



9.
**VEHICLE
PREPARATION
AND BUSH
REPAIRS**

Following your vehicle manufacturer's service handbook recommendations when doing maintenance will get you going in the right direction. Get yourself a good workshop repair manual and carry it in the vehicle particularly when on a trail. This chapter gives advice on proper maintenance guidelines and how to avoid common mistakes as well as remedies for common vehicle breakdowns far away from home.

MAINTENANCE

VEHICLE LUBRICANTS - THE KEY TO RELIABILITY

Engine oils contain additives that make them specific for use in internal combustion engines. These are: alkalis to neutralise acids created by the combustion process, anti-foam agents to prevent air becoming trapped in the moving oil, anti-oxidants to prevent varnish deposits in the engine, and emulsifiers to keep any water contaminants suspended in the oil.

Automatic transmission fluid can be used as engine sump oil in an emergency. It should not be mixed with other oils and should be replaced with engine oil as soon as possible.

Gear oils are labelled hypoid, hypoid or EP. Medium to heavy duty gear oils are specified GL 4 or GL 5. GL 4 oils are normally SAE 80 or 85/90. They have limited extreme pressure (EP) additive and are suited to gearboxes, transfer gearboxes and some hypoid differentials. GL 5 oils are suited to heavy duty uses such as hypoid differentials and swivel pin/CV joint houses. The EP additive in GL 5 oils reacts with bronze synchronisers in main gearboxes and should not be used as the additive is so effective that it negates the friction required for synchronisers to synchronise gear changes. EP additives in GL 4 oils are often insufficient to handle the gear tooth loads in hypoid differentials.

Borate oils are superior gear oils containing boron additives. They offer superior performance to EP oils. They are however costly and are very sensitive to water contamination which severely degrades their performance. These oils are used in transfer gearboxes and differentials, areas that are vulnerable to water ingestion when wading, so they are not well suited to a working 4x4.

Oil changes

Cheap oils are the cause of a great many serious engine breakdowns. Although the manufacturers of cheap oils can give accurate information about the lubrication properties of their oils, seldom do they detail the cleaning and anti-sludge additives in their products. To make matters worse, rarely do the engine problems occur while the cheap oil is in the sump, and this is why: a cheap oil is run for one or more service intervals of let's say 10 000 kilometres. Then the vehicle is treated to a high quality oil either by the service centre or the owner who now has a little more to spend. Now, the excellent cleaning properties of the expensive oil have to do the work of the many kilometres run with the cheap, non-cleaning oil.

The sludge is cleaned from the engine and is filtered by the oil filter, which soon clogs up. If there is enough sludge to block the

filter the engine's lubrication system fails and the engine seizes. This is then blamed on the new oil or the service mechanic. Oil is the life blood of your vehicle. Buy the best.



After deep water wading, water ingestion into gearboxes and axles can do hidden damage. Be sure to check for cloudiness in the oil - the first sign of contamination by water.

SERVICE INTERVALS

Many 4x4s are part-time and therefore low mileage vehicles. Engine lubricants degenerate even if the vehicle is not being used, whereas gear oils less so. Acid, oxidation and sludge formation are the chief villains. Six month intervals for engine oil changes and 18-month intervals for transmission oil changes should be adhered to.

When a vehicle is being operated in severe conditions, service intervals indicated in the handbook may have to be revised. For instance, if the vehicle is doing a lot of wading, water contamination of the axle and gearbox oils could mean that oil changes are required weekly. Heavy dust will mean that air and fuel filters will need to be changed frequently. Cleanliness of oils, filters and vehicle components has a direct effect on a vehicle's working life.

Service intervals and diesel engines

Diesel engines require servicing more often than petrol engines. I am told this is more the case in Africa than in First World countries due to the relatively poor quality of the diesel fuel and the quantities of dust in the atmosphere. If you have a diesel engine and want it to last more than 300 000 kms, as they frequently do in Europe, it is recommended that the sump oil and filter are changed every 5000 kms.

BREAKDOWNS

Most breakdowns in the bush can be handled with a good tool set and spares such as fanbelts, rotor arm, points, spark plugs, gasket paper, silicone sealant, a packet of odd nuts, bolts and screws and a length of wire.

