

# Concise 4x4 Driver Training Manual

(compliments the Comprehensive Training Manual)



Land Rover Owners Club  
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## **Introduction**

This manual contains the ABSOLUTE MINIMUM knowledge deemed necessary to be known AND **UNDERSTOOD** by the average LROC member. However, this manual does not endeavour to explain the information presented here and therefore not everything presented here may be understood. This concise manual is complimented by the comprehensive manual where ALL this information is repeated but expanded with explanations where applicable.

The LROC **STRONGLY** encourages its members to, at least once, read the entire comprehensive manual, just to understand how much more there is WORTH knowing.

### *Written exam*

This "Concise Manual" also serves as the basis for the LROC's written exam. Nothing outside of this manual will be asked in the exam. The exam will test knowledge only and is not intended to "be difficult". It will not test the candidate's understanding of the material. It is left to the member to ensure that a thorough understanding is reached where something is not understood – for your own benefit.

Most of what is written in this manual regarding driving techniques are GUIDELINES due to off-roading situations being so variable (even though the wording may suggest otherwise). Therefore the most TYPICAL approach is presented here but with experience you WILL find that different/innovative approaches are sometimes called for.

However, there are 3 non-negotiable RULES:

The next 3 RULES are MOST IMPORTANT and **ALWAYS** apply!!!

- Be safe and responsible
- Drive as slow as possible but as fast as necessary (ASAPAFAN)
- Consider the environment

## **Changing a spare wheel on a LR**

Except for Discovery3 (and Freelander and Range Rover3?) all LRs have hand brakes that brake the rear prop shaft and not the wheels. This arrangement can therefore result in the vehicle rolling off a jack when a flat wheel is changed. It is therefore highly recommended that special care be taken to immobilise the vehicle when a wheel is changed as follows:

1. Engage diff-lock
2. Engage low-range
3. Engage 1<sup>st</sup> gear
4. Place chocks (stones) in front and behind the wheels on the axle without the puncture

### **Low range: what is it and what is it used for.**

Low range offers a stronger set of gears than the "high range" which is used mostly for town and open road driving. Low range is used specifically off road and in difficult terrain where high range does not offer enough power, or where slower speeds are required.

### **How to engage/disengage low range.**

Modern gearboxes are "synchromeshed". This means that gears can easily be changed while the vehicle is moving. The gears in the **transfer box** are typically **not synchromeshed**. This means that there is no mechanism whereby the gears are automatically aligned to easily mesh with each other. When the vehicle is standing dead still a situation could exist whereby the teeth on two gears wanting to mesh meet "head to head" resulting in the driver being unable to select high or low range.

**The best approach to engage high or low range is while the vehicle is still moving dead slow (<1km/h) with the gearbox in neutral and clutch depressed.** This allows the relevant gears to mesh gently without placing undue stress on them.

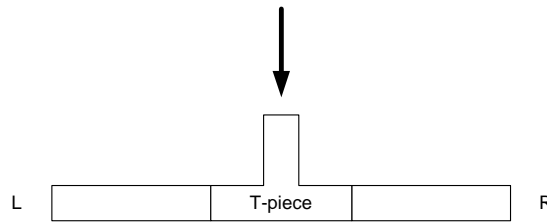
### **What is “Diff Lock”?**

Defenders, Classic Range Rovers, Discovery series 1 and Discovery Series 2 (facelift) also has a feature whereby the centre diff (located in the transfer gearbox) can be locked. This forces equal amounts of engine power to the front and rear wheels.

Diff Lock should ONLY be engaged BEFORE driving conditions become such that loss of traction by the wheels can be expected. Diff Lock can be engaged /disengaged on the move but DEFINITELY not while the wheels are spinning already. Diff lock should NOT be used on tar (wet or dry) or even on a good dirt road.

### **What is a differential?**

A differential is the round bulge found between the wheels on the front and rear axles. In Range Rovers, Discoveries, 90 and 110 vehicles a differential is also found in the transfer box.



