Electronic locking differential

Operators handbook and fitting instructions

Vehicles both 2 and 4-wheel drive, require differentials. The differential allows the outer wheel to rotate faster than the inner wheel during a turn, this is necessary as during the turn the outer wheel travels further and faster than the inner wheel. The speed of the outer wheel is proportionally faster than the inner wheel. Without a differential the transmission would bind up during road driving causing tyre scrubbing and unpredictable steering. The differential assembly also couples the input shaft (usually a prop shaft) to a pinion which in turn drives a crown wheel which is attached to the differential. The crown wheel and pinion also provide the final drive gear ratio for the vehicle. From the differential half shafts connect the drive to the wheels.

On high traction surfaces such as tarmac, torque is transferred equally through the differential to the wheels, driving the vehicle forward. On low traction surfaces like snow or when a wheel lifts clear of the ground while off road the drive follows the path of least resistance allowing the wheel with the least or even no traction to spin freely as the torque is directed through the differential.

This basic system is known as an open differential and is typically fitted to vehicles as standard. An open differential is ideal for a road going vehicle but has limited capability off road. Four-wheel drive transmissions provide twice as much traction, but even the most capable 4x4 vehicle can lose grip or lift a wheel in extreme conditions causing the vehicle to spin to a halt.

Fitting a Terrafirma electronic locking differential or 'E Locker' can make the difference between success and failure when tackling off road obstacles or negotiating very low grip conditions. When the switch is activated and electric current is supplied to a powerful electromagnet, as the electromagnet is energized, torque is created on a drag-plate that activates a ramping mechanism. The ramping mechanism translates rotational force into the axial motion of a locking mechanism. The locking mechanism engages into slots on the differential side gear and locks the side gear rotation to the differential housing. The result is on-demand traction and a fully locked differential. Deactivating the switch causes a series of return springs to promptly force the locking mechanism to disengage and the E Locker again operates as an open differential.

The Terrafirma E Locker provides instant traction by transferring drive equally to each wheel. With E Lockers fitted front and rear your 4x4 can be driven in a much slower, more controlled manner reducing the likelihood of damage to the vehicle and the environment.

A manually operated locking differential means that you the driver has control, enjoy the precise and predictable handling of an open diff on road and then 100% drive locked, when you need it most off road, simply engage, and disengage the E Lockers as and when you need them.

The Terrafirma E Locker has the simplest operating system of any switchable diff lock, no compressor, complicated wiring loom or air lines. 2 wires and an illuminated dash mounted switch is all that is required. The uncomplicated switch arrangement also means the E Locker is the fastest switchable diff lock to install, no cutting or welding is required. A simple drilled hole for the electrical cable gland is the only machining operation that is required. A competent mechanic should take no more than a few hours to completely install a Terrafirma E Locker from start to finish. No special oils are required.

Applications.
Defender 90, Discovery 1 & Range Rover Classic 24 spline front & rear, Defender 110/130 front and Discovery 2 front & rear.
Part No TF450

Defender 110 2002 on (Wolf/short nose) rear and Range Rover P38.
Part No TF460

NB. The Terrafirma E Locker can be fitted into 1983-1994 Defender 90s, 1989-1994 Discovery 1s & 1971-1994 Range Rover Classics and will require the half shafts to be changed to 24 splines.

Installation

Pre-installation preparation.
These fitting instructions are to be used in conjunction with vehicles manufacturer's workshop manual.

Tool kit recommendations.
Standard size metric and imperial sockets and spanners.
Dial gauge for measuring ring backlash.
Torque wrench.
Drain container for old differential oil.
Electrical crimps.
12mm drill bit.

Consumables required.
Carrier bearings Land Rover part number RTC3095 X 2.
Replacement differential oil: EP80/90 1.7 litres.
Thread lock.
Silicon sealer for the differential housing to axle joint.

Application note.
This Terrafirma locking differential centre is designed as a direct replacement for the centre fitted in a Land Rover differential assembly and will accept 24 spline half shafts only.