Don't start taking complicated components apart until you are absolutely sure that this is the cause of the problem. On my travels I have assisted with a number of breakdowns and it is startling how many times the carburettor is the first component to be accused as the villain and stripped only to find that it is not at fault. Once the carburettor is reassembled its settings have been altered and the



vehicle now has an additional malfunctioning component. Remember, if you need to strip something, you will be working in far from favourable conditions and repairs will have to be improvised with what you have with you. With

a workshop repair manual a repair job is made very much easier and one should always be carried, even if you think you know your vehicle well.

If you have a breakdown and intend to do what you consider to be difficult repairs, do not do these repairs too far away from the side of the road or track; do not hide your reasons for stopping. Nobody will stop and offer assistance if they think you have merely pulled over for a picnic.

INSPECTIONS

Regular inspection of a vehicle on safari is advisable. Check the undercarriage for bent suspension components, oil leaks, leaking shock-absorbers, loose wiring, loose transmission drain plugs, and any other parts about to drop off. In the engine bay, radiator caps, fan belts, battery clamps, high tension leads, engine oil, coolant, hydraulic fluid and battery electrolyte levels should be checked daily.

The following is a check list of vehicle support items that should be taken when travelling into unpopulated areas:

Support Items

- Jerry-cans
- Tyre pump/s
- Workshop repair manual
- Spark plugs
- Fuses
- Fuel filter
- Distributor cap
- Points
- Plug suppressor
- Various nuts and bolts
- Galvanised wire
- Radiator cap
- Quick set epoxy glue
- Five litres gearbox oil.
- Insulation tape
- Loctite thread fastener
- Fuel hose - more than two metres - long enough to double up as a siphon hose.
- Second spare wheel (not essential if two similar vehicles are travelling together).
- Funnel
- Tyre repair kit
- Engine mount
- Globes
- Fan belt/s
- Rotor arm
- Condenser
- Coil
- Hand cleaner
- Electrical wire
- Spare keys
- Gasket cement
- Epoxy putty
- Hydraulic fluid
- Prestik

- *Automatic transmission fluid (automatic gearboxes, power steering)*
- *Medium and fine water paper*
- *Water repellent - Q-20 or equivalent*
- *Carry enough engine oil for at least one complete engine oil change.*
- *Set of main leaves for springs - (well-used vehicles) an entire spring is not necessary. These can conveniently be carried by securing them to the front bumper and attaching a set of shackles and shackle pins onto which the leaves are fastened*
- *Set of half shafts (Land Rover Series II), essential if vehicle is fitted with wide tyres.*
- *Exhaust sealing compound and tape.*
- *Various electrical connectors matching those used in your vehicle.*
- *Set of battery jump cables.*

Tools:

- *Spark plug wrench*
- *Ratchet for sockets*
- *Two tyre levers*
- *Screw drivers*
- *Heavy chisel ±25 cms*
- *Circlip pliers*
- *Flat nose pliers*
- *Mole wrench*
- *Watchmaker screwdrivers*
- *Two hammers - 1/2 and 2kgs.*
- *High lift jack - for breaking tyre beads.*
- *Set of spanners to fit your vehicle (metric and/or imperial sizes).*
- *Adjustable wrench - medium and large sizes.*
- *Ignition timing light or bulb and wire with crocodile clips.*
- *Set of sockets*
- *Power bar for sockets*
- *Tyre pressure gauge*
- *Hacksaw*
- *Sharp nose pliers*
- *Wire cutters*
- *Feeler gauge*
- *Impact wrench*
- *Valve spanner*
- *Jump-cables*



Poor quality jump-cables are more troublesome than they are worth

Carrying tools in a strong canvas bag is preferable to steel boxes. In canvas the tools will not rattle and will not be covered in a layer of fine iron filings as will be the case if carried in metal boxes.

RADIATOR DAMAGE

Big holes can be sealed with epoxy putty. Small holes can be fixed by breaking an egg into a bowl, removing the yolk, and pouring the white into the radiator. The water must not be hot when you do this. Do not replace the radiator cap until the temperature is up, otherwise the pressure will force the soft egg out of the holes. Remember to flush out your cooling system as soon as you can make permanent repairs. Porridge is an alternative to egg white.

Overheating

This is a common problem when driving in thick sand for long periods, especially when towing.

