
An Introduction to Sand Driving



RAHRC-ORAC

Prepared by
Ray Archer

(with support from ORAC Committee)

Based on

‘Introduction to Sand Driving talk’
October 2011



An Introduction to Sand Driving

Introduction

Inside this issue:

- Understand your vehicle—p4
- Gears—p6
- Angles—p8
- Essential Equipment—p10
- Spares—p14
- Sand Driving Tips
 - (how to get stuck) - p15
- Recovery
 - (how to get unstuck)-p22
- The environment—p25
- GPS and Thuraya—p26
- Some useful links and contacts— p27

Welcome to ORAC and this simple ‘introduction to sand driving’.

This document is intended for newcomers although I’m sure everyone will benefit in some way especially if more experienced drivers read this and give some feedback for its improvement.

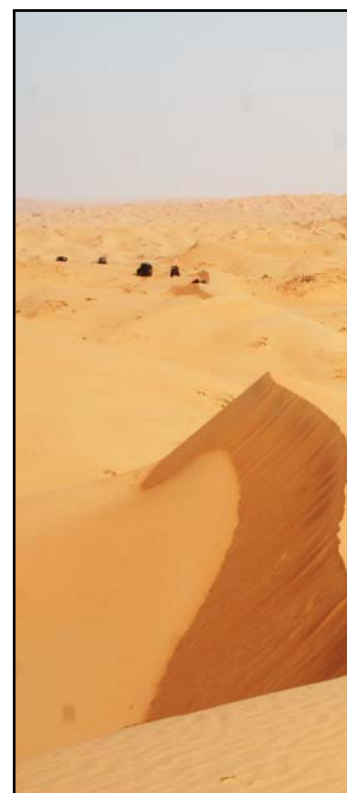
What’s in this booklet?

Well, twice a year we (that is ORAC) offer a series of fairly well attended training sessions (both theoretical and practical) for which there is a demand for ‘copies’ of presentation materials. This booklet has been compiled to satisfy this request. It doesn’t replace the talk but simply offers a more convenient way of sharing the slides.

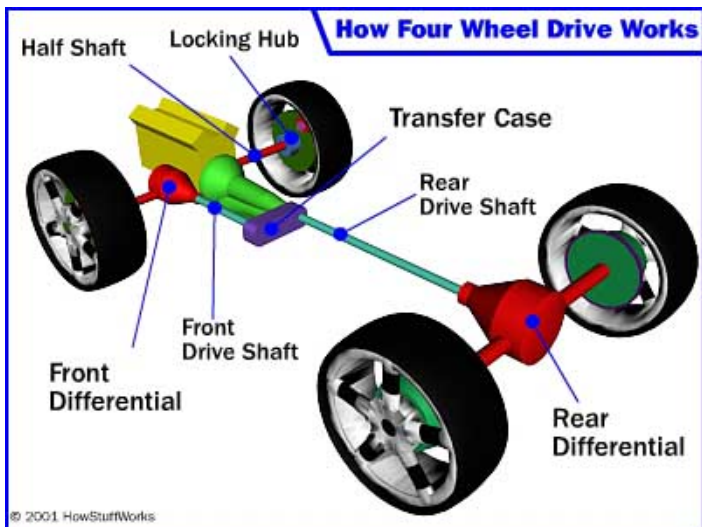
Let me know if this works or not.

(rarcher@omantel.net.om)

Most of the slides that are included are mine but please respect copyright as some have been contributed by Zaher Hajri, Frans van Vuuren, feather Mills and a few from unidentified internet sites.



Understand your vehicle



You are here reading this ideally because you own a 4WD vehicle and want to drive this off-road and especially in sand.

While it is not necessary to become an auto engineer, it is helpful to understand what your 4WD is being asked to do in order to increase your chance of getting it to agree with you, while of course minimizing the opportunities you have to cause damage.

A simple diagram (left) shows that, as with all vehicles, you have an engine and transmission or gear box (yellow and

green) for which no further discussion is necessary.

The **transfer case** is the true heart of the 4WD system. It is similar to the transmission but it has the additional duty of dividing the power between two output shafts, the **front drive shaft** and the **rear drive shaft**.

These drive shafts transfer power to front and rear wheels via the **front and rear differentials**.

These differentials and also the wheels themselves may be locked.

Transfer Case

"it's a male thing not to do this I know, but the best way to understand what's what in your 4WD is to read the manual.....not sure where mine is"

The transfer case is the heart of the 4WD system and allows power to be sent to front and rear wheels.

It provides a number of options which you will be familiar with in a manual 4WD, these are:

- 2H (2WD)
- 4H (4WD)
- N (Neutral)
- 4L (4WD)
- 4LL (4WD with Central Lock)

4L is fundamentally the same as **4H** except that the power runs through a planetary gear in the transfer case that increases power but decreases speed.

So selecting **4H** is fine for faster driving on the approaches to sand but generally does not give enough power for climbing steep slopes.

It's the same as comparing 1st gear in the transmission to 4th; you get a lot more power but your top speed is reduced and the engine will 'red line' at a much lower speed

You should never exceed 50 KMH while in **4L** (You'll be hard pressed to anyway, the engine will be screaming at 40 KMH).

I suggest you consider **2H** for normal blacktop driving. Use **4H** for the approach to sand ie tracks and patchy sand or gravel. Then use **4H** or **4L** when in sand dunes.

- My preference is generally to use **4L 3rd gear** during short steep approaches and

much of my desert driving. This gives me a reasonable low engine speed and quick continuous power when its needed.

- When a higher speed is needed, for example when driving up a long but less steep approach to a dune, I will then often use **4H 2nd gear**.

Only experience will help you decide if this works for you and your vehicle. Try it.

Most will agree however, that once you have chosen you will find it hard to change gear while driving 'up' sand. Momentum is lost so very easily in sand.

Drive Shafts and Universal Joints

The rear drive shaft has to freely move up and down to allow the rear wheels to rise and fall over uneven ground and this is achieved with universal joints (shown on the right) in the transmission.

Universal joints (and their supports) can be a points of weakness and are known to shear under high stress - such as bouncing on rough sand or grass.

Basically the wheel becomes airborne and may spin much faster but then grounds and stops abruptly on the next

bounce/contact with sand thus shearing the joint.

The important thing is to realise this and try and minimise bounce, either by choosing a better route, or a slower speed.

The same effect and damage can be done by becoming airborne or flying over crests.

Spares can be carried and with skill can be changed in the desert. Or a sheared joint can be disconnected and the vehicle removed to safety using care and 2WD only.



This set of photos shows our technical officer Simon Hatfield replacing a damaged CV joint 'over lunch' on a recent trip. This one had failed due to lack of adequate lubrication.

Front and Rear Differentials

These are essential to convert the drive shaft rotation into rotation of the front or rear wheels. The differentials:

- Transfer power to both wheels on each axle
- But at the same time also allow slip on one wheel—for example when going round in a tight circle the outer wheel travels further than the inner wheel and so the inner wheel 'slips'
- Differentials are fantastic on blacktop but become a potential problem for a 4WD in sand unless we manage this in some way.
- PROBLEM is that it allows the power to the free wheel
- Note how in the photo above the wheel that is clearly airborne will spin



freely while no power will be transferred to its opposite wheel on the rear axle which in this case is the one touching the sand.

- It is suggested that applying brakes (footbrake and or handbrake) slightly may provide enough resistance to get the stuck wheel moving. I have never achieved this successfully but give it a try and let me

2H-4H-or 4L...whats it 2B?