Removing the differential centre or carrier.
Remove the differential assembly from the axle.
Secure the differential assembly on a workbench, preferably clamped in a vice.
Prior to removing the carrier carefully inspect the crown wheel and pinion teeth for any adverse wear or chipping and replace as required.
It is advisable to replace the pinion oil seal at this point.
Knockout the roll pins that secure the bearing locking tabs, if roll pin type only, tap the pin away until it clears the serrated bearing adjuster.
Mark the bearing caps with a center punch so that the original bearing caps are replaced on the same side.
Remove the 4 bearing cap bolts and inspect to check they are not bent. Remove the crown wheel from the diff center.

Fitting the crown wheel to the diff center.
It is necessary to remove the electromagnet in order to fit the crown wheel. Carefully prize out the flat circlip and lift off the clip, magnetic clutch, push rods and bearing, paying attention to their orientation.

Thoroughly clean and de grease the crown wheel.
Ensure that the clamping face of the crown wheel is perfectly clean.
It may be required to apply heat to the crown wheel to expand it ans allow it to fit easily, do not hammer it into position or pull it on with the bolts.

Position the crown wheel onto the E Locker center.
Temporarily insert 2 crown wheel bolts to ensure alignment and tighten.
Mark these 2 crown wheel bolts to identify them later.
Now permanently install the other eight crown wheel bolts using stud lock on the threads and torque to 70 Nm.
Remove the two marked bolts, apply stud lock and torque to 70 Nm.

Replace the bearing, push rods, electromagnetic clutch and circlip, applying pressure by hand to the electromagnetic clutch will make fitting the circlip much easier.

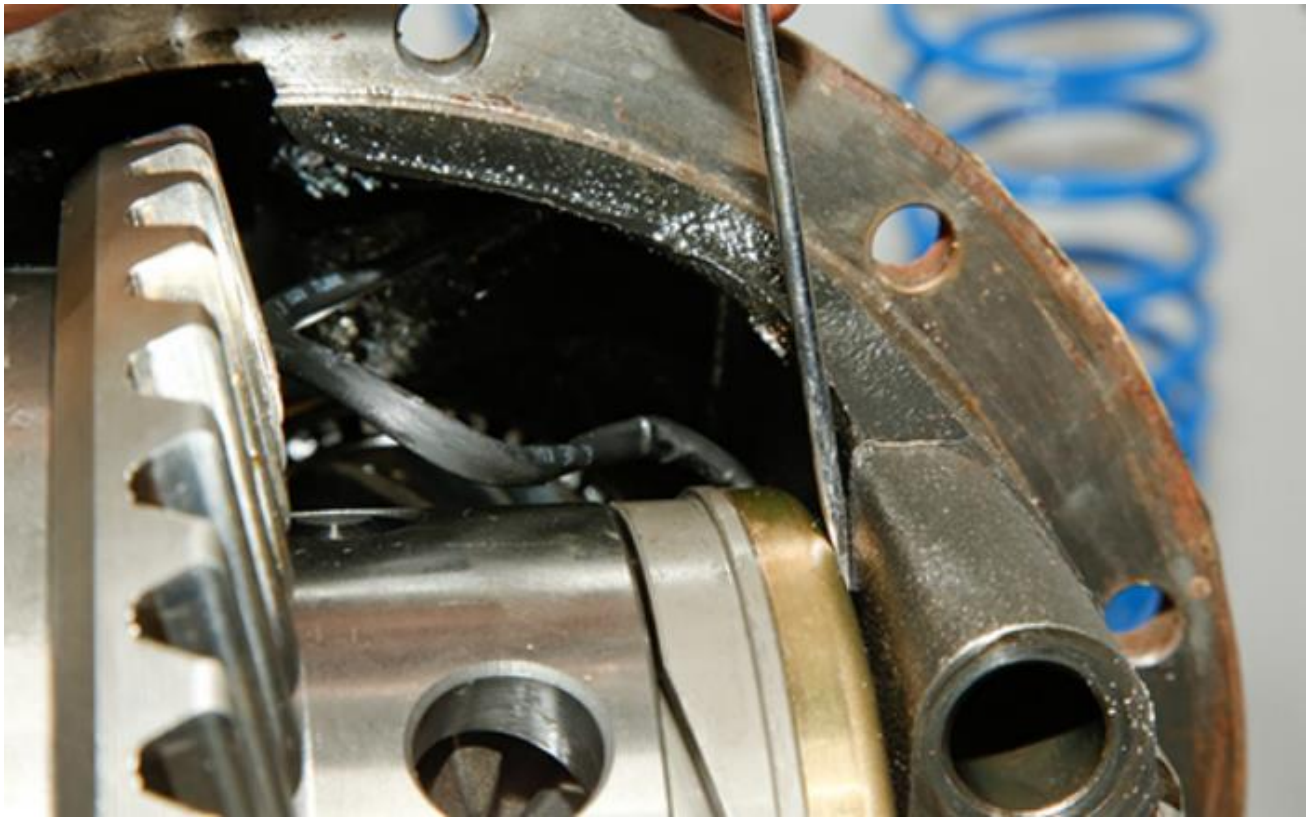
Installation of carrier bearings.
The carrier bearings are Land Rover part number RTC3095.
Press new carrier bearings on to either side of the E locker unit ensuring the taper is facing outward. Do not interchange the bearing shells.