The following causes should be investigated, and in this order:

- *A broken or loose fan belt. A fan belt is an essential item in your spares kit.*
- *Low coolant level. Do not remove the radiator cap when the engine is hot. The sudden drop in pressure will cause the engine temperature to rise sharply and this could damage the engine. Scalding steam could also injure you.*
- *Low engine oil levels. Oil cools as well as lubricates the engine. Make sure that the oil level is always at the high mark on the dip stick.*
- *Grass and grass seeds clogging the air gaps in the radiator.*
- *Vehicles with an air conditioner radiator sandwiched to the engine radiator - grass seeds and insects often clog the air gap between them. This cannot be seen unless one radiator is removed. Gradual engine water temperature increase over a long distance is often a result of this. Check your vehicle before your safari. Fit a grille net to prevent this build up.*
- *Badly adjusted ignition timing. You will need a timing light to set the ignition timing accurately. The timing specifications are given in the vehicle's handbook or workshop repair manual.*
- *Malfunctioning thermostat. Overheating will result if the thermostat is not opening to its full extent. Remove the thermostat and see if the overheating continues. If this does not help, replace the thermostat - it is not good practice to run an engine without a thermostat and one should be fitted as soon as a replacement is available.*
- *Auxiliary equipment badly positioned in front of the radiator. Overheating caused by a restricted air flow may only become apparent when the vehicle is worked hard.*
- *Research has shown that antifreeze increases the cylinder wall temperatures. If your vehicle does not live in a climate where freezing is a threat, remove all antifreeze and replace with a solution of pure corrosion inhibitor. An example is Motorcraft SXC103. The concentrations of water/antifreeze indicated on antifreeze product labels is often far too high for the Southern African climate. Reducing the concentration will aid cooling and reduce creep-seep. (The creeping properties of anti-freeze makes it ooze from pipe connectors leaving green stains over parts of the cooling system).*

RECOVERY OF A DROWNED ENGINE

I have only once drowned an engine and in the event getting going again was painless and took about forty minutes. If water is sucked into the cylinder heads the process to safely evacuate the engine is as follows:

- *Remove the air filter.*
- *Remove water from the intake pipe and turbo. Check for deposits of sand.*
- *Chock the wheels and jack up one rear wheel. Engage two-wheel drive (or unlock the centre diff) and engage high-range fourth gear. Release the handbrake.*

- *Remove the glow plugs (diesel) or spark plugs (petrol). An alternative for the diesel is to remove the injectors, but they are often more difficult to remove than glow plugs.*
- *Turn the engine by rotating the rear wheel. Rotating the engine in this way prevents the starter being stressed and prevents the possibility of a bent conrod at any stage of the flush because with hand-power, resistance can be felt and nothing is forced.*
- *Once all the water is out of the cylinders, clean, dry and replace the glow/spark plugs. Replace all seals. Only replace the air filter if it is dry, because a wet paper element could be sucked into the engine giving you a bigger problem than you started with.*
- *Have your mother-in-law stand behind the vehicle and start the engine. Why your mother in-law? Think about all the water in the exhaust pipe which has got to have some place to go when that high-compression engine starts up!*

CLUTCH FAILURE

If your clutch fails, ascertain the cause of the problem. If you have a hydraulic clutch as do most 4x4s, check the level of the fluid. In the event of a fluid leakage from the master or slave cylinders this means that the piston rubbers are leaking. Bleeding the system may provide a temporary solution. If you dismantle and reassemble these components cleanliness is paramount. If you do not have hydraulic fluid almost any liquid will do. (In an emergency, add dishwashing liquid to water but avoid bubbles). Do not use mineral oils as they will soon rot the rubber plungers in the slave and master cylinders. If your vehicle has a cable operated clutch, check the tension of the cable. Adjust so as that there is a very small amount of free play ($\pm 2\text{mm}$).

If you are unable to get the clutch working, try changing gear without one. It just takes a little practice. When starting off, warm up the engine so that it will start easily and then switch it off. Engage first gear, and restart the engine. The vehicle will move forward and when the engine fires you will be on your way.

Gear changes are made in the following way: accelerate the vehicle until the engine is revving a little higher than for a normal gear change. By doing this you are allowing for the additional time it will take for each gear selection. Now, decelerate slightly until the engine is neither pushing the vehicle nor holding it back. The gear stick should move to the neutral position very easily. Now decelerate slightly until the engine revs match the wheel rotation as they would when engaged in the gear you are about to select. (If you are changing up a gear you will need to accelerate the engine). Change to the new gear slowly and gently - do not use force. When your engine revs are correct, the gear will engage quite easily and after a little practice you will make quite smooth gear changes. For obvious reasons, I do not recommend doing this in stop-start traffic.

