

Specifications

Steering

Steering geometry	
Steering wheel diameter	412 mm (16.22 in)
Front wheel alignment	-10' ± 10' toe-out
Rear wheel alignment	+5' ± 15' toe-in
Camber angle - Front	-10' ± 45'
Camber angle - Rear	-10' ± 45'
Castor angle	3° 15' ± 45'
Cross castor	1° Maximum
Cross camber - Front	1° Maximum
Cross camber - Rear	1° Maximum
Swivel pin inclination - static	7° Check with vehicle on level ground at EEC kerb weight. Rock the front of the vehicle up and down to allow it to take up normal static position.

Turning circle between kerbs	
90 Models	
265/75 x 16 tires	12.65 m (41.5 ft)
All other tires	11.70 m (38.4 ft)
110 Models	
750 x 16 tires	13.41 m (44 ft)
130 Models	
750 x 16 tires	15.24 m (50 ft)

Steering box and pump	
Steering box make and type	Adwest Varamatic - worm and roller
Steering box ratio	Variable: Straight ahead - 19.3:1 on lock - 14.3:1
Steering wheel turns - lock to lock	3.375
Steering pump make and type	JTekt P4

Power steering system

Fluids and capacities	
Power steering fluid	Texaco Cold Climate 33270
Fluid capacity - steering gear and reservoir - LHD	2.90 litres (5.0 pints)
Fluid capacity - steering gear and reservoir - RHD	3.40 litres (6.00 pints)

Torque specifications

Description	Nm	lbf-ft
Drag link to drop arm	40	30
Ball joint nuts	40	30
Clamp bolt (M6)	9	7

Steering column bracket nuts	22	16
Steering wheel nut	43	32
Tie bar to mounting nut initial torque	80	60
Tie bar to mounting nut final torque	110	80
Universal joint pinch bolt	30	22
Steering gear adjuster locknut	60	45
Steering gear drop arm nut	175	130
Steering gear sector shaft cover to steering box	75	55
Steering gear to chassis	80	60
Steering gear fluid pipes 14mm thread	15	11
Steering gear fluid pipes 16mm thread	20	15
Steering gear tie bar	80	60
Power steering pump high pressure fluid pipe	20	15
Power steering pump mounting	35	25
Power steering pump pulley bolts	10	7
Power steering pump hose clamp	3	2
Power steering pump front mounting plate bolts	9	7
Power steering reservoir hose clamp	3	2

Fixing size	Nm	lbf-ft
M5	6	4.5
M6	9	7
M8	25	18
M10	45	33
M12	90	65
M14	105	77
M16	180	133
1/4 in	9	7
5/16 in	24	18
3/8 in	39	29
7/16 in	78	58
1/2 in	90	65
5/8 in	135	100

Torque specifications in the table above are for all screws and bolts used, except for those specifically referred to in the Torque specifications table.

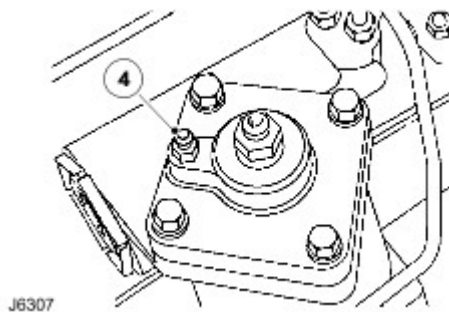
Power Steering System Filling and Bleeding

1. Check that fluid level is at maximum level.
2. Run engine to normal operating temperature.
3. Recheck reservoir fluid level, top up if necessary.

4. **NOTE:**

Maintain maximum fluid level in reservoir. Do not increase engine speed or move steering wheel.

With engine at idle speed, slacken bleed screw. When fluid seeps past bleed screw re-tighten screw.



5. Check fluid level.
6. Clean fluid from around bleed screw.
7. Check hose connections, pump and steering box for fluid leaks by holding steering on full lock in both directions.



CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

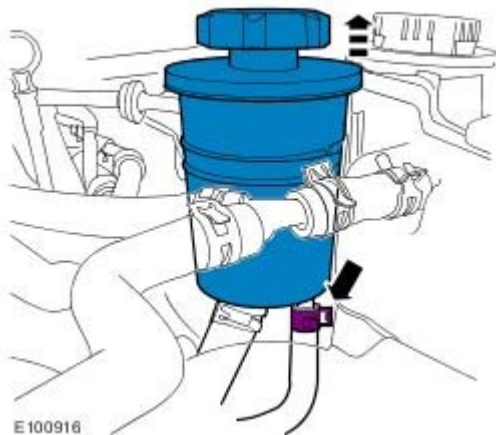
8. Carry out road test.
9. Check and top-up fluid level.

Power Steering System Flushing

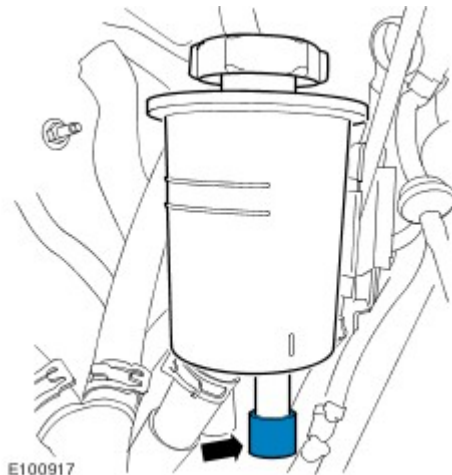
NOTE:

If heavy steering or contamination within the power steering system is found, it is necessary to carry out the system flush procedure as detailed below. If any components have been replaced in the power steering system the procedure below must be carried out in full.

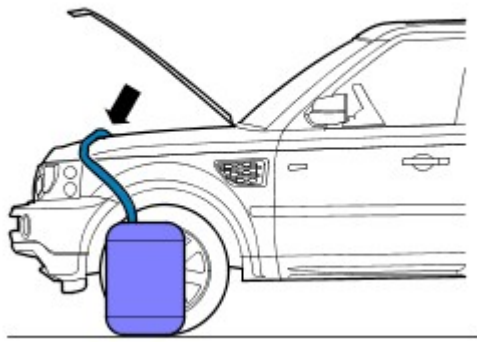
1. Remove the power steering fluid reservoir cap.
2. Using a syringe, remove the power steering fluid from the reservoir.
 - Release but do not remove the power steering reservoir.
 - Release the power steering return hose from the reservoir.



3. Cap the power steering reservoir return pipe using a suitable plug.



4. Attach a suitable pipe to the power steering return hose to allow fluid to drain.



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5.



WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

6.



WARNING: Do not run engine as damage to the power steering system may occur.

Turn the steering lock to lock 10 times

- Allow the fluid to drain.

7. Flush the power steering system.

- Top up the power steering fluid reservoir with approx half a litre of fluid.
- Turn the steering lock to lock 10 times
- Allow the fluid to drain.
- If necessary, repeat the above procedure.

8. Refit the power steering reservoir.

- Remove and discard the blanking plug.
- Refit the power steering reservoir return hose.

9. Fill and bleed the power steering system.

10. Install the reservoir filler cap.

Steering Gear Adjustment

1.



WARNING: Adjustments of steering box should not be required while in warranty period. If box is stiff or tight and within warranty, it must be returned to manufacturer. No attempt must be made to introduce backlash.

Apply park brake, chock wheels and jack up front of vehicle until wheels are clear of ground.

2. Support chassis front on axle stands.

3. Disconnect drag link from steering drop arm.

4. Check torque to turn.

[Steering System](#)

5. **NOTE:**

Only check for no backlash when steering box is in central position.

