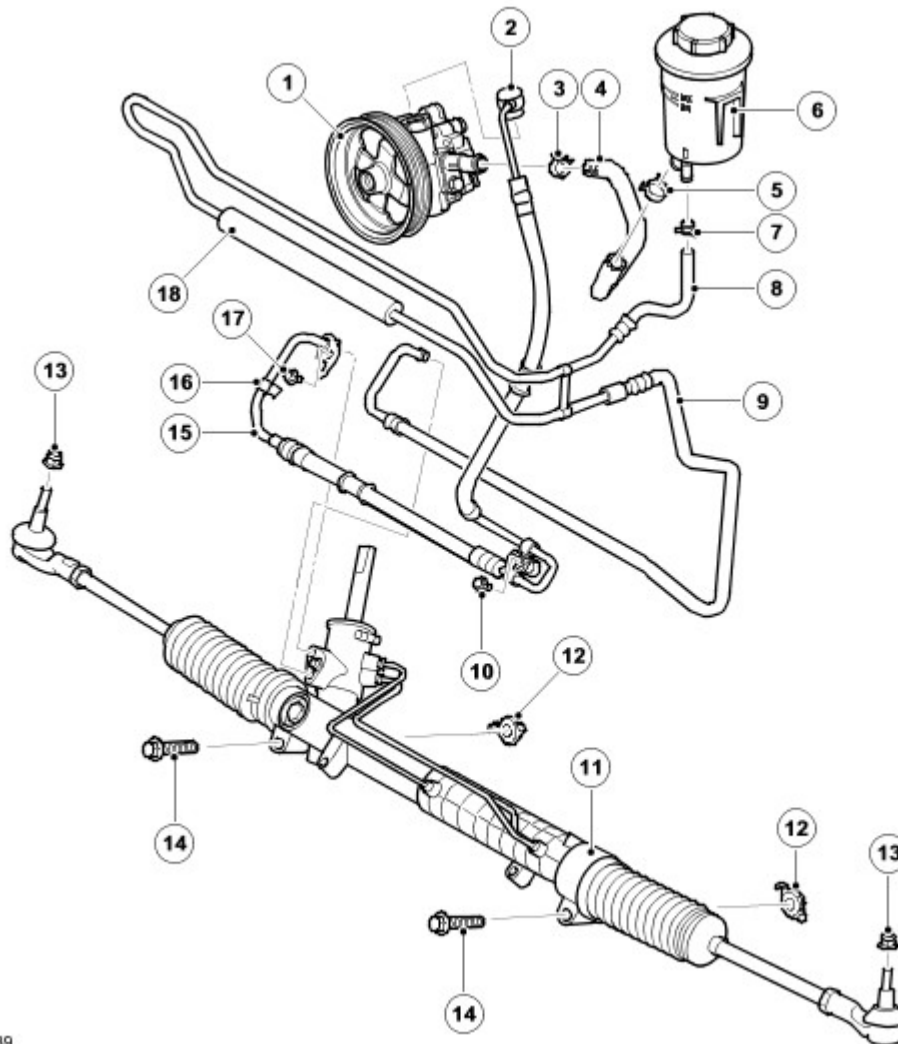




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## Power Steering

### Power Steering - Component Layout



E46939

Item	Part Number	Description
1	-	Power steering pump
2	-	Banjo bolt
3	-	Spring clip
4	-	Suction hose - reservoir to pump
5	-	Spring clip
6	-	Reservoir
7	-	Spring clip
8	-	Fluid cooler and hose assembly - fluid return
9	-	Hose assembly - Steering gear to cooler - return
10	-	Screw
11	-	Steering gear