Before trying to discuss this there are a few **important points** to make—the first is that driving in sand is personal, there are guidelines but no fail safe rules. This booklet must not be seen as prescriptive, there is never a perfect answer to how to drive. Do what feels comfortable and what works for you that is safe for you and others. Conditions and terrain will change by the month, day, time of day, your mood, the state of your car and so on. Even experienced drivers need about an hour or more to warm up and get a feel for the sand. I drive like a ‘bull in a china shop’ for an hour then relaxand get stuck—try harder then after that all is well. Look at the following ‘suggestions or rules of thumb’ - please try them and remember that failure is an important part of the learning process! Your ability to drive is a function of both your confidence and experience. Also remember that almost always your car can do much more than your head!



What gear should I drive in is a common question that often gets an answer like shorts and T-shirt are fine. But in reality there are no hard answers, but I suggest you try the following:

- **2WD** is for blacktop
- **4WD** for approach to sand, low slopes or gravel
- **4WD (H) 2nd gear** can be used on sand and may give you greater speed on

long slopes that are not overly steep

- **4WD (L) 3rd** is commonly used by Jeep drivers as the standard gear and is especially good for shorter steeper slopes that need more power but less speed
- **4WD (L) 2nd** for seriously steep but careful not to over rev the engine.

- **4WD (LLD)** check if you have this—its locks front and rear drive shafts. These refer to ‘Diff Locks’ —check if you have as these can lock both wheel on the same axle and prevent the free wheel from getting all the power when the stuck wheel is the one that needs this power to get you free.

4L v 4H



4WD **4L** v 4WD **4H** is basically a similar setup

- except that the power runs through a planetary gear in the transfer case that increases power but decreases speed.
- It's the same as comparing 1st gear in the transmission to 4th; you get a lot

more power but your top speed is reduced and the engine will red line (**and risk damage**) at a lower speed.

- You should never exceed 50KMH while in 4WD4L (You'll be hard pressed to anyway, the engine will be literally screaming at 40 KMH).

Summary for your first attempt

- 2H is for blacktop
- 4H for the gentler approach to the sand
- 4H or 4L for real sand driving
- Try 4H 2nd gear for longer slopes more speed and less power—see later

section on ‘Speed v Momentum’

- 4L 3rd gear can give more power for steep sand
- Differentials are typically not locked so beware of exposing one wheel to the air—the differential is designed to give power where

it is least well used—a typical management system!

- Universal joints can be sheared if you treat them harshly.
- Find out how to disable your airbags (remove a fuse?) they can go off under harsh desert condi-

tions.

- Consider disabling or overriding engine management systems that don't like it when you lose traction.
- Consider disabling anti lock brake systems—can cause problems when sliding down sand—see later section.

Automatic Transmission



Many modern four wheel drive vehicles have **automatic transmission**.

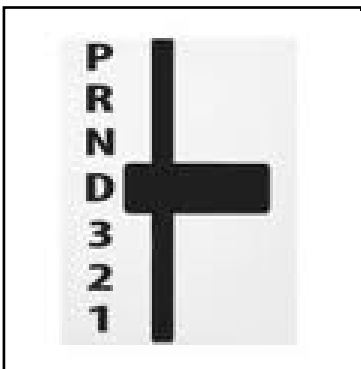
- This configuration comes with its' own advantages and disadvantages.
- If your car is capable of changing from 2WD, to 4WD H, and 4WD L, and can be manually shifted down to 3rd, 2nd, and 1st gears, **it is dune worthy**.

As a guide only—and you should try and find what is comfortable for you:

- Generally speaking, 2WD should be used for black-top,
- 4WD H for tracks and approaches,
- and 4WD L for soft sand and dune climbing.
- If you are in relatively easy sand terrain, the vehicle can be left in Drive, and allowed to shift up and down, as this is the most fuel efficient mode.



- As soon as you begin a long or steep climb, you should shift down to 4WD L 3rd or 2nd. This is because in Drive, during a high speed approach, your automatic transmission might shift you into 4th gear which does not have enough torque for the last



steep bit of the climb, and you will lose momentum if your auto transmission shifts down part way up a slope.

- On particularly difficult or steep terrain, you should shift down to 4WD L 2nd, and allow the engine to reach very high revs, so that you have torque all the way to the top.
- Remember, (and this is true for manual and automatic) select the gear you will need for the most difficult part of the section you are approaching, and drive the entire section in that gear.
- Gear changes, even automatic ones, cause a loss of momentum.

Some automatic vehicles do not actually shift down into the lower gears while in 4H, even though the dash display may read 1st or 2nd.

You need to be familiar with how your vehicle is set up. In some cases, even when you are in 4L, and shift down to a lower gear, your transmission will not actually make the shift, if your engine is revving too high.

This can be particularly dangerous when you are driving

down slip faces, when it is crucial that you be in the lowest gear you have, and coast down the slip face under engine compression.

Running Air Conditioning on a very hot day, can cause your engine to work very hard, and rev very high. This alone can occasionally cause you to not shift down. Therefore, when approaching slip faces, shift down early, and test the “feel” of the car to make sure you are actually in the gear you want to be.

Diff Locks:

Many automatic vehicles often come with a manual differential lock. If you have this option, you need to know if this is a limited slip differential, or a true locking differential. Driving with the diff lock on for long periods of time can be very hard on the drive train. It is best to engage it only when you really need it, ie; you are “almost” stuck or driving through a bottomless soft patch.

Every vehicle is a little bit different, and it is advisable to practice in relatively easy terrain until you are sure you understand the idiosyncrasies of your drive train.



Angles—why are they important?

Three angles are important on your 4WD when driving off road:

- Approach angle
- Departure angle
- Break over angle

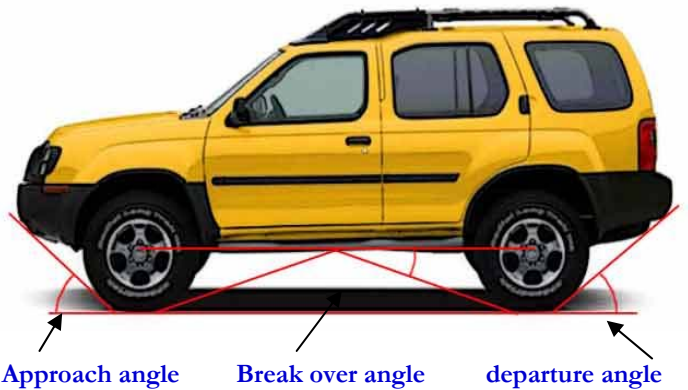
The **approach angle** effectively controls the maximum slope you can try and climb without sand and your front bumper coming into contact.

The **departure angle** controls the maximum slope you can descend without scooping sand into the rear skirt of your 4WD and ripping off the

rear bumper. A little bit of thought and a trip back to school geometry will tell you that the smaller of the two angles controls both of these maneuvers. In an SUV type of 4WD quite often the approach angle is good but the main restriction is caused by the small departure angle (see the picture of the Pajero below).

The **break over angle** is effectively ground clearance and controls the height of a sand crest that you can clear without getting stuck.

Take a look at the cars in any



Approach angle Break over angle departure angle

car park and see what is best for off-road.

Note just how many modern 4WD have excellent approach angles but dreadful departure angles.

Also note that an under slung spare wheel at the rear of the 4WD is likely to interfere with the departure angle.

So—what to do?

Jeeps tend to have very good approach and departure angles but without modification may have poor break over angles. Lifting suspension is a solution beyond the scope of this introduction.

For the Pajero/Prado type of 4WD an easy solution is to avoid anything steeper than the smaller of the two front and rear angles.

However as shown in the adjacent figures while sand

can remove front and rear bumpers very effectively, a mechanic can do it for about 30 Rials and its cheaper than a new bumper.

Be aware that the ROP don't understand this and you may be stopped to and from the sand on the assumption that you have had an accident.

Remember to keep number plates on.