NOTE:

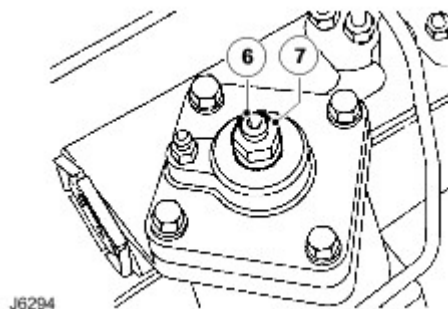
If steering wheel is not straight, it should be repositioned

Centralise steering box.

[Steering Gear Centralization](#)

6. Adjustment is obtained by rocking the drop arm about centre whilst an assistant slowly tightens the steering box adjuster screw.

7. Tighten locknut when all backlash has been removed.



8. Repeat the check for backlash. If backlash exists loosen locknut and repeat adjustment procedure.

9. Turn steering wheel lock to lock and check no tightness exists.

10. Ensure front wheels are aligned and in straight ahead position.

11. Adjust drag link 924 mm between ball joint centres.

12. Connect drag link and tighten to 40 Nm (30 lbf.ft).

13. Lower vehicle to ground level and remove chocks.

14. Road test vehicle
[Steering System](#)

15. RH drive vehicles - if steering wheel is to right, drag link is too long. If steering wheel is to left drag link is too short. LH drive vehicles - if steering wheel is to right, drag link is too short. If steering wheel is to left drag link is too long.

16. Adjust drag link until steering wheel points straight ahead when vehicle is travelling in a straight line.

Steering Gear Centralization

1. Disconnect sector shaft arm drag link from drop arm.
[Sector Shaft Arm Drag Link](#)
2. Turn steering wheel on full RH lock.
3. Turn steering wheel back exactly two turns.
4. Fit sector shaft arm drag link.
[Sector Shaft Arm Drag Link](#)
5. Repeat operation for LH drive vehicle but turn steering wheel on full LH lock.

Steering Lock Stop Adjustment

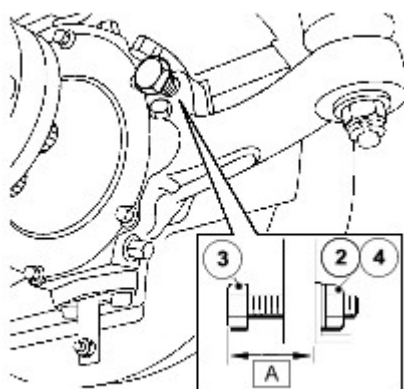
1. Measure clearance between tire wall and radius arm at full lock. This must be not less than 20 mm.
2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check clearance between tire wall and radius arm on each lock.

6. NOTE:

Alternatively lock stop adjustment may be carried out using following procedure.

Measure stop bolt protrusion 'A'. Refer to table for correct setting.

Alloys	Size	Setting
BF Goodrich Mud Terrain	265	59.7 mm
Goodyear GT+4	235	55.7 mm
Michelin M+S 4X4	235	52.2mm
Steels	Size	Setting
Goodyear	205	55.2 mm
Michelin	205	55.2 mm
Avon	7.50	56 mm
Michelin	7.50	56 mm
Goodyear	7.50	56 mm