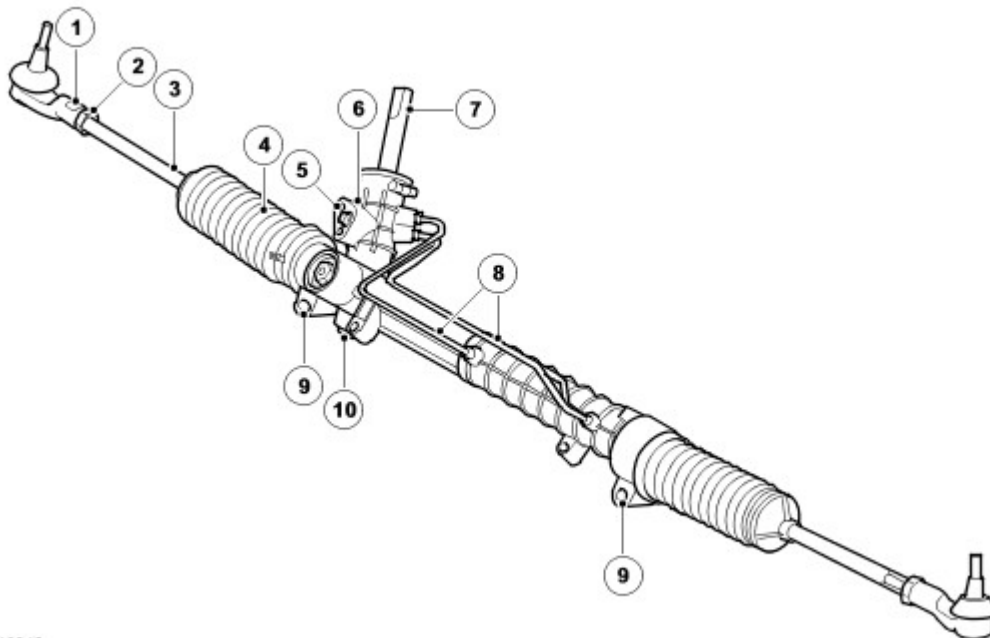
12	-	Caged nut (2 off)
13	-	Self-locking nut (2 off)
14	-	Bolt (2 off)
15	-	Hose - pump to steering gear - pressure
16	-	Pipe clip
17	-	Screw
18	-	Cooler

## GENERAL

The steering system comprises a TRW manufactured rack and pinion steering gear, a power steering pump, a reservoir, a fluid cooler and fluid hoses. The steering gear is a conventional end take-off rack and pinion power assisted unit.

The steering gear rack has a travel of 166 mm (6.53 in). Lock to lock requires 3.32 revolutions of the steering wheel which gives a ratio of 50 mm (1.96 in)/revolution.

## STEERING GEAR



E46942

Item	Part Number	Description
1	-	Tie-rod end
2	-	Locknut
3	-	Tie-rod
4	-	Gaitor
5	-	Pressure/return connection from/to pump
6	-	Valve unit housing
7	-	Input shaft
8	-	Pressure/return pipes
9	-	Steering gear casing attachment lugs
10	-	Pinion housing

The steering gear is located at the front of the engine, below the accessory belt drive. The gear is attached to two brackets on the chassis and is secured to the brackets with flanged bolts and caged nuts. The cage prevents the nuts from turning when the bolts are loosened or tightened. The cage nuts can only be used once and must be replaced when the gear is removed. For service, M12 Nylock nuts are available as a replacement for the cage nut.

The steering gear comprises an aluminium, cast, one piece housing which contains a mechanical steering rack, a valve unit and an integrated hydraulic power unit.

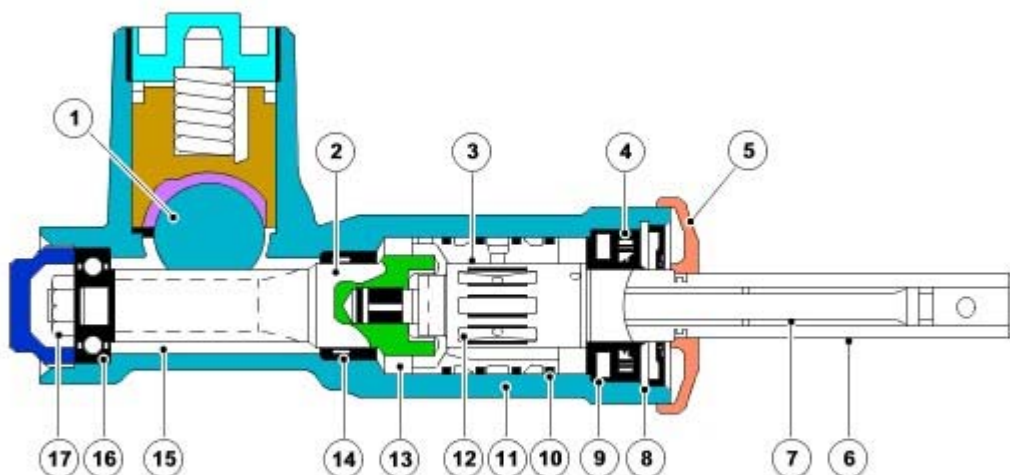
The steering gear uses a rack with an integrated piston which is guided on plain bearings within the rack housing. The pinion, which is attached to the valve unit, runs in bearings and meshes with the rack teeth. The rack is pressed against the pinion by a spring loaded yoke which ensures that the teeth mesh with the minimum of play. The pinion is connected to the valve unit via a torsion bar. The rotary motion of the steering wheel is converted into linear movement of the rack by the pinion and is initiated by the valve unit. This movement is transferred into movement of the road wheels by adjustable tie-rods.