Sadly modern bumpers clearly



take up half of the front and rear body work and contain lights and sensors—but think of the cost of repair.

Maybe get a friend in the office to write an explanation in Ara-

bic and take it with you in case you are stopped by the ROP.

Road checks often increase during the Wahiba Challenge time due to increased security around National Day.

Do angles vary that much?

Yes, compare the adjacent Pajero and Wrangler.

The Pajero and Wrangler may have similar approach angles but (a) the departure angles are so different

(b) break over angle also very shallow on the Pajero

It's a simple message if you

drive a Pajero/ Prado/ Land-cruiser—don't follow a Wrangler without careful thought.

Its not 'macho' its all about angles!

In the Pajero I cant ascend a steep slope as my rear will scoop sand—in the Wrangler I can go up and down the same angle of slope and even

if I descend too steeply then my bumpers are simply solid steel bars. The Pajero type of 4WD is in contrast, flimsy plastic. Be aware or pay the price!



Am I exaggerating on Angles?

I guess the pictures tell the truth....
Jeeps do get stuck!

A few photo examples can help here.

A—a crested Wrangler, not enough momentum to get over, front right wheel airborne no traction

B—a crested Wrangler sitting on body and front wheels have traction but still more or less airborne

C— and **D** both vehicles have suffered the angle problem and have front and rear body-work supporting the wheels which now have no traction.



Prepare your 4WD for the Sand—be realistic

Murphys Law says that
“what can go wrong—
will go wrong”

The Wahibas is not the
place to test that.

In the talk I say quite simply check it, check it again then give it a final check.

- Has it been serviced recently?
- Do all electric sockets work—how many cameras, GPS, Sat phones, hair dryers will you need power for?
- Is the battery showing any signs of distress? In Oman I find dodgy batteries can fail in 24-48 hours.
- Fan belts/alternator and AC—if belts are cracked change them
- Hoses—are they good to go? Squeeze them they should be soft and show no cracks.
- Fluids topped up?
- Fuel lines OK and rubber

bits and connections checked?

- Tyres and spare checked?
- How far can you travel on a tank of fuel? Check others if you don't know. You will need spare fuel— it's a matter of how much?

As a guide and maybe an overkill, I change all fluids before every major trip even if they are only weeks apart.

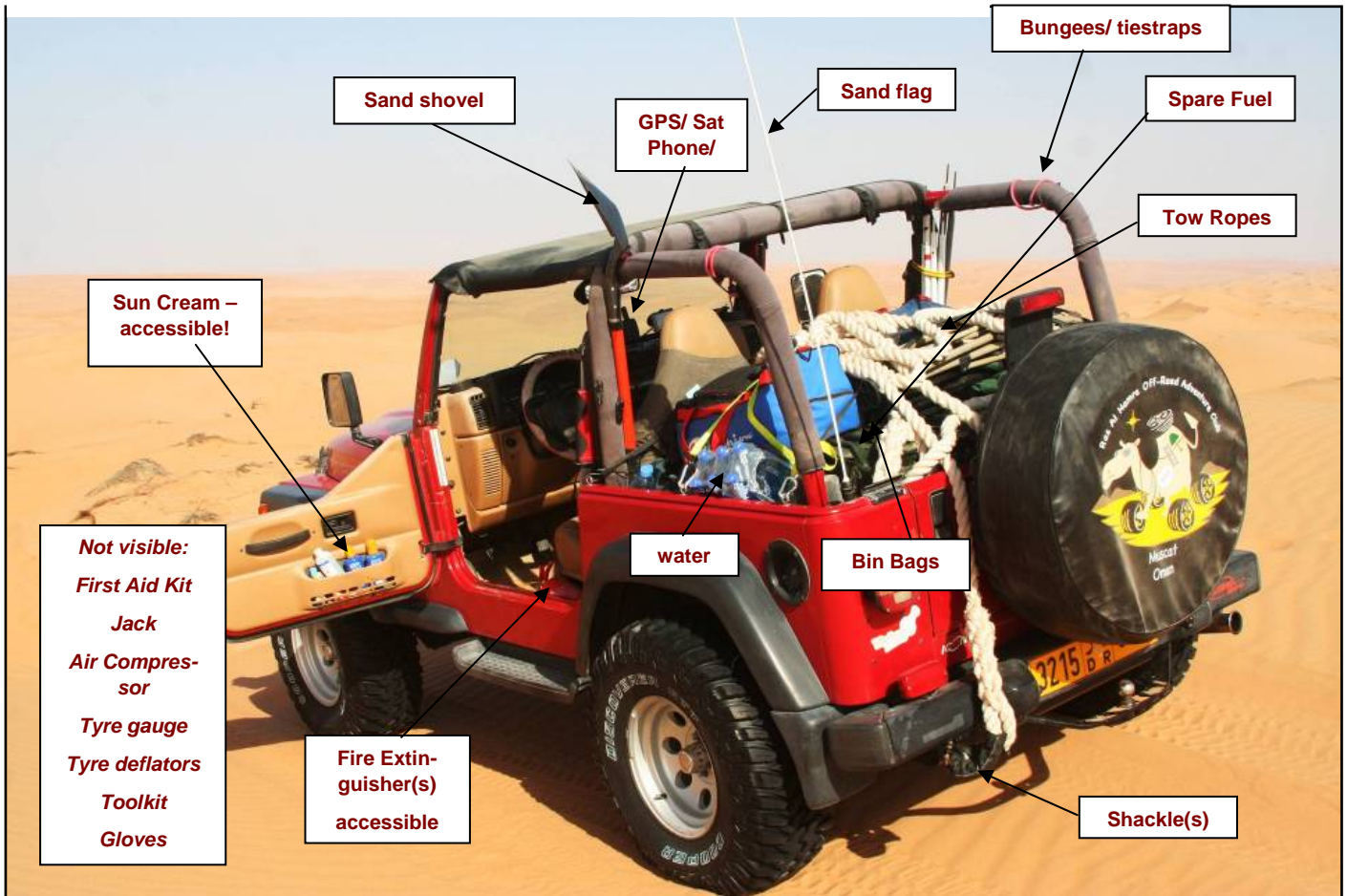
I also seem to hold the record for shearing old rubber fuel lines—so be prepared.

And while its not a vehicle that is allowed on Wahiba Crossings with ORAC, the photo below has a clear message.....in the desert what can fall off—will fall off!!

(by the way check the shadows—I still think its photo-shop'd)



Some Essential Equipment



The slide above gives an idea of what's possible, its not complete but has basic safety items.

Make sure things are packed so that essentials can be accessed easily and not just chucked in like mine!

First Aid Kit—see later for details

Jack—make sure it works for your vehicle (see later section)

Air Compressor—big enough? (see later section)

Tyre gauge—is it calibrated?

Tyre deflators -save time and back ache but are not essential

Fire Extinguisher(s) - accessible and in working order?

Sun Cream—no good if its

hidden

Water—I suggest the recommended daily amount plus a few gallons extra for radiator/ washing etc

Sand Shovel—actually rarely used except for digging private holes in the dark.

GPS/Sat phone—will get badly shaken, get a good mount

Sand Flag—vital as this allows others to see that you are over the other side of small dunes. Always nice when friends 'drop in' but not when in a 4 ton Hummer. Quad bike sand flags are easy, flexible ideas—fishing rods cheap but rigid and don't like going under trees.

Bin Bags—crucial—please take all your rubbish home.

Bungees and tie straps—essential as there's always something coming loose. Keep everything tied down so if you hit a dune, your gear doesn't hit the back of your head.

Spare fuel—check how much you might need and check the can for cap leaks over rough ground. Remember the spout or cut an empty water bottle to make an impromptu funnel.