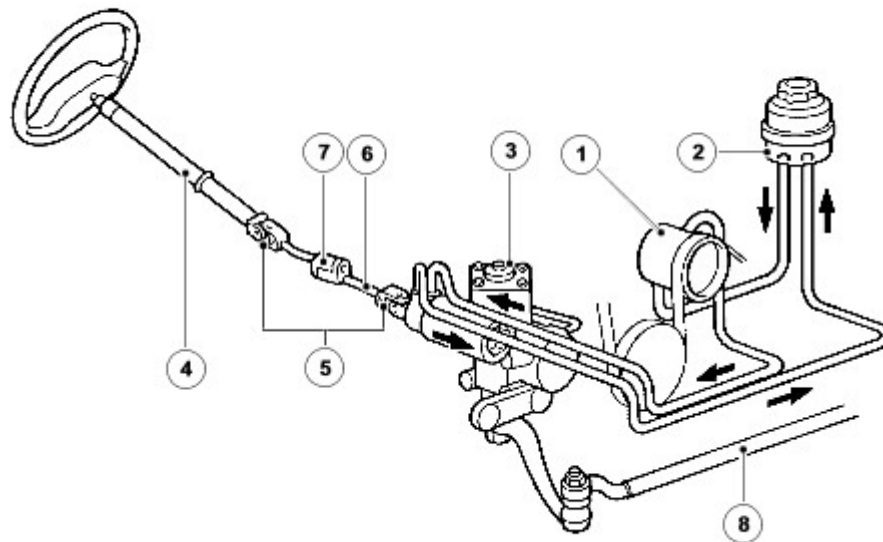


J6295A

7. Loosen stop bolt locknut.
8. Turn stop bolt as required.
9. Tighten locknut.
10. Check wheel position at full lock.

Steering System

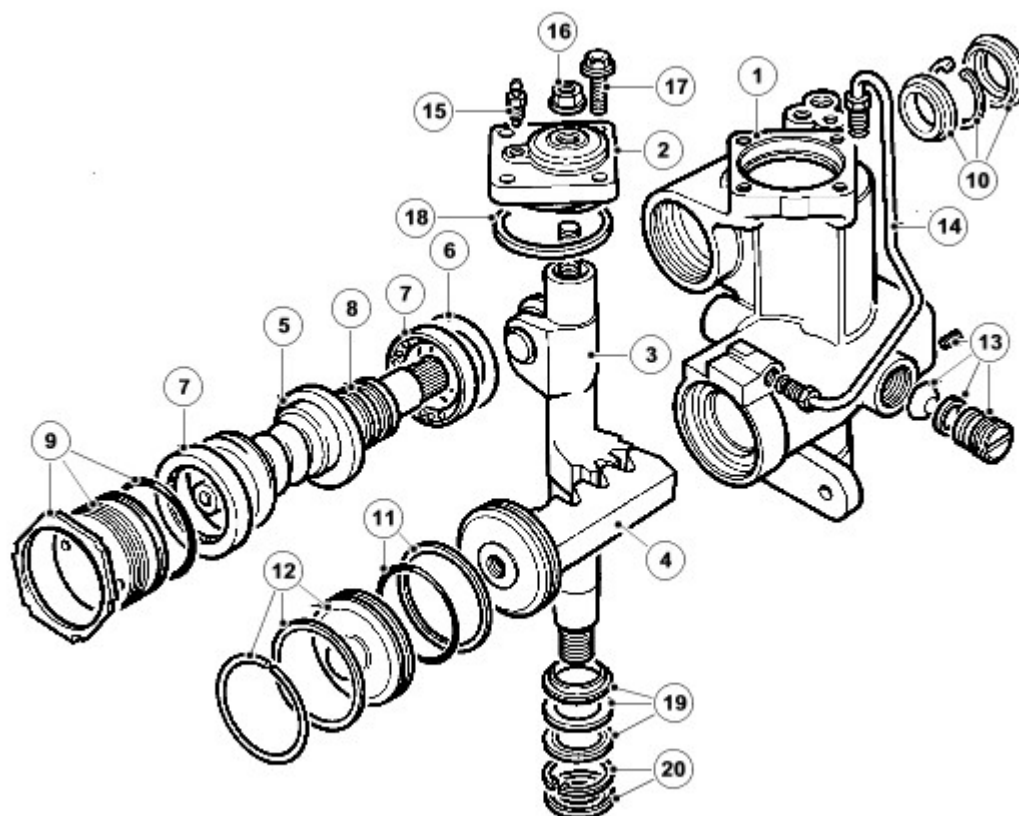
Power steering system



J6291

Item	Part Number	Description
1.		Hydraulic pump
2.		Fluid reservoir
3.		Steering box
4.		Upper column
5.		Universal joints
6.		Lower shaft
7.		Compression joint
8.		Drag link