The 49 mm (1.92 in) diameter piston of the hydraulic power unit is located at one end of the gear housing. Each side of the piston is connected to fluid pressure or fluid return via external metal pipes which are connected to the valve unit.

Each end of the gear has a threaded hole which provides for the fitment of the tie-rod. The external ends of the gear are sealed with gaitors which prevent the ingress of dirt and moisture. The tie-rod has a long threaded area which allows for the fitment of the tie-rod end. The thread allows for the adjustment of the steering toe. When the correct toe is achieved, a locknut is tightened against the tie-rod end preventing inadvertent movement.

The gear has a central hole machined along its length. The hole allows the air in the gaitors to be balanced when the steering is turned. The gaitors are serviceable items and are retained on the gear housing and the tie-rod with zip ties.

## Valve Unit



E46943

Item	Part Number	Description
1	-	Rack
2	-	Pinion shaft
3	-	Outer sleeve
4	-	Oil sleeve
5	-	Dirt seal
6	-	Input shaft

7	-	Torsion bar
8	-	Circlip
9	-	Oil seal
10	-	PTFE ring
11	-	Steering gear casting
12	-	Slots
13	-	Pin - Pinion shaft to outer sleeve
14	-	Oil seal
15	-	Pinion shaft
16	-	Bearing
17	-	Pinion shaft nut

The valve unit is an integral part of the steering gear. The principle function of the valve unit is to provide maximum power assistance (i.e. when parking) with minimum effort required to turn the steering wheel.

The pinion housing of the valve is an integral part of the main steering gear casting. The pinion housing has four machined ports which provide connections for pressure feed from the power steering pump, return fluid to the reservoir and pressure feeds to each side of the cylinder piston.

The valve unit comprises an outer sleeve, an input shaft, a torsion bar and a pinion shaft. The valve unit is co-axial with the pinion shaft which is connected to the steering column via the input shaft. The valve unit components are located in the steering gear pinion housing which is sealed with a cap.

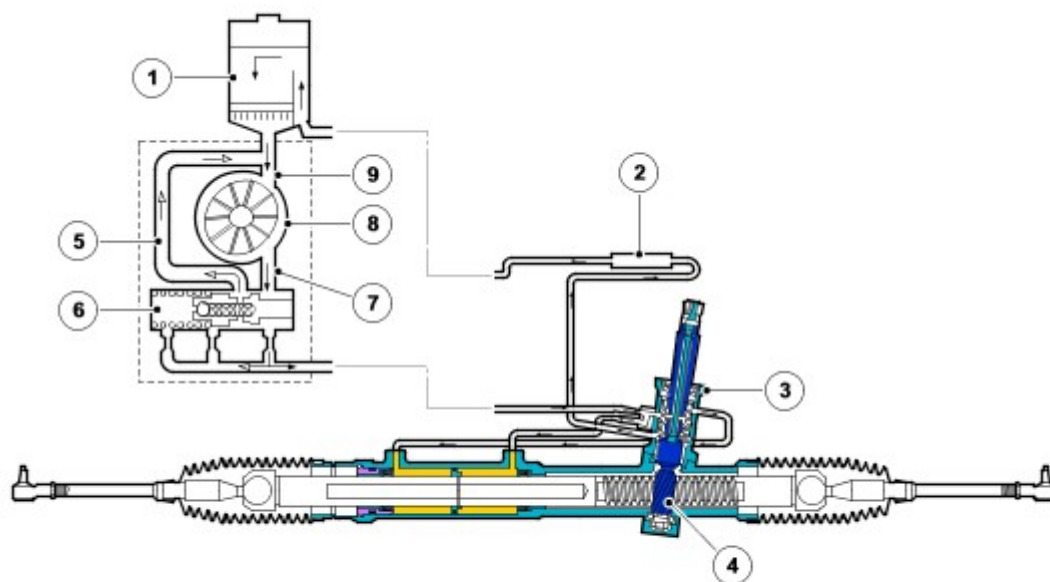
The outer sleeve is located in the main bore of the pinion housing. Three annular grooves are machined on its outer diameter. PTFE rings are located between the grooves and seal against the bore of the pinion housing. Holes are drilled radially in each annular groove through the wall of the sleeve. The bore of the outer sleeve is machined to accept the input shaft. Six equally spaced slots are machined in the bore of the sleeve. The ends of the slots are closed and do not continue to the end of the outer sleeve. The radial holes in the outer sleeve are drilled into each slot.