Tow ropes—slings are easy to get make sure they're up to the weight of your vehicle. Same for shackles—they will have a red painted pin if they have been rated. Anything

from Supermarkets be very careful they may come back to haunt you through the wind-screen.

A kinetic rope will give you a much more pleasant life (see later). These can be acquired in the UAE but so far not in Oman.

Spare parts—I take fuses, spare belts, radiator cap and hoses, fuel line, hose clips, cable ties tyre repair kit etc

And a **tool kit**

Come back to me and tell me what else!!

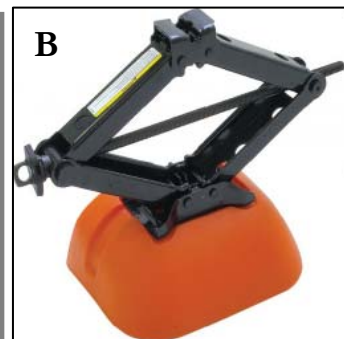
Essential Equipment—lifting



Don't avoid the issue—you will get stuck and lifting equipment is crucial in the sand. It must work and work safely. You should practice rather than assume its OK. Of greater importance is a base plate—only an air jack will work in the sand without a base plate.

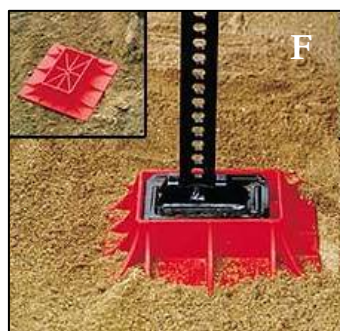
Bottle Jacks (A) are simple and often come with the vehicle. Their main drawbacks are they often don't give enough lift and they can suffer when sand gets into the seals. When in doubt—throw them out as they are relatively cheap. Practice using them in sand on a base plate as a slight shift or tilt can make them skid off the jacking point.

Scissor Jacks (B) are also often supplied with vehicles and the one illustrated has its own moulded base plate (I have never seen this for sale in Oman). Easy to use and often skids less easily than a bottle jack but sand in the threads of a scissor jack can make it collapse without warning—check frequently and careful with grease—its essential on a scissor jack but attracts the unwanted sand into the threads.



not correctly engaged and they are notoriously unstable if not used with care and some degree of skill. Read the warnings. A user guide will eventually be added to this document.

An adaptor is shown below (G) to enable a saloon to use a high lift by engaging hooks into the wheels.



The classic **high lift jack (E)** (shown left) is popular with jeeps as it gives good lift and jeeps have easy mounting points. It is virtually impossible to use with other 'saloon' type vehicles due to the lack of mounting points.

They can be purchased with very good base plates (F) although I use mine with a 1" thick wooden square which doubles up as a workshop bench in the sand.

High lift jacks come with a dozen or more warnings about their safety. They can collapse if not used correctly, the lever can cause injury if the ratchet is



A good **trolley jack (C)** is probably one of the safest ways to get a good stable lift in sand. A base plate is still essential.

The disadvantages are that they are usually heavy and take up space. Not overly attractive because of this for jeps.

Air bags (D)—that is 'good' air bags are available in Oman and will lift heavy vehicles



Essential Equipment—Slings



Recovery equipment for pulling out a stuck vehicle is fairly simple but must be of high quality as the stress placed on ropes/slings /straps and shackles can be very high.

To the left is a picture of a standard strap, its not a rope and in reality it's a sling designed for lifting heavy loads. The one shown here can be easily bought from good shops in Muscat and is 10m long and is rated to 4 metric tonnes.

Its flat and about 4-5 inches in width.

When using a strap like this it is important to remember this piece of kit is pretty rigid and inflexible. Take a run before pulling with a strap like this and you may do some damage to your car , the other car or even both.

Set up the pull and run with the slack in the rope, I would say no more than 1m.

Look after the rope and discard if its frayed.

PLEASE—don't buy straps and shackles from super-markets.

Essential Equipment—Kinetic Ropes



A kinetic rope is very different to a static strap or sling in that it is elastic and may stretch by 10-20%. The one shown left is spun like a rope but some may have a sheath and look like a static sling.

The one on the left is about 2 inches in diameter.

The advantage is that when you pull with this rope you can leave several metres slack, take a moderately fast run and the impact

will be soft as energy is stored in the rope. If while pulling you run out of speed the pulled vehicle is still being pulled by the 'stretch' in the rope.

These ropes or straps are your best option—import is necessary.

So far these cannot be bought in Oman. They can be bought in the UAE.

Essential Equipment—Shackles



Without good shackles a rope or sling is simply extra weight, never tie a rope or sling without a shackle. Shackles come in a few shapes and sizes and again please buy from a reputable supplier and not a supermarket.

Good shackles are rated and the lower ones to the left are rated to almost 5 tons (even if its tonnes I am happy). I know they are rated because they are colour coded. OK anyone can paint a shackle—use a reliable oil field supplier or

equivalent. The top ones are stainless steel and allegedly less reliable and brittle—not rated but supplied to me by a heavy lift specialist. I use them on my jeep because the towing point is small diameter and can't take the big shackles shown bottom left.

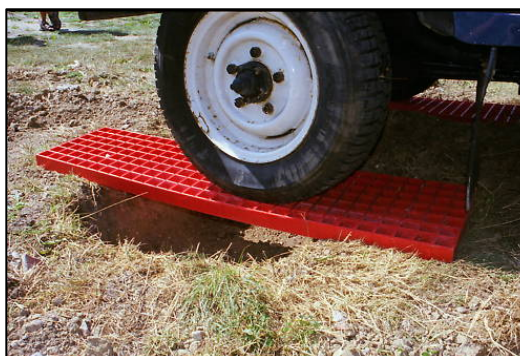
Tighten and back off half a turn to aid releasing these as on a hard pull they can distort. Keep a thin rod handy to unscrew.

Essential Equipment (?)—sand ladders

I have a reputation for suggesting that **sand ladders** are not worth their weight and size except for use as wind breaks when cooking.

A good and redeeming point made to me is that they can be valuable in self recovery situations where you may be stuck and the next vehicle isn't near or is busy, or in soft sand bowls where you don't want to risk getting another vehicle stuck.

Safety warning—a sand ladder under a wheel can get good traction and fire the sheet of metal or plastic from under a spinning wheel like a bullet. No spectators in the firing line please and also tie the



ladder to your vehicle so once you are out you don't have to walk back to collect the ladder.

A simple rubber roll up version is now available through Carrefour in Muscat for about 30 Rials. Safer, work well but are still quite heavy.



Essential Equipment—compressors

Vital equipment for any trip into the desert as tyre pressures are so important for crossing sand.

Compressors come in all shapes and sizes and the first tip is to avoid the tiny ones that fit in your pocket and claim to inflate jumbo jet tyres in minutes.....of course they do—we believe that!!

Compressors can be single or dual cylinder and dual cylin-

ders can be more effective. The measure of effectiveness is the volume of air they are delivering and also something called the 'duty cycle'. Duty cycle is critical as it says how long you may use the pump without letting it cool down. Duty cycle may be quoted in % or in time. A 30% duty cycle can be used for about 20 minutes in 1 hour without risk of damage. Think before you buy—a low volume pump

with a low duty cycle will take for ever to inflate your over-size tyres.

Local shops sell things that look like those shown here (these are from the quadratec catalogue) and local ones at 20-30 Rials have, for me, proved quite OK.

Warning the coiled plastic pipe—like all plastic in this climate deteriorates and may simply crumble in a year. Check before going out.