STARTING WITH FLAT BATTERY

A flat battery need not cause panic. Assuming that the battery has enough power left to be able to fire the engine but not turn the starter motor, and you are unable to push start the vehicle due to

heavy sand, by jacking up a wheel and rotating it with a length of rope the engine can be restarted. Do the following:

- *Switch off all electrical equipment - conserve all of the power the battery has left in it.*
- *As the vehicle cannot be held by the handbrake the vehicle must be chocked. In sandy conditions one way to do this is to dig shallow holes behind the back wheels and push the vehicle into them. On hard ground, a heavy log, buried in a shallow trough and laid in front of the wheels, works well.*
- *Jack up one rear wheel but do not remove it.*
- *Wind a long length of rope tightly around the tyre so that when it is pulled the hub will rotate in the same direction as it would if the vehicle was moving forward. To do this make a knot in the end of the rope and wind the rope around the tyre crossing over at the knot. The rope must be wound as tightly as possible. Then wind the rope another two or three times, maintaining tension all the time.*
- *Gear selection depends on the size of engine and you may find that if the gear selected is too low, the vehicle may fall off the jack. Some trial and error may be required. A good ratio to begin with is high-range third.*
- *Switch on the ignition. Add choke if required.*
- *Depress the clutch and get someone to pull the rope. Release the clutch when the wheel reaches maximum speed and the engine should turn over.*
- *If your battery is totally dead and an alternator, as opposed to a generator, is fitted, this will not work. (most modern vehicles are fitted with alternators) It will also not work with automatic transmission.*

NOISY SUSPENSION

During a safari a vehicle's suspension takes a great deal of pounding and if the vehicle is overloaded it is often the suspension which is the first thing to break. Wearing of components such as rubber bushes is accelerated by the combination of heavy loads and mud and dust.

The most common causes of suspension noises are:

- *Shock absorber rubber bushes worn or missing.*
- *Shock absorber mounts badly worn so that the shock moves in the mount.*
- *Spring shackles worn (leaf springs) - replace*
- *Misaligned coil springs - park the vehicle so that the suspect spring is extended. Try and rotate the spring. A clunk can be heard as it returns to its correct mounting position. If the noise persists, slip a short length of plastic garden hose onto both top and bottom of the spring.*
- *Coil spring suspensions have many rubber bushes linking each component. Any of these bushes in a worn state could cause suspension clunks.*

Steering vibration

Violent steering vibration, sometimes triggered by the front wheels hitting a bump, is caused by a fault with the steering

damper. The steering damper is a shock absorber that lies horizontally in front of or behind the front axle. It links the steering system to the axle, absorbing vibration so that steering kickback over rough terrain does not rattle the driver to pieces. The fault can be a loose connection, a broken fitting, worn rubbers or a worn damper. The symptoms seem to be aggravated by well-worn front tyres.

ORDERING SPARE PARTS

Ordering parts when in an outback village or town may be possible.

Parts dealers will require the following information:

- *Vehicle engine and chassis number.*
- *Part number if possible.*
- *Quantity of parts.*
- *Specify left or right side of vehicle. (This is indicated as if you are standing behind the vehicle and looking forward).*
- *If you do not know what the part is called but have to describe the part, avoid colourful language - keep the description as simple as possible.*

When the parts are received, check the packaging. Most genuine manufacturer parts are well packed and protected. Pirate parts are often mishandled, badly packed or damaged and may not be complete. Always order original parts if you can.

ACCIDENTS IN THE BUSH

Northern Botswana 1988:

I opened my eyes. The view of the road ahead was obliterated by the bonnet which had been torn from its hinges. I looked around. Everyone was motionless - staring forward in a stunned silence. The driver's door was jammed shut, so a little shaken I climbed out through the window.

We had been game viewing on the narrow dirt track that links Serondela camp site and Ngoma, the bridge over the Okavango river and the border post between Botswana and Namibia. I looked around - resting in the bush was the Toyota Land Cruiser that had rounded the blind bend at high speed, and smashed into my Range Rover. The Toyota did not appear to be badly damaged - the rear canopy was torn and the driver's door was badly dented.