Think of a differential as a T-piece in a water pipe as shown in the picture above. When water is pumped into the T-piece and both ends are open we would expect ½ the water to run out the left opening and the other ½ to run out the right opening.

Should the left opening be partially blocked, some water run out the left side with the remainder running out the right side.

Should the left side be fully blocked all the water will of course run out the right side.

Applying this analogy to a vehicle, we find that should the left wheel on an axle be firmly on the ground (water pipe blocked) and the right wheel dangling in the air (water pipe completely open) or in very slippery mud or on ice (ie without traction), all the power (“water”) will tend to go to the wheel dangling in the air / mud / ice. This wheel will spin aimlessly whilst the other wheel on firm terrain will not contribute towards movement. Only when both wheels are firmly on the ground (both ends of the water pipe equally blocked) will power be transmitted to both wheels equally. **The main purpose of the differential is to allow the wheels on the same axle to rotate at different speeds when going around a corner whilst providing power to both wheels – provided both have traction.**

## **Driving a 4x4**

### **The basics**

- Choose the correct gear ratio before you enter an obstacle, and stick to it until the obstacle is cleared.
- Ensure that your tyre pressure is correct for the terrain you are driving through. Deflating tyres not only widens the footprint but also makes the footprint longer.
- Competitive situations: Don’t allow yourself to be encouraged into doing something you are not confident with.
- Consider the legal implications: Vehicle is damaged or person injured - who will be responsible
- Every Land Rover that intends venturing off-road should ideally be fitted with
  - Recovery points
  - Fire Extinguisher - mount where reachable from outside the vehicle
  - Tow rope

- Emergency medical kit

## **Know Your Vehicle**

**Know your vehicles capabilities.**



- The approach angle and departure angle (but only from the rear of course).



- The break-over angle.
- The lowest point of your vehicle is normally under the differentials. Know where they are from the driver seat point.
- The maximum safe wade depth.
- The maximum rollover angle. Remember packing both inside and on the roof rack influences this angle.



## **Trailers**

- **WARNING:** In thick sand and mud a trailer acts like an anchor. Many a traveller has experienced great difficulties in getting through (or even out of) areas with thick sand. In some cases trailers were even abandoned as the owners found it impossible to get through or out of the sand. In such places it is best to carry everything in or on the vehicle.

## **Driving Know-how**

### **Obstacle Basics.**

General comment:

Whilst there are guidelines with regard to driving there are ALWAYS exceptions as well. In this course we present the guidelines but they should NOT be seen as absolute, never-to-be-disobeyed, hard and fast rules. Off-road driving should therefore be approached with a good amount of good old common sense.

- Reduce tyre pressure to typically 80% of normal pressure, 50% at most, 7.50x16 tyres with tubes can go as low as 0.8 kpa). UNLADEN, tyre pressures of less than 1.6Kpa is seldom required. Heavily laden 1.8Kpa should be adequate for thick sand. VERY thick soft sand may require less than 1.6Kpa
- **Always** walk the obstacle first, and consider the plan of action.
- **ALSO CONSIDER YOUR ACTION IF THE PLAN DOES NOT SUCCEED!!**
- If it's a difficult obstacle, let the passengers get out of the vehicle and stand aside.
- Make sure you have selected the correct gear and diff-lock before entering the obstacle.
- Avoid changing gears in an obstacle.

