain scheduled medications need pre-approval for transport over borders, such as morphine.

Insurance

- Make sure that your insurance company is aware of your travel outside of South Africa. They should be able to provide you documentary confirmation of your cover outside of South Africa.
- Check the fine print, make sure that the insurance company will recover your vehicle from point of breakdown and that you are not responsible to bring your vehicle to the closest South African border post.
- Don't forget to get cover for your trailer as above.
- Check the extent of cover in respect of accessories and personal items.

- Check that you have genuine Off-road cover.
- Check that you are covered in all the countries that you intend visiting.
- Ensure that your cover includes medical evacuation and repatriation of your family members.

Currency

- Keep your currency out of sight and only have the amount you absolutely need on hand.
- Keep more than one type of currency with you.
- Have a range of denominations of each currency as you may have a problem to extricate your change.
- At some Border Posts, if you do not have correct amount to be paid, the officials may not issue you with change.
- Know the prevailing exchange rate.
- Try to exchange currency at banks or at a *bureau de change*. Local currency exchangers are con artists at best.
- When more than one currency is accepted, look which one offers the best rate of exchange.
- Off-roaders have encountered situations in mid Zambia where the local currency was not accepted, but Rands were! At the next point only US\$!
- US\$ are generally accepted in SADC countries, in fact they are normally the preferred currency, but not in South Africa.
- US\$ have another peculiarity. Old US\$ notes have *Small Heads*, that means that the picture of the President does not fill the height of the note. These notes are no longer accepted in African countries. The new US\$ notes have a *Larger Head* of the President and are generally accepted. It is very difficult to get information on this aspect, visit Wikipedia, which has images of the notes or to check that your notes have a recent date on them.
- In some SADC countries Petrol Cards and/or Credit Cards are accepted. Do not rely on this and ensure that you have sufficient cash on hand. Inform your bank that you are travelling cross border and will use Petrol and/Credit cards.
- Be vigilant when using your cards and make ensure that they are not cloned.

Security

All the security measures you normally exercise, still apply, but the following are highlighted.

- Try to never leave the vehicles unattended, even if half of the group visit the customs and then the other (people have been robbed inside the secure customs enclosure in Botswana).
- Lock your vehicle even when in you are in the roof top tent.
- Stick together as a convoy at all times.
- Keep doors locked while driving and especially rear doors and canopies.
- When sleeping, keep keys and valuables under or in pillows etc. Criminals

- silently cutting tents with a blade and steal while you sleep!
- When leaving your vehicle, even in the most remote areas, close and lock your vehicle.
 - Do not leave your keys in the ignition, unattended, even for a short while.

Two Way Radios Require Special Attention

- Two way radios licensed in South Africa require separate licences in each neighbouring country as there is no SADC wide license. Each country requires a license to be purchased individually.
- In South Africa licensing of radios is handled by ICASA. The frequencies used by AAWDC affiliated clubs are handled by the Off Road Radio Association (ORRA).
- Contact the radio licensing authority in each of the countries you wish to visit and get a license. This process normally takes a few weeks so start early.
- Some low powered hand held units do not require licenses, but these are seldom any use in convoys due to their short range.
- Satellite phones are almost indistinguishable from large cell phones and are highly recommended for remote travel.
- Ensure that the Satellite phones can connect to satellites that are in the area you intend visiting.
- Ensure that your account is in good standing before departing.
- Take the battery charger along with you.
- Remember to include your Satellite phones on the DA65 SARS form!

Time Zones

- In the SADC region, Namibia and Angola are the only countries that use Daylight Saving Time. They are 1-hour later than South Africa in winter.
- Take this into account when crossing the border. The two border posts do not always align their opening and closing. You could be forced to wait for an hour.

Time Management

- Time management — distances travelled may differ hugely in relation to the *normal* time taken. Road conditions, road blocks, border crossings, or congestion at Ferry crossings influence travel time.
- Convoy driving is slower than driving alone, especially when there are lots of congestion, traffic lights or on dusty roads.
- Some border crossings may take as long as a day to clear. Plan accordingly!

Vehicle Reliability And Roadworthiness

- Ensure your vehicle and trailer or caravan is serviced at least 2 weeks before going on a trip and drive your vehicle for at least 200 km to ensure everything is in working order.

- Check all fridges, radios, GPS and other equipment that is going to be used on the trip.
- Ensure your batteries and charging system are working.
- Remember to take chargers for cameras, phones and lights.
- Ensure all reflectors, light lenses, etc. are not broken or covered with mud.
- Keep spare bulbs and fuses in the vehicle.
- Keep a spare number plate in the vehicle.
- Ensure you have adequate spares and tools to do basic repairs. Different vehicles can carry different tools which can be pooled when required, to reduce the loads.
- Consider the area and terrain you going to and even take a second spare tyre. Throw a spare inner tube in for emergencies.
- Make sure that all tyres are of the same diameter, size and that rims have the same stud pitch.
- If the rims differ on the tow vehicle and trailer, check that the wheel nuts are interchangeable.
- Check that tyres meet the minimum tread depth requirement, as you do not want to be fined, or have to buy new tyres when across borders as this could be inconvenient.

References

- Automobile Association of South Africa (www.aa.co.za)
- National Institute for Communicable Diseases, Johannesburg (www.ncid.ac.za)
- South African Revenue Services (SARS) and Customs (www.sars.gov.za)
- Off Road Radio Association (www.aawdc.org.za, follow the link to the ORRA Forms)

Country Websites

<i>Botswana</i>	<i>www.gov.bw</i>
<i>Lesotho</i>	<i>www.gov.ls</i>
<i>Mozambique</i>	<i>www.portaldogoverno.gov.mz</i>
<i>Namibia</i>	<i>www.grnnet.gov.na</i>
<i>Swaziland</i>	<i>www.gov.sz</i>
<i>Zambia</i>	<i>www.zambia.co.zm</i>
<i>Zimbabwe</i>	<i>www.zim.gov.zw</i>

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