The road was totally blocked. In the middle my 1971 Range Rover, with bits of it strewn around. Soon a large truck appeared. It was full of locals and to my surprise ...tourists! Local transport consists largely of open flatbed trucks used by the villagers and smaller four-wheel-drive vehicles used by government personnel and wealthier tourists.



These tourists were American students bumming their way around Africa on dollar-a-day, and for them our accident scene was a welcome break in the monotony of their overland travels.



Closer inspection of the damage was made after the Land Cruiser towed the Range Rover to Ngoma Gate, a place to work out in the open safe from lions and elephants. On first inspection it appeared that we would not be driving anywhere for some time! The entire right fender and valance had been twisted beyond recognition and the battery had split in two. The wheel rim was wrecked and the drag link, tie rod and radiator fan were badly bent. The radiator appeared undamaged, but the header tank had been holed, a problem easily solved with some epoxy putty, one of the many 'quick fix' items taken on our overland trips.

Many times during my travels in the bush had I been called upon to make repairs, but these had always been simple problems. I remembered repairing sheared bolts on a front shock turret and an oil pump failure. What confronted me now was my pride and joy with half of its front end torn up. We were a long way from home - three days of travel and the prospect of having to tow the Range Rover all the way, in searing heat and in heavy sand and corrugations. The motivation was so great to get our vehicle going again that we set about our task with intense enthusiasm.

We began by removing the front fender. The wheel arch was unbolted and the metal had to be cut to free the brake lines which would now have to be supported with some wire. The strut supporting the bonnet slam tray was removed and mounted at an angle from a bolt on the steering box to a long bolt fixed to the top of the radiator. This would prevent the radiator from moving backwards and hitting the fan. Wire from a coat hanger, another 'quick fix' item, supported the bottom. The expansion tank, once sealed and the epoxy left to set, was mounted on the now bent front bumper and secured with some shock cord, normally used as a tie-down on the roof rack. It soon seemed possible that we may just be able to get driving again. We worked tirelessly through the heat of the day and by now we had consumed most of the rest of our beer - new motivation for getting the Range Rover back on the road.

The auxiliary battery used to drive the winch was rewired in place of the main battery and the cables tied down with plastic ties. It would have been unwise to have used wire for this because the constant vibration due to the bad roads and the choking dust would have caused the wire to wear through the cables likely to result in a short circuit. A hot fire, a four pound hammer and a large flat rock were needed to straighten the steering drag link, tie rod and the fan blade. Finally the winch cable was attached to the top of the radiator as added security. It took almost two days to complete the repairs, after which we really felt as if we had accomplished something. We filmed the entire repair process with my

home video camera and when I got home I edited the sequence to music - Monty Python's 'Always Look On The Bright Side of Life'.

The following day we packed up our 'Strange Rover' for a test run to Kavimba, a small town about 20 miles away on a reasonable dirt road. Because we no longer had a bonnet fitted, I could see the engine running in front of me. After about ten miles I noticed the radiator moving about a bit too much so we stopped to sort out the problem. The right side of the radiator was not properly supported but tying the invaluable four-pound hammer to the chassis member under the radiator quickly solved the problem.

The effort that we had put into the repair had paid off and the drive home was easier than anticipated. The border post officials, pedestrians and motorists were very amused by our Rover as it created a lot of attention whenever it was seen. At the border the customs official showed utter amazement. He walked around and around shaking his head, pausing to look more closely at the four pound hammer supporting the radiator.

"Howa!" he yelled.

"It's the bad roads here...everything just fell off," I explained with a smile.

After a thoughtful pause he asked, "Was it the Nata - Maun Road?" Readers who know the Nata - Maun Road as it used to be will understand the absurdity of this comment.

WELDING ON A VEHICLE

You will need two batteries connected in series to give 24-volts. (12-volts is not enough). Use a pair of jump leads to connect the two batteries and a third lead as the welding cable. Commercial welding rods are best, but if these are not available the carbon stick from a torch battery works well. Wrap aluminium foil around the back end of the carbon to prevent the lead from melting. Round the end and taper the rod slightly. You will need goggles. If you do not have any you will require a minimum of three pairs of sunglasses. Be warned, eye damage caused by arc welding without sufficient protection can be permanent! Coat hanger or fence wire or even winch cable will work as a metal filler.

Disconnect the battery and ground the positive terminal as close as possible to the welding site. Use a jumper lead to connect the negative terminal to the positive of the other battery. Connect the negative terminal of the second battery to the carbon stick. If welding is being done off the vehicle, run the engine to keep up a good charge. If welding is being carried out on the vehicle, disconnect the alternator to prevent possible damage.