### **Descending Slopes**

- Maintaining directional control (steering) is most important above all else.
- Always try and drive directly down the slope
- First gear, "low range, diff lock on" – Let your engine do the braking as much as possible.
- As slow as possible as fast as necessary (ASAPFAN) still applies!!!!
- Braking is allowed to achieve ASAPAFAN.
- IF THE DECENT IS SO STEEP/SLIPPERY that the car starts to skid THEN:
- Feet off the clutch and brake pedals – never touch the clutch and avoid braking as far as possible.
- If steering is lost, you may even have to accelerate as little as possible but as much as necessary until control is regained and to sustain control. Otherwise, the rear end of the vehicle will tend to "come around"

### **Ascending Slopes**

- Criteria for driving up a slope: Am I prepared to REVERSE DOWN this slope ?
- Plan the course of action
- Then plan what to do if the ascent should fail (what will happen if the attempt fails, where will the vehicle go, can it be turned around, where are anchor points etc)
- Then mentally rehearse the ascent stall procedure;
- TD5/V8 Use 2<sup>nd</sup> gear, low range, diff lock – keep your momentum. TDI, 4cyl will tend to use 1<sup>st</sup> low;
- Build momentum on good parts before arriving at the bad parts to have some reserve momentum. Try to maintain steady speed. ASAPAFAN!!
- Avoid deep holes / ruts as far as possible (X-axles)
- DO NOT SPIN EXCESSIVELY

**Ascent stall procedure: What do you do when you don't reach the top?**

- Simply allow the engine to stall or force a stall by applying the brakes, but **do not depress the clutch**.
- Apply the brakes (The hand brake should NOT BE USED in this procedure).
- Select reverse while holding the brake: depress clutch, select reverse, release clutch. Make sure reverse gear is properly engaged. (A common mistake is that reverse is not engaged properly and when the brakes are released the vehicle rapidly accelerates down the hill as the gears are in neutral)
- Verify the direction in which the front wheels are pointing
- Once ready, release the brake **SLOWLY (this is to ensure that reverse was engaged properly)**
- Start the engine by just flicking the starter key.
- Avoid getting the vehicle sideways at all cost – accelerate if necessary!

### **Driving at an angle**

- Walk through the obstacle. Inspect the terrain. Look for slippery spots. The rule should be “can this be avoided”
- Check the track both on the upper and lower side. If there is a hole on the downside, the angle will increase. If there is an extra obstacle on the upper side the angle will also increase.
- Make sure your load is evenly distributed and secure.
- Let your passengers sit on the upper side to help with balancing.
- First gear ‘Low range, diff lock’, use the engine to control the speed and not the brake or clutch.
- To follow the desired path, a degree of steering wheel turn in the uphill direction will be required.
- MOST IMPORTANT: Be ready to rapidly turn downhill and accelerate maximum if a fall over is – it the terrain allows...
- If possible, anchor the vehicle to prevent roll



### **Cross - axle situations**

With normal (open<sup>1</sup>) differentials a cross-axle occurs where all power is lost to one wheel, on each of the axles.

- Try to take a route that will at most have 1 wheel in the ditch
- Maintain a moderate, constant speed - ASAP AFAN
- Avoid excessive power - serious side shaft breaking situation

<sup>1</sup> This is a diff without traction control or an aftermarket dif locker.



You can prevent cross-axle this way

### **Rock crawling**

- Walk the obstacle!
- 1<sup>st</sup> low range
- Take it slow, at idle speed.
- Have someone you trust, guide you through to avoid damaging the chassis on rocks or getting stuck on them.



### **Crossing Water**

- **Never wade** unless you have absolutely no other choice! Water **can** be “sucked” into diff’s and gearboxes and **can** cause damage if not attended to.
  - Know the wade depth of your vehicle.
  - If your vehicle is fitted with a bell housing and/or timing housing wading plug, make sure it’s fitted.
  - Know where the air intake of your vehicle is. Allowing water to be sucked into the air intake could result in very expensive damage.
  - Always walk the water crossing. Feel for adequate traction, holes and/or rocks.
  - If the water flow is too strong to walk, it’s also too strong to drive through.
  - Protect the radiator and engine by covering the radiator grill with a cloth, jacket or some suited cover. This will resist the water entering the engine compartment while the vehicle is moving.
  - Immobilise the fan: If your vehicle does not have a fan de-coupling system, remove or slacken the fan belt to ensure that it slips when it is submerged – the fan could destroy the radiator ENDING your trip – until repaired;
  - Get your recovery equipment ready **before** you enter the water.
  - First or second gear - ‘Low range, diff/hub lock’. ASAP, AFAN
  - Passengers can walk to lighten the load.
  - Do not use your safety belt during wading – saves time if you do have to get out in a hurry