Essential Equipment—pressure gauges

The **pressure gauge** that comes with a locally sourced compressor can be your downfall. As an example on my first Wahiba crossing a colleague reduced his tyre pressure to 14psi using the compressor gauge and found he was unable to follow the

rest of the group. After a number of frustrating pulls and digs we checked his tyres with a good gauge and found he was driving at 24psi. Down to 14 on a good gauge and suddenly a new driver is born! Compressor gauges have several problems—first they are-

cheap and unreliable. But equally important we need to work in the range 8-35 psi. A compressor gauge (shown right) will often go from 0—200 psi and its resolution where we need it—5-20 can be impossible to use.



Pressure gauges –and deflators



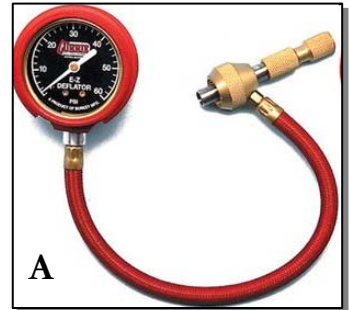
Look out for a good gauge and test it against others. I avoid the battery types as digital gauges are hard to read in the sun and batteries.....well what if they run out and so on.

Then consider **deflators**. These come in many shapes and forms and can make accurate deflation an easy job.

Shown right (A) is a simple deflator that screws onto the tyre valve and then an inner rod removes the tyre valve and lets air out until the required level when you simply screw it back in again. Easy and quick but only one wheel at a time and still bent over in the hot

sun. As this actually pulls out your valve I suggest you carry spares if you use one of these deflators.

So—consider something like **Staun deflators**. These come in sets of four and you adjust them using your spare tyre and a good gauge to the setting you want. Screw one on each wheel and it will automatically shut off at the required pressure. Go sit under a tree and contemplate life while this happens.



Spares—what to take?

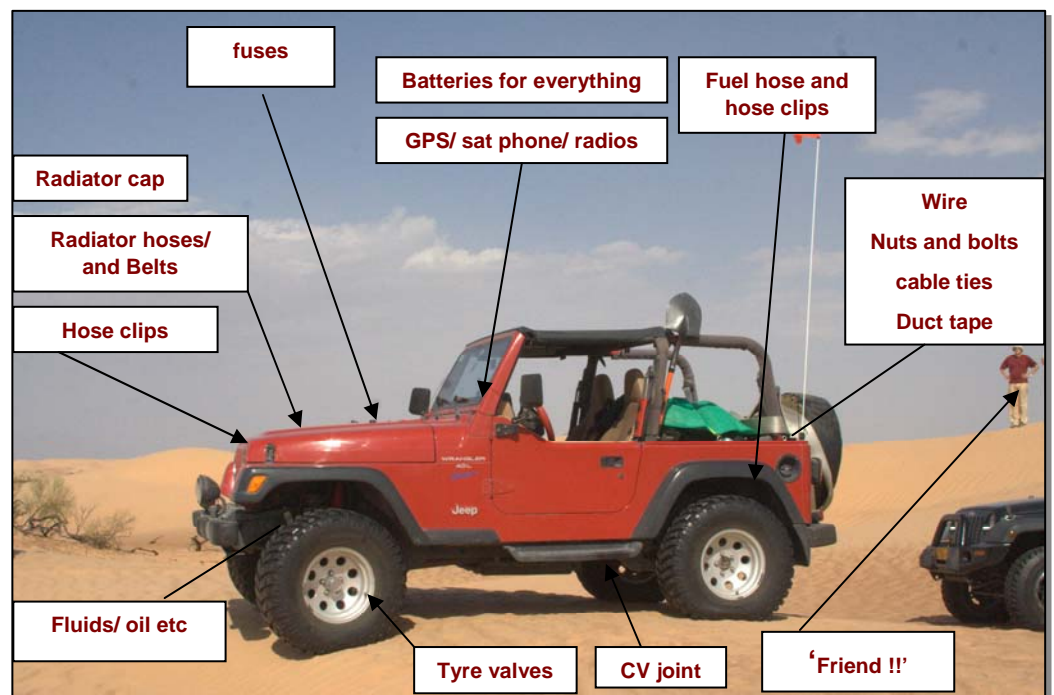
A few suggestions based on what I carry—use it as a prompt but not as a final list.

Pretty obvious and no need to enhance here except for the cheeky addition of ‘friend’ -

its hot and hard work—make sure that you don't lose the one you started with —no spares here!

Give me some feedback on things you have taken that

proved invaluable. I realise a corkscrew is invaluable but lets stick with sand driving!



At last—Sand Driving



Don't be too disappointed as I say in the talk—this is the hardest part and I usually end up simply showing pictures. I can't teach you to **read sand**, but that is the key to success. Like riding a bicycle, try, fall off, get back on and it will become more natural.

First a little about sand.

Shape: sand dunes typically have a main sand body and a slip face which is downwind. They can be elongate (Sief dunes), crescent shaped (barchan) dunes, star shaped dunes and many more. All can combine and all more or less reflect the prevailing wind conditions. (so there's a clue)

Orientation: wind is driving force and sand is carried up the main body of the dune and is then dropped down the slip face. Sand is winnowed from the low angle slope of the main sand body, but is then dropped as wind speed falls in the lee of the dune and especially in enclosed bowls.

Height: can be small as 1 m and as high as 100s m. Big dunes can carry small dunes which themselves can carry ripples.



Softness: new sand dunes are soft and old ones normally harder; edges and crests are commonly but not always soft. Where the wind is strongest it is likely that sand will be firmer. Where sand is dropped from the air it is likely to be softer ie downwind of the dune. (another clue).

Colour: bright coloured sand dunes are considered to have small sand grains and are soft while dark (bigger grains) are normally harder. Maybe but I don't rely on this 100%.

Stable: stability is variable and after high winds the slip face may be very soft and ava-

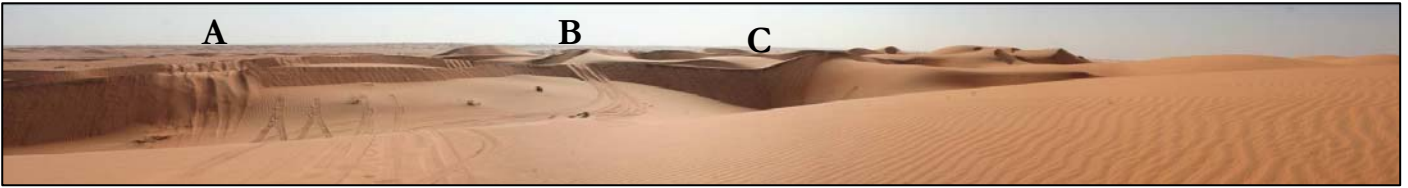
lanche. Downhill is fine but uphill can be quite a challenge.

Connections: sand dune accumulations will have connecting points and these can be used for smooth drive – these are typically areas where wind speed has been high and the sand winnowed.

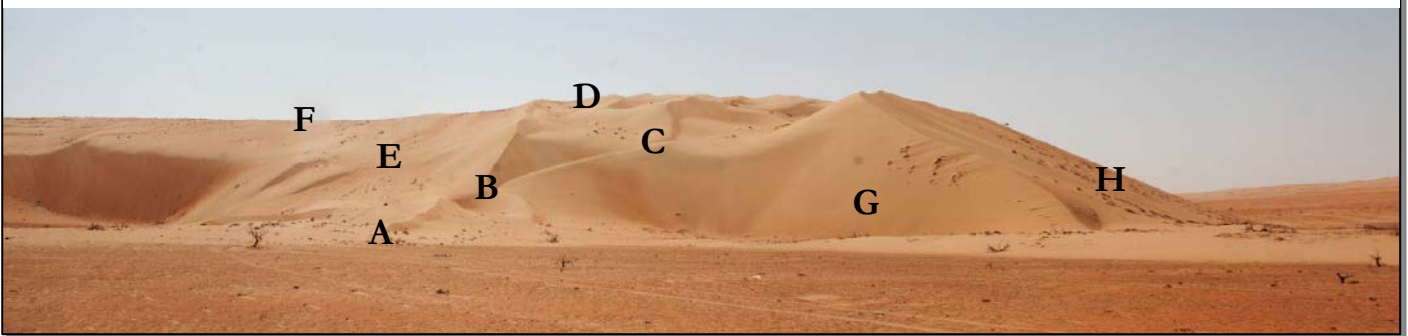


A long slope may justify driving in 2H for greater speed—take an oblique path and avoid the grass clumps.