The input shaft has two machined flats at its outer end which allow for the attachment of the steering column intermediate shaft yoke. The flats ensure that the intermediate shaft is fitted in the correct position to maintain the optimum phase angle. The inner end of the input shaft forms a dog-tooth which mates with a slot in the pinion shaft. The fit of the dog-tooth in the slot allows a small amount of relative rotation between the input shaft and the pinion shaft before the dog-tooth contacts the wall of the slot. This ensures that, if the power assistance fails, the steering can be operated manually without over stressing the torsion bar. The central portion of the input shaft has equally spaced longitudinal slots machined in its circumference. The slots are arranged alternately around the input shaft.

The torsion bar is fitted inside the input shaft and is an interference fit in the pinion shaft. The torsion bar is connected to the input shaft by a drive pin. The central diameter of the torsion bar is machined to a smaller diameter in its central section. The smaller diameter allows the torsion bar to twist in response to torque applied from the steering wheel in relation to the grip of the tyres on the road surface.

The pinion shaft has machined upper teeth on its central diameter which mate with teeth on the steering gear rack. A slot, machined in the upper end of the pinion shaft mates with the dog-tooth on the input shaft. The pinion shaft locates in the pinion housing and rotates on ball and roller bearings.

## Power Steering Hydraulic Operation



E46944

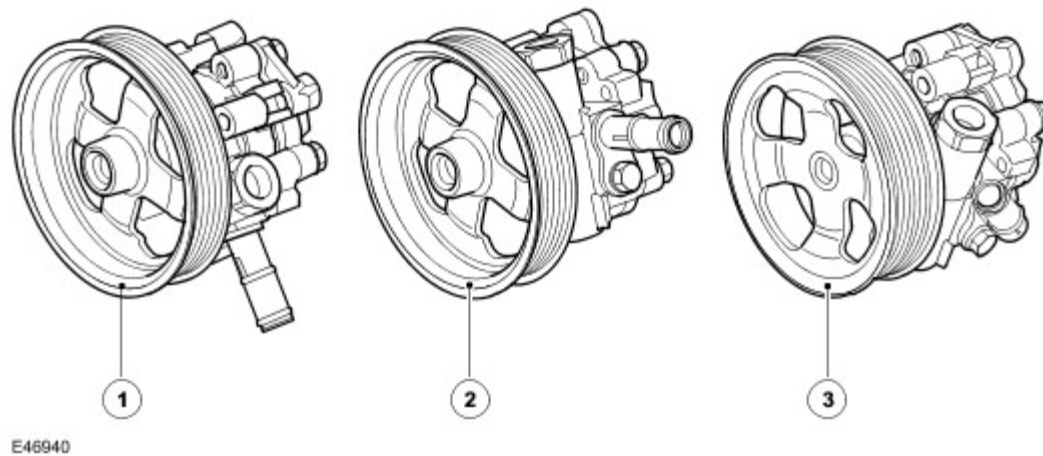
Item	Part Number	Description
1	-	Reservoir
2	-	Cooler
3	-	Valve unit
4	-	Steering rack and pinion
5	-	Flow control/pressure relief return
6	-	Flow control/Pressure relief valve
7	-	Output port
8	-	Power steering pump
9	-	Low pressure suction line

When the engine is started the power steering pump draws fluid from the reservoir into the low pressure suction line. The fluid passes through the pump and emerges as pressurised fluid at the outlet port. The attenuated high pressure hose passes the pressurised fluid to the steering gear valve unit.

If no steering effort is applied, there is minimal restriction within the system and the supply pressure from the pump is low. Minimal pressure is applied, via the valve unit, to each side of the piston in the hydraulic cylinder and the full flow from the power steering pump returns to the reservoir via the fluid cooler.

When steering effort is applied in either direction, the return flow of fluid to the reservoir is restricted, causing the supply pressure from the pump to increase. The pressurised fluid is directed to the applicable side of the piston in the hydraulic cylinder, via the valve unit, providing the power assistance required to reduce the steering effort. Fluid displaced from the low pressure side of the cylinder is returned via the valve unit and fluid cooler to the reservoir. The fluid cooler reduces the fluid temperature which prolongs the life of hoses and seals in the system.