- Windows should be OPEN!! (to allow fast escape)



### **What do you do when the vehicle gets stuck?**

- DO NOT SPIN EXCESSIVELY.
- Engage reverse and go back along your own tracks, in the process compressing the surface. Move back a meter or two. Then try again with a bit more momentum.
- 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.

### **Mud**

- Deflate tyres – typically not less than 1.6Kpa (max  $\pm 50\%$  of normal pressure; but not less than 0.8kpa in extreme circumstances)
- Default: 3<sup>rd</sup> gear low range or 1<sup>st</sup> high for V8 or TD5s. On TDI, 4, 6 cyls and normally aspirated diesel engines 2<sup>nd</sup> low may work better.
- a degree of wheel spin is actually required but excessive wheel spin would be counterproductive
- Swing steering wheel left to right and back to utilize grip from tyre edges.
- If stuck, attempt to reverse on own tracks until a pull away is assured and try then again.
- “Rocking” the vehicle forwards and backwards may also help.

### **Driving Through Sand or soft ground**

- Deflate tyres ( $\pm 50\%$  of normal pressure; not less than 0.8kpa in extreme circumstances)
  - Sand/mud/rocks will tend to lodge between tyre and rim causing deflation
- Choose correct gear before entering thick sand (3<sup>rd</sup> low range/1<sup>st</sup> high)
- Always keep moving
- Don't brake - roll to a halt
- If stopped or stuck, reverse on own tracks until a pull away is assured and try again.

- Know where your front wheels are pointing and keep them in the direction of travel.
- Do not spin while moving very slow or stationary – it only causes more digging and it makes recovery more difficult. Use ladders, branches, carpets, etc. for more traction.

### **Driving on Dunes**

- Significantly deflated tyres will be required. Deflating too much can cause the tyre to be forced off the rim allowing all air to escape instantaneously (in case of tubeless tyres – most common on today's landies)
- Always walk the dune. The wind can change the dunes in a few hours. There may be a new, near vertical cliff on the other side.
- Always drive straight up or down the dune.
- Progress to the top in second or third gear low and then stop.

**If required, dig the crest away. Engage low-range to descend.**

### **Convoy driving**

1. **Do not let the vehicle behind you out of your sight. You are responsible for the vehicle behind you!**
2. **Keep up with the vehicle in front of you.** Do not let the gap increase to more than 50 meters unless doing so would be positively dangerous. The lead vehicle will set the pace. Do not abuse rule 1 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, then you will slow down, then he... then you...)
3. If you have a problem and need to stop, try and do so only after you have flashed your lights at him/her in order to bring the entire convoy to stop fairly quickly.

### **Gravel roads**

- Stop regularly to check wheel nuts. Corrugated roads tend to loosen them.
- On high speed gravel roads, engage diff lock only if traction is highly doubtful e.g. when muddy or thick soft sand

### **Recovery Techniques**

**A full recovery kit would consist at least of the following:**

- Gloves
- Strong welded chain with shackles (to enable ends to be linked)
- At least 4 RATED BOW-shackles
- Tow rope
- Kinetic rope
- Spade
- Tree protector

If the vehicle has a winch, add:

- Remote control for the winch;

- Snatch block;

### **Kinetic ropes (or “Snatch rope”)**

## **!! DANGER !! !! DANGER !!**

Whilst very effective and quick to use, the kinetic rope can potentially be **VERY DANGEROUS**. **ALL POSSIBLE CAUTION MUST BE EXERCISED!!** As with all 4x4 related activities **GOOD COMMON SENSE MUST PREVAIL**. The drivers/owners of **BOTH** vehicles should consider the legal implications if any damage / injuries should result.