This welding technique is a cross between gas and ordinary arc welding. Heat is controlled by the arc length - the arc is started by scratching the part with the carbon rod and then pulling it away. When the weld area is molten, feed in the filler metal and proceed along the joint. Have someone keep an eye on the temperature of the ends of the jumper cables as these could melt. A field welding kit should include two heavy jumper cables with soldered connections, a third cable of the same length with eyes to fit onto the battery, eye protection, a coat hanger and welding rods.

Mobile welding kit

Unipower Electronics, by fitting a series of specially designed components, convert an ordinary vehicle engine into a potent generator, fit even for heavy-duty arc welding. For details see chapter 3.

FILTERS

In very dusty conditions, the bigger the air cleaner the better. Air pre-cleaners, designed to filter out heavier dust particles before they enter the standard air filter, are a good idea if extended desert travel is intended.

Cleaning a paper element air filter is possible, although it is always preferable to fit a new one. Soak the element for up to 60 minutes in a solution of a biodegradable, non-sudsing type washing powder as used in automatic washing machines. Rinse well and allow to dry in a dust free area out of direct sunlight. Drying the element too quickly could damage it. Do not refit a damp element as the engine suction could collapse the paper. Cleaning a paper element fuel filter is done by thoroughly rinsing it in clean fuel. Wipe the filter bowl with a clean, dry cloth before refitting. See also Safari Snorkel air cleaner extensions in chapter 3.

If in-line fuel filters are fitted, a spare should be carried as these are not reusable. In Third World countries, it is wise to fit at least two fuel filters as the fuel is often full of sediment. Resultant clogged fuel lines and misbehaving carburettors are a common cause of vehicle breakdowns in these countries. Bowl-type fuel filters can be reused in an emergency after thorough rinsing in clean fuel. Be careful not to over clean the element as the paper becomes fragile as it gets old.

HANDLING FUEL

Decanting fuel

Whenever aircraft are refuelled in the field, one end of a steel cable is clamped into a metal part of the airframe and the other end to the fuel drum. This allows any static electricity which may have built up to be discharged before any filler caps are removed. An electrical discharge occurring during refuelling could cause a catastrophic explosion. This is done because aircraft fuel is of a high octane and the fuel is extremely flammable. Motor car fuel, although not as flammable, could still ignite. So remember: discharge any static build-up **BEFORE OPENING ANY FILLER CAPS OR JERRYCAN LIDS** by touching the jerrycan against any bare metal part of the vehicle. Open jerrycans slowly, especially if they are hot. Pressure builds up inside the can as it is shaken about and heats up on the roof rack. The pressure release can spray precious fuel everywhere. Remember, empty jerrycans are more dangerous than full ones as they contain an explosive air-fuel mixture.



The jerrycan spout clamps directly onto a jerrycan preventing spillage and makes decanting quick and easy.

Select a funnel by first making sure it can fit into the filler without aid as two hands are needed to hold the jerrycan.



FUNNELS & SPOUTS

A small green spout designed to clamp onto the spout of a jerrycan is the only method I have found of pouring into a fuel tank without spillage. They are cheap and are a real boon to the 4x4 adventurer. They are, however, only suitable for use with steel jerrycans. Unlike the jerrycan spout, a funnel is versatile. When selecting a funnel get one that will allow you to pour fuel single-handed and which can be placed in the filler pipe and stay there unaided. Wide brimmed plastic types with a removable pipe and a gauze strainer are easy to use and easy to stow. Rigid steel types that have a bend in the filler pipe are bulky to pack and are prone to rust. A gauze filter through which the fuel is poured either in the funnel or the vehicle's filler pipe is highly recommended. To repeat warnings I have issued a number of times: fuel purchased in Third World countries, especially in remote areas, is often dirty. Some older vehicles have fuel pipe gauze fitted as standard.

Buying fuel

If you are filling up with fuel from an electrical or mechanical fuel pump, make sure that the pump gauge registers zero before pumping begins and keep a good look that it does not stop turning while fuel is still flowing. There are cases of thievery by petrol pump attendants who 'suddenly notice' after some time that the pump has broken and then claim that they have pumped far more than they actually have, and demand vast sums before allowing their customers to proceed. They then threaten to



Refuelling in remote villages can be a challenge and is always time-consuming. In this case fuel had to be decanted from 50-gallon drums into a measuring can. Each can full measured 38 litres. In this case, paper, pen and calculator were needed and it took over an hour and a half to manually fill all three vehicles and 13 jerrycans.

call the police. The entire affair can turn into a very unpleasant incident.