Examples of Sand as 'food for thought'



Sand needs to be considered on different scales—consider the above and how life is different depending on whether you are coming or going over this sand. Towards the camera, a lot of people got stuck at 'A' while at 'B' life was easy. Had you chosen the slight dip at 'C' you might have spent quite some time recovering. Away from the camera some would do 'A' for a challenge while accepting 'B' was sensible!



No unique answers but look for some routes over this bigger scale challenge A-B-C-D maybe who knows what after C until you try or A-B-E-F. Jeeps are unlikely to make G but H is a possibility. This is food for thought only.



Whatever you chose this is going to be tough, keep moving it looks very soft, stay out of hollows and keep near ridges or crests.



Travel left or right the problems are evident and its firm and easy going—right to left careful of leaving the ground and with too much caution plenty of chances to end up stuck on a crest.



Travelling to the camera a good low spot was chosen—not to know, but to the right and a much bigger drop. Possibility of soft sand after such dunes should be considered.



Weave through these carefully and don't get stuck in soft sand filled bowls where such features may coalesce.

Sand Driving—the basics

It's not a race and you are merely the driver so look after your colleagues, passengers, the rest of the team, the environment, wild life, locals and your vehicle.

Listen to feelings, opinions, concerns and plan how to get everyone through the event with a smile. Its not a race but a team event.

Keep everything tied down and wear a seatbelt OR make life interesting by allowing that can of coke you lost to roll under your pedals as you begin a descent down a 100m slope in the wrong gear!

Respect convoy rules (covered

later) and also get involved.

You got it stuck—at least help your mates to fasten a tow line to your vehicle and remove it afterwards.

Start the sand part of the journey by airing down.

Think about convoy rules and where you are in the plan.



Practice just stopping over a crest (cresting) so you are ready to move on downhill



If you see someone without a smile—give them one of yours!

"Momentum is your friend while speed is your enemy"

"As fast as you need but as slow as you can"

Sand Driving—more tips

4WD is essential:

- As discussed earlier (4WD) 2H and 3L are options and you should try both. What works for you is the best choice.
- You need momentum to get up sand and this requires speed.
- In sand momentum is your friend. Speed at the top is your enemy but they

do go hand in hand.

- Gauge the optimum balance for each set of conditions.
- The next catch phrase to remember is you should go as slow as possible but as fast as necessary.
- Always have the priority of maintaining traction.
- On the flat 40 kph is a good guide—on a slope

you will be lucky to achieve this.

- On long firm slopes I find 2H gives me control at a higher speed
- On soft and steep sand 3L gives me more power and torque at a lower speed.
- Don't fly just because photographers like it—your suspension doesn't—and who is waiting at the other side?

- Careful with grass as bouncing can help shear transmission shafts.
- Judge speed and momentum and learn to 'crest'



Looks good but your suspension may disagree.

Sand Driving—and more

- If you feel its not going good stop and back off before you are stuck.
- Stay perpendicular to the slope—especially downhill.
- Try again—new sand may be easier than churned up sand.
- When you stop keep your

engine running to cool the engine block

- No hard braking
- You can't easily change gear on an upward run
- Stop on firm flat ground or slightly downhill.
- Learn to crest and check out what's next.



You need speed and momentum. This driver backed off a little too early and ended up settled on the top of the crest.

Sand Driving—downhill

- Stay perpendicular to the slope.
- Use 4L-1st gear and the engine will do the braking for you. Make sure your front wheels are straight and check this by looking out of the window, not just your steering wheel.
- Some say no brakes but I prefer to top up the engine using brakes to build up a wedge of sand in front of my tyre (*no rules its personal to me*)—but don't brake continuously and don't brake too hard. This works well for jeeps but for longer wheel based vehicles braking may cause the rear wheels to drift sideways which can be dangerous.
- don't get too close to the vehicle in front and you should have a visual confirmation that the car in front is clear before starting to go over a big edge.
- Get a passenger to walk to the edge and check if its clear if you are unsure.
- No handbrakes as this can

take you out of line

- You usually have no choice but do try and miss trees and bushes on the way down as its very hard to extract you from a tree.
- Careful at the bottom as the angle may be sharp.
- If circumstance permit be ready to speed up at the base to get enough momentum to get up the next one—this is usually only for smaller slopes The really big dunes are often flat from the base onwards. Clearly in 4L1 you will have less chance to do this.



Good practice is to crest and wait to see if the route is clear before setting off down a steep slip face. Stopping on a steep dune face isn't an option—without the help of a tree of course!



Stay perpendicular to the slope and use your engine as a brake.



Don't cross slopes if at all avoidable



Be prepared to accelerate if your rear starts to drift to the side or steer into the side that's drifting.