## **THINK!!**

**IMPORTANT:** It is **VITALLY** important that the kinetic rope only be used where **BOTH** the stuck vehicle and the recovery vehicle are fitted with very strong recovery points.

**IMPORTANT:** It is **HIGHLY** recommended that the recovery be performed with multiple low speed attempts, rather than a single high speed attempt. This will limit the energy of any projectiles which may result of parts separating from the vehicle and hence the potential damage / injuries that can result.

### **The following points are all equally IMPORTANT:**

- **NEVER (others see and learn!!) USE A KINETIC ROPE BY ATTACHING IT TO AN ORDINARY TOW hook.** These tend to break and when they do, the ball acts like a cannon ball hurtling towards the other vehicle.
- Proper and very strong recovery points are a non-negotiable pre-requisite - no sharp edges anywhere near the recovery points
- Keep bystanders and passengers far away when recovering a vehicle.
- **DO NOT** join snatch straps using metallic shackles. To join them feed the one end through the eye of the other or use a short (200mm) hardwood stick approx 20mm in diameter) through the loop of the end that was fed through the other. Avoid linking snatch ropes if at all possible.
- Use vehicles of equal weights & sizes;
- Snatch rope must be free of twists, knots, cuts or chafes;
- Make sure that kinetic rope will not snag/cut/chafe on any obstacle (rocks, trees etc) at any time during the recovery process;

### **The recovery process using the snatch rope**

1. A third person should preferably control the entire operation from a safe distance preferably with a view of both vehicles;
2. Once the rope is connected to both vehicles lay the rope in a zig-zag pattern on the ground making sure that it won't catch on any obstacles protruding from the ground;
3. When the controller gives the indication for the recovery vehicle to move forward, the driver of the stuck vehicle should apply power but without excessive wheel spin.
4. The snatching vehicle should tug at the stuck vehicle using multiple gentle tugs moving the stuck vehicle a little bit each time, instead of one massive tug, gradually increasing speed as necessary, with each attempt, if the stuck vehicle does not budge. Multiple gentle tugs will also ensure the maximum life of the rope;
5. The snatching vehicle should never release its clutch fully as extensive mechanical damage can occur as a result. The better the traction available to the snatching vehicle the more important this guideline is. When the rope tightens this forces the snatching vehicle to a standstill which could cause highly conflicting forces: The engine / gearbox is trying to accelerate the vehicle whilst the wheels / snatch rope is trying to stop the vehicle. In extreme cases this could cause diff / prop shaft / gearbox failure. Automatic vehicles (without torque converter lock-up) are to some extent protected against mechanical damage by slippage of the torque converter.
6. Never drive over the rope

## **Hi lift jack**

- Safety first!
- Use gloves!
- Maintain jack in good working order; mechanical parts should be well oiled.
- Lift point on car must be suitable for HLJ;
- Never have any body part in the path of the handle. This includes
  - Head
  - Hand (Do not hold the HLJ shaft with the other hand) in case the jack malfunctions and the handle snaps upwards
- Beware of top end of jack moving towards body as car is jacked - can cause damage
- ALWAYS terminate jacking by parking the handle in the upright position;
- Be careful of the moving part falling on feet when lowering the jack
- HLJ is not meant for changing wheels.

## **Winching**

### **General**

- Safety first: Safety should be foremost in your mind and not getting unstuck
- Don't rush
- Use gloves
- no passengers during winching
- Bystanders to be at least 20m away
- Must have at least 5 windings on the drum
- Assist battery with alternator, rev the engine @2000rpm (more than this achieves nothing)
- Winch motor gets hot quickly - don't let it labour. Use single snatch or double snatch to relieve the strain.
- Most electrical winches are not designed to work under water;
- Best done with competent partner using hand signals
- Prevent the cable from chafing over rocks - use logs/branches/boots etc
- Change the obstacle to make recovery with the winch as easy as possible.