Drilling the hole for power supply cable.
On the top of the differential in the suggested position (below image) drill a 12mm hole through the differential casing.
Place a cloth around the pinion head to catch metal swarf.
Remove all traces of metal swarf from inside the differential casing.

Fitting the new E Locker and crown wheel assembly.

NB. It may be necessary to remove some material from the inside of the bearing cap in line with the bearing housing to allow correct adjustment of the crown wheel, this is due to the crude casting of the bearing cap.

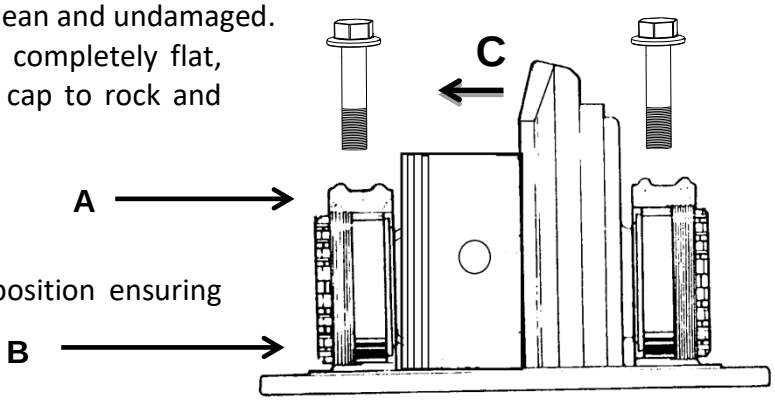
Place the assembly into the differential housing and move the E Locker and crown wheel tight against the pinion gear (direction fig C). **Note the comment above**



Position the electric cable and anti-rotation peg on the electromagnet to the top so they are visible when you fit the bearing caps.

Ensure the threads of the adjuster nuts are clean and undamaged. Check the bearing caps to ensure they are completely flat, excessive heavy use can cause the bearing cap to rock and surface to become uneven.

Place the bearing caps in position (fig A)
Note the comment above
Place the bearing adjuster nuts (fig B) in position ensuring they are not cross threaded.