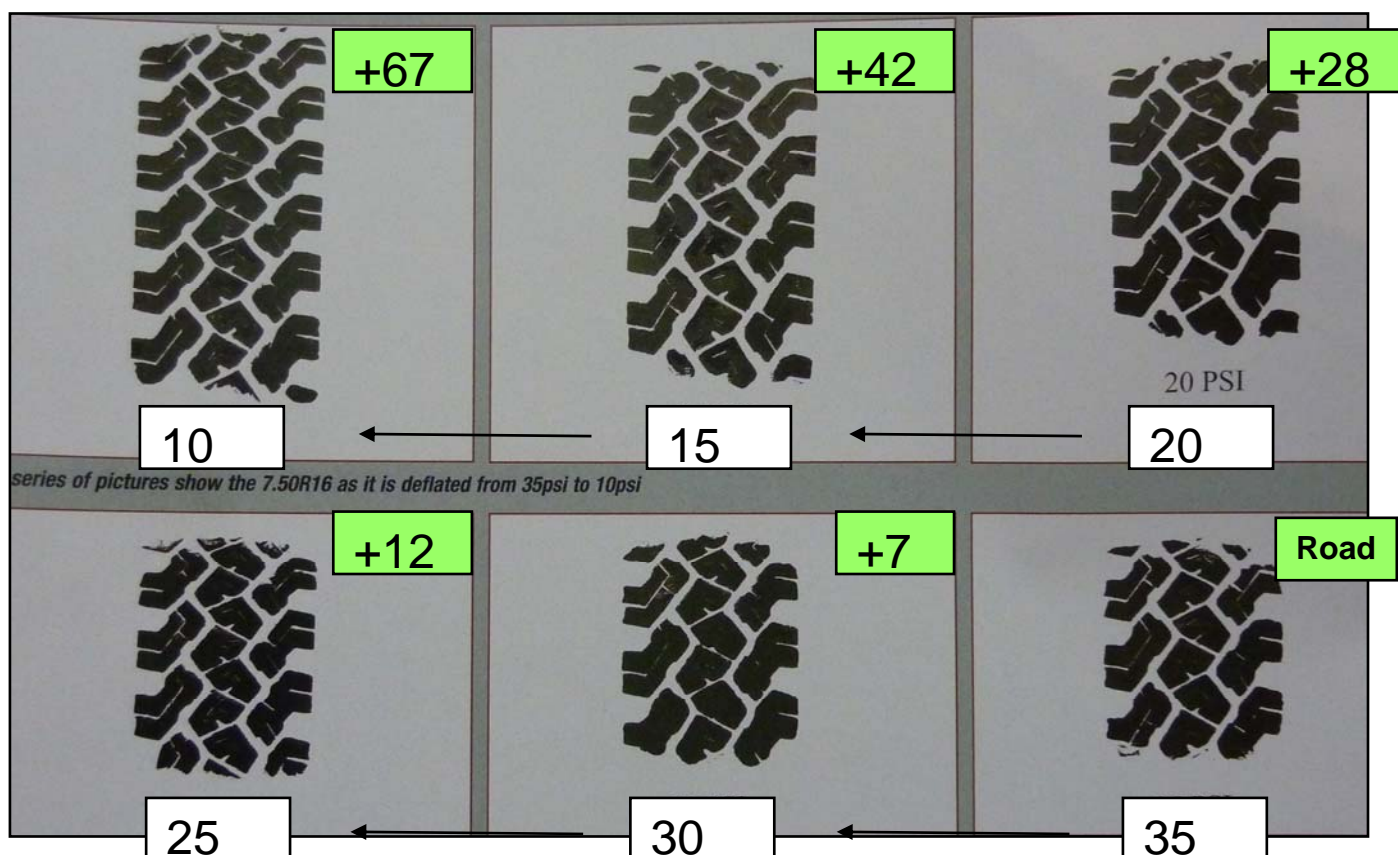


If you go down—make sure you can get out

Tyre Pressure



The photos below are copied from a magazine article in which a tyre at normal road pressure (bottom right) is painted black and lowered onto a sheet of paper and its area measured. Pressure is reduced to 35, then 25, 20, 15 and finally 10 psi. The green boxes show the increase in tyre area in contact with the sand. Not much change until 20 psi then a massive increase to almost 70% increase at 10 psi. Note how it's the tyre area and not the tyre walls as some people will tell you. It is this increase in tyre 'area' in contact with the sand and that's aiding your 'traction' or 'grip'.



So, we will start by 'airing down' as this sounds much more skilled than simply letting our tyres down.

The tyre pressure we choose depends on a number of things:

- the terrain
- Type of tyre
- Type of vehicle
- The load in the vehicle
- 12-18psi is a good start especially for heavier Landcruiser/Pajero vehicles
- Consider different front and rear pressure depend-

ing on the distribution of your 'load'.

- Give it a try at 18psi and if doesn't work head towards 12 psi
- Remember tyres will heat up as you drive in the hot sand.
- Check tyre pressure frequently
- Unless you are experienced don't go too low. Some Jeep drivers go to 8 psi or less.
- Once tyres are deflated don't make sharp turns or the tyre may come off the rim.
- Don't drive across steep slopes as again the tyre may come off the rim
- When your tyre pressure is good you will feel the vehicle effectively 'float' across the sand.
- Deflated tyres will also make a deep humming noise—don't worry its normal!

The picture below shows that a deflated tyre can easily be pulled off the rim by erratic driving or crossing a steep slope.

Check a later section for how to get it back on the rim.



Driving in Convoy

Sounds a bit harsh to have to keep in line like a row of schoolchildren on a day out, but in the desert it makes a lot of sense.

The principals are:

- A **lead driver**, usually experienced takes front position and explores the route ahead
- **Number two** vehicle at a suitable time will follow the lead vehicle
- **Three** will follow two and so on with inexperienced drivers taking up position number two or three rather than three or four.

- An experienced driver takes up the **rear position** and may scout around helping inexperienced drivers in the middle although he always returns to rear position.

The convoy only works if number one never proceeds unless number two is keeping pace (if not he may be stuck). Two doesn't proceed unless three is keeping pace and so on.

In this way the convoy moves on when it can but is very effectively stopped if any one vehicle has a problem.

Rules: don't jump out of line and always look out for the vehicle behind—stop if its not following. No radios required!

That's it—it works and its fail safe if you follow the rules.

In the desert you can be 100m away from someone and be lost if they leave it too long to look for you



Note how in this photo we have five vehicles moving in a good convoy. The cars are well spaced and the rear white car is holding his position while the red car descends a steep sand face. Car 4 is perched on the crest while he makes sure car 3 has safely cleared the dune.

Convoy failures— an example

OK convoys work unless.....

A real example on a recent training trip. Five groups of four or five vehicles moving more or less in the same direction when a rogue driver decides to go it alone over some more difficult sand.

Number 3 car has a problem but recovers and sees some tracks and follows them.

Number two isn't watching so my team ends up with two vehicles only while a group of three novices ends up following the rogue 4WD that is looking for harder 'vertical' sand.

The outcome was an experienced driver ended up having to extricate 3 novices from very difficult sand without help while I plodded on

oblivious, knowing my number two was following me so everything must be OK.

What can go wrong—will.

Lesson—avoid criss-crossing fresh tracks. But also try and remember which vehicle you are following and being followed by—if it changes size or colour something has gone wrong.

Vehicle Recovery—Safety First



Do what you can to make sure this is not the last thing you see when you are stuck at the base of a dune.

Most newcomers to sand driving have an image of digging holes in the hot sun to recover stuck vehicles. Without putting a percentage the majority of stuck vehicles are recovered by pushing rocking and so on with a quick pull on a 'strap' being perhaps the quickest and easiest solution.

Note I avoid the use of tow-rope deliberately as these are sold in supermarkets to pull broken down cars along the highway, not for pulling a 4 ton Hummer out of a hole in the sand.

So you are stuck—what to

do ?

- First and foremost are you safe? Being stuck in soft sand is a nuisance, being stuck at the base of a 10m dune when the car behind can't see your flag is a situation that needs immediate attention.
- If the situation is the latter then the passenger must be out of the vehicle and up the dune face to warn off oncoming vehicles asap—but safely. This entails avoiding your own tyre tracks as these are

most likely the route for following cars. The driver can do a bit of aggressive horn blowing to get attention.

- Good practice is for following vehicles not to go over a crest at speed if the vehicle in front hasn't visibly exited. Hovering on a crest (cresting) is good practice.

Vehicle Recovery—in practice



If you cant see the driver—he can't see you—keep out of the way on dunes.

Lets start with some easy ideas. First of all check tyre pressures.

Pushing and shoving is actually more effective than you think—try it. But at the same time the driver must be encouraged not to just keep digging deeper by spinning the wheels.

Try turning the wheels left

right etc turning the wheels slowly while being pushed—maybe get some traction.

With the vehicle stationary try rocking the vehicle from side to side quite violently—each rock lifts the wheel by a few mm and sand goes under the tyre. Same on the next rocking and so on. This can be very effective in lifting tyres out of sand.



D'yer think if we rock it a bit we can shift it?

Told yer not to spin the wheels!



Check out the tracks, this jeep has gone in a circle trying to maintain speed and momentum but has lost the fight. An ideal case for sand ladders as bringing another car in to tow could easily result in two stuck vehicles.



You don't need a shovel to dig holes—best to stop and get a simple pull or in this case forward left a few inches backwards right a few inches and so on maybe twenty times. The jeep was driven out without assistance.



Come on guys I wouldn't be stuck if there wasn't 14 of you in my car!

Recovery—the easy way



Sorry mate, new club rules—you got it stuck, you dig it out!

Actually the picture left is deliberately cropped. In situations like this digging is rarely a solution. The way ahead (right) was soft so pulling from behind had this jeep out in a few minutes.