Dirty or contaminated fuel is a common cause of vehicle breakdowns in all of the remote areas of the world. When buying fuel from old drums, check the labels on the drums. If it appears that the drum once contained another liquid, beware of contaminants or residues that may have dissolved in the fuel. For example, resin dissolved into fuel will cause severe damage to a vehicle's fuel system.



Always buy genuine metal jerrycans. Cheap imitations leak.

Fuel sampling

Testing can be done with the use of a length of PVC tubing, your nose, your eyes, a litre-measure and a small scale. It is an advantage if you are familiar with the appearance and smell of 'healthy' fuel. The PVC tube should be at least one metre in length and should be bound to a piece of stiff wire to keep it rigid.

Taking a sample

The density of the contaminant will have a different density to the fuel itself, causing the heavier liquid to sink and the lighter liquid to float. This is why tipping the barrel to take a sample will not be an accurate way of establishing what is inside.

Lower the PVC tube into the fuel until it touches the bottom. Place your thumb over the hole and withdraw it. A level-by-level sample will be contained in the tube. Release the contents of the tube into a clear glass container. Plastic containers may soon be clouded up as the petrol chemically attacks many plastics. An empty whisky or gin bottle is ideal.

Next, smell your sample. Shake the contents and then smell it again and note any difference. If possible, weigh one litre of the sample.



If a vehicle breakdown occurs far from home and help, take a break, make some shade and consider all options. Create a clear plan as to how to effect repairs and avoid deviating from the preset plan. All too often, breakdowns in the bush result in unnecessary panic. The result is unwise decisions made in haste which can cost lives.

Diesel fuel

Diesel engines can be difficult to start in very cold weather. The answer to this is a high capacity battery in good condition. To prevent diesel from freezing it can be mixed with petrol in a ratio of one part petrol to fifteen parts diesel.

PHYSICAL PROPERTIES OF FUELS

| | |
|-----------------|---|
| Petrol: | Volatile, highly flammable vapour. Light straw or pinkish colour. Distinctive smell. |
| Paraffin: | Non-volatile. Light straw colour or clear with a pungent smell similar to that of diesel. |
| Diesel: | Non-volatile. Light straw colour with a pungent smell. |
| Fuel oils: | Non-volatile. Black with a smell similar to diesel. |
| Foreign bodies: | Can be seen settling to the bottom. Very fine particles may remain in suspension but will be filtered out by vehicle's own filtering devices. |

DENSITIES OF LIQUIDS:

| | | | |
|---------------------|--------------|-----------------|--------------|
| Water | 1.00 | Antifreeze | 1.114 |
| Petrol | 0.78 | Battery acid | 1.28 |
| Diesel | 0.86 | Lubricating oil | 0.91 |
| Alcohol | 0.79 | Kerosene | 0.76 to 0.86 |
| Silicone oil (WD40) | 0.76 to 0.98 | | |

DIESEL FUEL CONTAMINATION CHART

| CONTAMINANT | CONSEQUENCES | TEST METHOD |
|---------------------|---|---|
| Water | Damage to pump and injectors. Rapid rusting, possibly overnight. | Visual inspection of sample of settled fuel. Water will be seen as a separate layer. |
| Foreign bodies | Damage to pump and injectors. Possible pump seizure. | Visual inspection of sample. (dirt) Large particles will settle at bottom. Small particles can be filtered out. No loss of smell. |
| Petrol (Gasoline) | Fire risk - 2%. Contamination makes diesel as hazardous as petrol. Damage to pistons. | Petrol is less dense so will settle at top. Strong gasoline smell. Poor hot start. |
| Kerosene (paraffin) | Reduced lubrication leads to pump and injector damage but only with severe contamination. | Only detectable by the weight/density test. No detectable change in smell. |
| Fuel oil (boiler) | Carbon build up in injectors and cylinder head. | Colour jet black. No detectable change in smell. |
| Oxidisation | Only heavily oxidised fuel is a risk. | Colour darkens. Acrid smell. |

(Source - Land Rover's Manual For Africa - Land Rover LTD.)