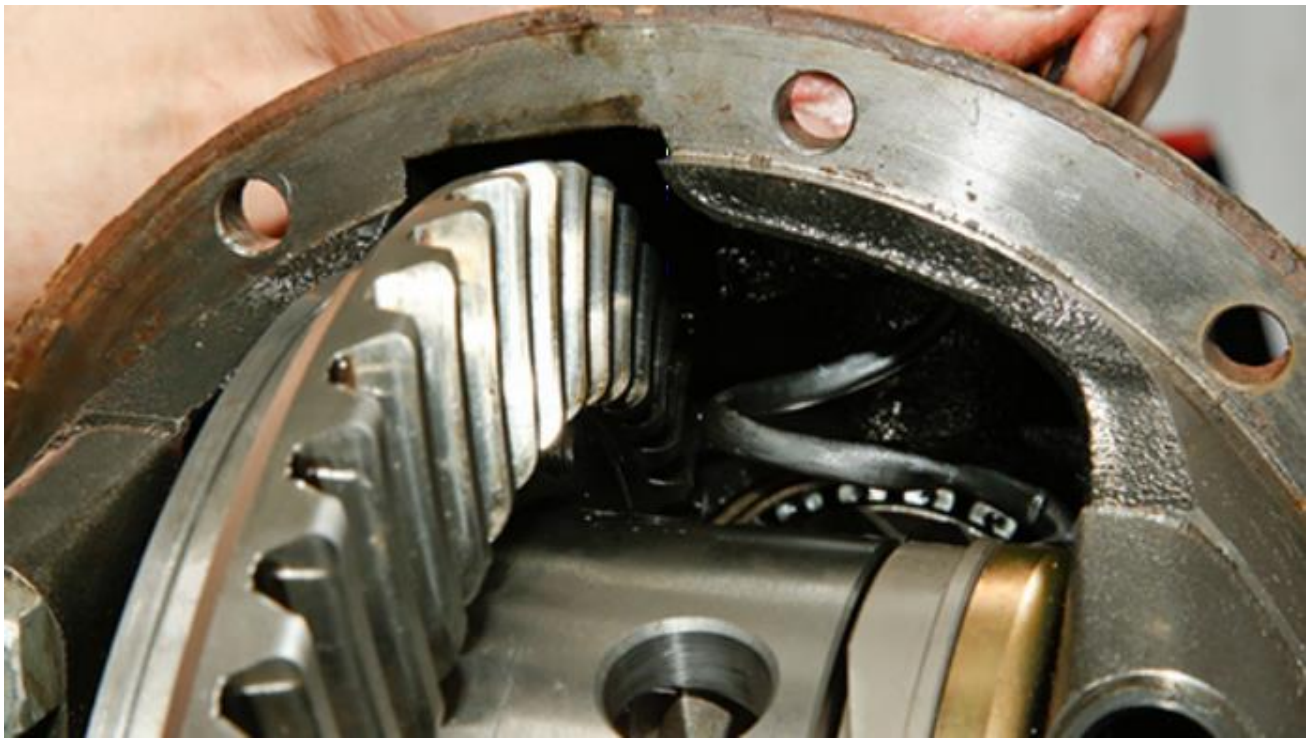


Position the anti-rotation plate and 2 supporting washers onto the bearing cap and insert the bearing cap bolts into position and rotate the bearing adjuster back and forth a couple of times to check the thread alignment.

There should not be a gap between the two clamped surfaces.
Now tighten bearing cap bolts lightly to 85Nm

Adjust the bearing nuts to achieve a backlash between the crown wheel teeth and pinion of 0.10-0.17mm. Measure the backlash with a dial gauge against the crown wheel.

Pull the cable and gland through the hole in the diff casing and carefully tease the gland into position, a small amount of silicone will act as a lubricant and a sealer both between the gland the diff housing and between the gland and the cable. Ensure the cables are unable to rub or make contact with the rotating crown wheel and differential.



Testing
Temporarily connect the E locker to a 12v supply. You will hear a clicking sound as it engages and disengages.

Refitting of the differential unit to the axle.

Refit complete differential assembly to the axle housing using silicon sealer in the joint.
Ensure all nuts are evenly tightened.
Reassemble the axle as a reversal of the strip down.
Fill with 1.7l of EP80/90 gear oil.

DATA

Crown wheel run-out	0.10-0.20mm
CW/P backlash	0.10-0.17 mm
Diff Locker Oil	EP80/90 Fill 1.7 litres

TORQUE SETTINGS

Crown wheel bolts	70 Nm
Bearing cap bolts	85 Nm

Exploded view.

Wiring

In the fitting kit you will find a plastic socket, carefully push the 2 wires from the E locker into their positions in the socket paying attention to fully locate the lock tabs on the terminals securely, slide the sealing glands into place.

Run the wiring loom along the chassis allowing enough slack for suspension travel and secure with cable ties.

Find a suitable position in the cabin for the E locker switch.

Connect the red wire to ignition live.

Connect the blue/white wire to the side lights or ignition live to illuminate the switch.

Connect the black wire to earth.

Secure all wiring.

Connect the wiring loom to the E locker.

Test the operation of your new Terrafirma E locker and you are ready to go.

Wiring diagram