A few rules or guidelines for safe towing:

- Use a correct rated sling and shackles
- Try and use gravity and pull downhill where possible
- Secure to each vehicle using the correct mounting point
- When using a kinetic rope leave some slack
- The driver of the pulling car needs to check if the stuck car is ready and does nothing until this is confirmed.
- The pulling car should then make a firm but not too

fast drive which will stretch the kinetic rope and effectively ‘jerk’ the stuck vehicle free.

- If possible the towing car keeps moving until both vehicles are on firm ground.
- Throughout, the towed car

should try and maintain traction—no revving and digging deeper please.

- Ideally have a coordinator, but keep all spectators well back.
- Using a normal strap is the same but with a more gentle run before pulling.



Coordination is effectively what’s happening in the photo to the left. Pulling a vehicle off a crest in reverse—one man is in control, no spectators to get in the way or be injured if ropes, shackles or mounting points break.

Although it’s a wise move we

don’t see this happening enough, and we should.

A Jeep stuck in soft sand (below) is being pulled slightly uphill as circumstances prevent the use of gravity to pull downhill. The pull will be hard and the lady in black is wrapping a sand mat around the tow rope to prevent injury if rope or shackles break.



Winching is pretty much the same but perhaps greater chance of cables breaking and causing injury. Above, spectators are well back and the cable has a tow strap wrapped around to prevent it whipping back if the cable breaks. Again one coordinator working closely with the stuck vehicle.



Recovery—the skilled way

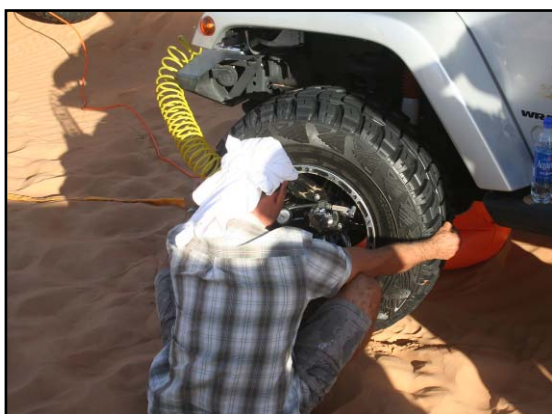
With deflated tyres a quick reaction to avoid a clump of sand or unexpected hole can

result in a tyre coming off the rim. Don't panic and don't drive on as losing one 'bead'

is easier to fix than losing both 'beads'. Some photos below show how to approach the problem



1. *With a tyre off the rim try and get the vehicle into a safe and level position*
2. *Jack up the vehicle from under the drive ie lift the wheel and not the body of the vehicle.*
3. *Empty as much sand as possible from the tyre*
4. *Wash sand off the rim with plenty of water*
5. *Try not to fill the tyre with water*
6. *Connect an air line and start pumping air.*
7. *You can increase the compression on the tyre forcing it onto the rim by tightening a ratchet strap around the tyre. It works but so far in Oman I have never seen this needed.*



8. *Pull the tyre onto the rim firmly—maybe knees or feet on the rim to keep the vehicle stable*
9. *Pull, wiggle and jiggle the tyre around until it begins to seat back on the rim*
10. *Check with water that it has a seal—keep fingers out of the gap*
11. *its important enough to say again—fingers out of the gap*
12. *Keep pumping air and the tyre will/ should pop back onto the rim. Be prepared—popping back on the rim can be quite a loud event!*
13. *IMPORTANT—you now have sand inside your tyre and cannot drive at high speed on blacktop. As soon as possible get the tyre removed and all sand blown out.*
14. *OR swap your spare tyre once on blacktop for a faster ride home.*

Safety is a big issue here as the vehicle is jacked up quite high and is eventually going to be jerked around quite harshly—make sure it is stable get others to keep an eye on the jack while you are working. Keep arms legs knees feet and whatever from straying underneath. Its much easy to pull the tyre with legs underneath **DON'T DO THIS!**

Leather gloves, builders gloves are a big help as tyres and wheels etc can be quite hot to handle.

Fingers away from the tyre to rim gap as when this springs back on it is very forceful and my guess is you would lose rather than bruise a finger if its in the gap.

The Environment

Environmental issues creep into all aspects of modern daily life—more so in the desert where most things that survive seem to do so in a very fragile way.

Just a few photos here and simple messages.

Realise that no matter how hard we try to clean up both our own and other peoples rubbish and respect the desert, to many people we are actually intruding and damaging the environment.



Be friendly when it is appropriate but accept that you may not be welcomed in every case. Avoid farms and camps and drive carefully where there are children. In the desert kids are not street wise when it comes to traffic.



Good for a camp fire but is it really dead?



Give a wide berth to animals whether they be goats or camels. A convoy of jeeps can freak out restrained camels and scatter goats. A tethered camel and worse still a hobbled camel can be seriously injured.



Late winter and amazing how much dead charcoal firewood springs back to life.



A great end to the trip but careful what you burn and even more careful about what you leave behind. Cans burned on a fire still need to be taken out of the desert.

GPS—An Overview

So many times in giving this talk I have used the words 'most important for desert driving'. However in the desert we have no maps and the GPS is our only way of driving to where we want to go and also retracing our steps if we need to change route etc.

Best choice? I really can't advise but I have used only Garmin, I have a handheld Garmin -76S which I find too small for use in a vehicle and I have moved on to a Garmin-276C which has proved to be excellent and a common choice for off road drivers in Oman.

The choice is personal taste and for me the ability to see a large screen in sunlight is an advantage as is an ability to orient my map in the direction of my destination point makes driving solo much easier. Lots of other bells and whistles, sunrise, sunset, phase of the

moon, tides etc but these are all extras.

How to use?

I'm not going into detail here but suffice to say we prefer to use the UTM coordinate system.

- In the UTM system, the globe is divided into zones and the area of Oman that we will drive falls into the zone 40Q.
- Failing to enter this zone will place your coordinates somewhere else in the world.
- On a recent training trip when we gave coordinates for a camp site some suggested it was in Pakistan.
- Well 40Q is in Oman and 42Q might just make it into Pakistan.
- Remember this zone is critical and if you are trying to use a simple cheap

GPS unit then make sure you can select the correct zone.

- A good GPS can give coordinates in other formats but in the desert this can be slow—best to have a unit that can accept UTM.
- Check it out—the entrance to Carrefour Qurm top level on the car park is.....

40Q 0651194

2611748

.....according to Google Earth.

You may have trouble finding a GPS-276C in Oman as this is a discontinued model. However it still seems to be available on the internet—try Cleopatra's in Ruwi a veritable Aladdin's cave of electronics.



The Garmin Map 276C isn't exactly designed for walking but in a vehicle its claim to be readable in sunlight is in my view a winning point.



The UTM grid for the M East region showing Oman in the 40Q 'zone'. Beyond this each zone is divided into northing and easting coordinates based on 'metres' from the bottom and left boundary

Satellite Phones

Again I don't know much about which is best, but in Oman we tend to use Iridium or Thuraya satellite phones and as only one per team of vehicles is necessary then they tend to be 'borrowed' from ORAC or others.

- Borrowing phones works well as its simply a matter of inserting your SIM card into the satellite phone which will then either use a normal signal or the satellite system when out of range.

- 'Try before you rely' is a good message as you need either a post paid SIM or a pre paid SIM with 10 Rials or more credit.
- And you need to remember to add the country code (00 968) when using the satellite system to call.
- Usually part of the Wahiba Challenge pre-qualification process needs you to prove you can make a call.
- Sounds silly but a large number still try to use pre-

paid cards without enough credit or fail to add 00968.

- As mentioned, try it before you leave home!
- The Iridium sat phone is more expensive to but has a greater international range



Expensive and just a photo here to fill space not a recommended make or model! - suggest borrowing from the club or often PDO departments have. Your card goes inside so you pay all the bills its easy.