### **Establish a secure anchor point.**

- As high as possible (minimum risk) - up and out - preferably directly in front of car
- Must be capable of withstanding the strain
- Caution – normal tow hook is not suitable for winching!
- When using a tree use the “tree protector”<sup>2</sup> - the tree protector must itself not sustain damage while winching.

### **Safety aspects.**

- Lift the bonnet – not mandatory but this adds to the safety margin.
- Roll out the cable.
- NEVER STEP OVER THE CABLE!
- NEVER USE DAMAGED CABLE - replace before trip
- NEVER LET YOUR HANDS SLIDE OVER THE CABLE
- Hook must point to sky to prevent catching on stone and slipping out.

### **Dampers.**

- Place blankets / snatch rope / tow rope over cable to act as brake should it break - weakest point is at hook.

<sup>2</sup> Incorrectly named: A “tree protector” will tend to strip the bark off the tree which will cause it to die anyway.

### **Operating the winch.**

- Do final inspection - don't trust assistants – Legal: Who will be responsible in case of injury?
- Plug in winch control - prevents someone inadvertently operating the winch - at the wrong moment.
- Duck behind dash - if possible.
- Rev engine 2000rpm (not more – serves no purpose) to help with alternator
- Assist with vehicle 1<sup>st</sup> low - gently – with VERY little wheel spin, don't dig in!
- Never drive over the cable
- Stop and assess / rearrange cable as often as necessary
- If possible steer the car directly in the direction of the winch

### **When recovery is complete**

- Don't slide cable through hands!
- Same person operates control and cable for last two meters
- Let car idle to charge batteries
- At first possible opportunity - inspect the cable for damage - may prevent you from entering a situation where you may have to rely on the winch only to find your cable is not usable.
- Rewind neatly under tension - Prevents cable from slipping in between other windings and getting pinched or jammed

### **Towing another vehicle with a tow rope**

- Safety first!! (this will determine the towing speed)
- Use a rope of approx 5m (too short is not good and too long is also not good)
- If possible no passengers in towed vehicle;
- The driver of the towing vehicle is to drive as smooth as possible but definitely not brake suddenly;
- The driver of the towed vehicle has two main responsibilities:
  1. To prevent the tow rope from dragging on the ground or driving over it by always ensuring that there is tension in the rope. This is done by PRE-EMPTING situations where slack in the rope can arise and by applying brakes to maintain tension;
  2. By following directly behind the towing vehicle;
- Situations where slack in the rope can arise are as follows:
  1. When the towing vehicle changes gears (manual);
  2. When stopping – this requires the towed vehicle to brake HARDER than the towing vehicle;
  3. When going downhill – sustained braking is required for the DURATION of the downhill. STOP if brakes overheat;
- A snatch rope can be more effective when towing a vehicle in off-road situations by causing less violent jerking when the rope does go slack and tight in undulated terrain.

### **Ecological considerations**

#### **Driving with consideration**

- Only go where you are welcome
- Drive as slowly as possible
- Stay on the path, don't make new tracks
- Respect others right of way
- Be polite and considerate to officials

#### **Recoveries with consideration**

- Make use of proper recovery equipment when recovering vehicles
- Don't expect others to recover your vehicle if you don't at least have the basic equipment and recovery points
- Clean up after a recovery.

#### **Camping with consideration**

- Only camp where you are welcome

- Site your camp with care
- Respect the rights of others to enjoy the solitude.
- Take all rubbish with you
- Try to restore the campsite as far as possible, before leaving

**Adventuring with consideration**

- Leave only footprints behind
- Don't disturb or collect fauna or flora, or any natural formations
- Don't attempt to pet or feed wild animals
- Avoid spilling chemicals, fuels and oils
- Only collect firewood when permission is granted by the owner
- Don't make bonfires!

Promote considerate off-roading amongst all other four-wheel driver users.

END