## POWER STEERING PUMP



Item	Part Number	Description
1	-	4.0L V6
2	-	4.4L V8
3	-	TdV6

The power steering pumps used on the three engine variants are basically the same pump with different connection fittings, therefore they are not interchangeable. The pump is a positive displacement, vane type pump which supplies hydraulic pressure to the steering gear valve unit. The pump is driven by a Poly Vee belt from the crankshaft pulley and output from the pump increases proportionally with engine speed. A self-adjusting tensioner is fitted to maintain the correct tension on the belt.

The pump has an internal pressure relief valve which also incorporates a flow control valve. The pressure relief valve limits the maximum pressure supplied to the steering gear to 114 bar (1653 lbf in<sup>2</sup>)  $\pm$  4 bar (58 lbf in<sup>2</sup>). The flow control valve limits the maximum flow to 8.8 l/min (1.93 gal/min)  $\pm$  0.5 l/min (0.1 gal/min) regardless of engine speed. The pump has a displacement of 9.6 cc/rev (0.58 in<sup>3</sup>/rev).

A shaft runs longitudinally through the pump. One end of the shaft is fitted with a pressed-on drive pulley, the opposite end of the shaft is closed by a cover. The shaft runs in bearings located in the body and oil seals at each end of the shaft prevent leakage of hydraulic fluid.

The pump contains ten vanes which rotate within a cam ring and are driven by the shaft. As the vanes rotate, the cam ring causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn from the reservoir via the suction hose into the space between the vanes.

As the shaft rotates, the inlet port is closed to the vanes which have drawn in fluid, trapping the fluid between the vanes. The cam ring causes the space between the vanes to reduce and consequentially compresses and pressurises the hydraulic fluid trapped between them.

Further rotation of the shaft moves the vanes to the outlet port. As the vanes pass the port plate the pressurised fluid passes from the pump outlet port into the pressure hose to the steering gear.

The pressurised fluid is subject to control by the flow control and pressure relief valve. The flow control valve maintains a constant flow of fluid supplied to the steering gear irrespective of engine speed variations. The pressure relief valve controls the pressure on the output side of the pump. A metering orifice is included in the discharge port of the pump. If the pressure in the orifice reaches a predetermined level, a spring loaded ball in the center of the flow control valve is lifted from its seat and allows pressurised fluid to recirculate within the pump.

The pressure relief valve will operate if the discharge from the pump is restricted, i.e.; steering held on full lock. If the output from the pump is blocked, all output is recirculated through the pump. In this condition, as no fresh fluid is drawn into the pump from the reservoir, the fluid temperature inside the pump will increase rapidly. Consequentially, periods of operation of the steering gear on full lock should be kept to a minimum to prevent overheating of the pump and the fluid within it.

## RESERVOIR



The fluid reservoir is located on a bracket in the left hand side of the engine compartment, behind the radiator. The reservoir comprises a body, cap and filter. The purpose of the reservoir is to contain a surplus of the hydraulic fluid in the system to allow for expansion and contraction of the fluid due to temperature variations. The fluid level ensures that the supply connection on the bottom of the reservoir is covered with fluid at all operating vehicle attitudes. Any air which is present in the system is exhausted from the system in the reservoir.

The body is a plastic moulding with two ports at the bottom which provide for the connection of the suction supply and return hoses. Moulded markings on the side of the reservoir denote the upper and lower fluid levels. A non-serviceable, 100 micron nylon mesh filter is fitted in the body. The filter removes particulate matter from the fluid before it is drawn into the pump supply connection.

The cap is rotated counterclockwise for one quarter turn to release from the body. The cap is fitted with an O-ring to prevent fluid leakage. The cap incorporates a breather hole to allow for changes in fluid level during operation and prevent vacuum or pressurisation of the reservoir.

## HIGH PRESSURE HOSE

The high pressure hose connecting the pump to the steering gear valve unit contains two attenuators. Each attenuator comprises a bullet shaped restrictor which is secured inside the hose. The restrictors damp pressure pulses from the pump, consequently reducing noise and strain on downstream components. The attenuators are an integral part of the hose and cannot be serviced separately.

## FLUID COOLER

The fluid cooler is located in the return line from the steering gear to the reservoir. The cooler comprises a flexible hose and a solid pipe which connect between the reservoir and the return pipe from the steering gear. The cooler is an integral part of the pipe and cannot be replaced as a separate component.

The cooler is a fabricated aluminium tube, through which the power steering fluid passes. The outer diameter of the cooler tube has aluminium loops attached to it which dissipate heat. Cool air entering the front of the vehicle passes over the cooler and flows through the loops. The loops act as heat exchangers, conducting heat from the fluid as it passes through the tube.