Power steering box components



RR4149

Item	Part Number	Description
1.		Housing complete with sector shaft bearings
2.		Cover plate complete with bearing
3.		Sector shaft
4.		Hydraulic piston/rack
5.		Worm/valve and torsion bar assembly
6.		Shims for centralizing worm/valve
7.		Ball race
8.		'Teflon' seals for valve sleeve
9.		Bearing adjuster, locknut and seal
10.		Worm shaft pressure seal, circlip and dirt excluder
11.		'Teflon' and rubber seal for piston
12.		End cover seal and snap ring
13.		Adjustment components for piston/rack
14.		Hydraulic pipe
15.		Bleed screw
16.		Sector shaft adjustment lock nut with seal
17.		Cover plate bolts
18.		Cover plate seal
19.		Seal, washer and backup seal
20.		Circlip and dust cover

GENERAL

The steering system incorporates a compression joint in the lower shaft and is designed to collapse on impact. The mis-alignment of the upper steering column with the steering box and the inclusion of two universal joints, is also designed to prevent the column moving toward the driver under frontal impact.

The steering box is located behind the first chassis cross member and is connected to the road wheel swivel housing by a drag link and track rod. A hydraulic damper absorbs shocks in the steering, caused by road wheel deflections when operating on rough terrain.

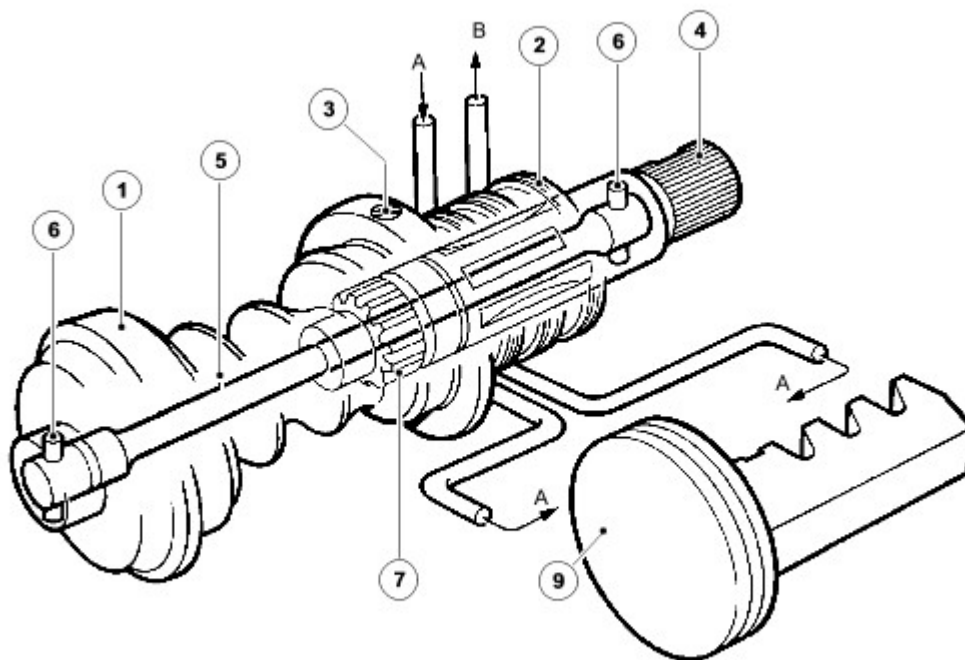
Power steering system

The power steering system comprises a hydraulic pump which is belt driven from the engine and supplied with fluid from a reservoir that also acts as a cooler.

The steering box houses a self neutralizing rotary valve which is part of the worm/valve assy and an hydraulic piston/rack to assist the mechanical operation. The rotary valve which is operated by movement of the steering wheel, directs fluid pressure to the appropriate side of the hydraulic piston/rack to provide assistance.

Rotary valve operation

Rotary valve at neutral



RR3620M

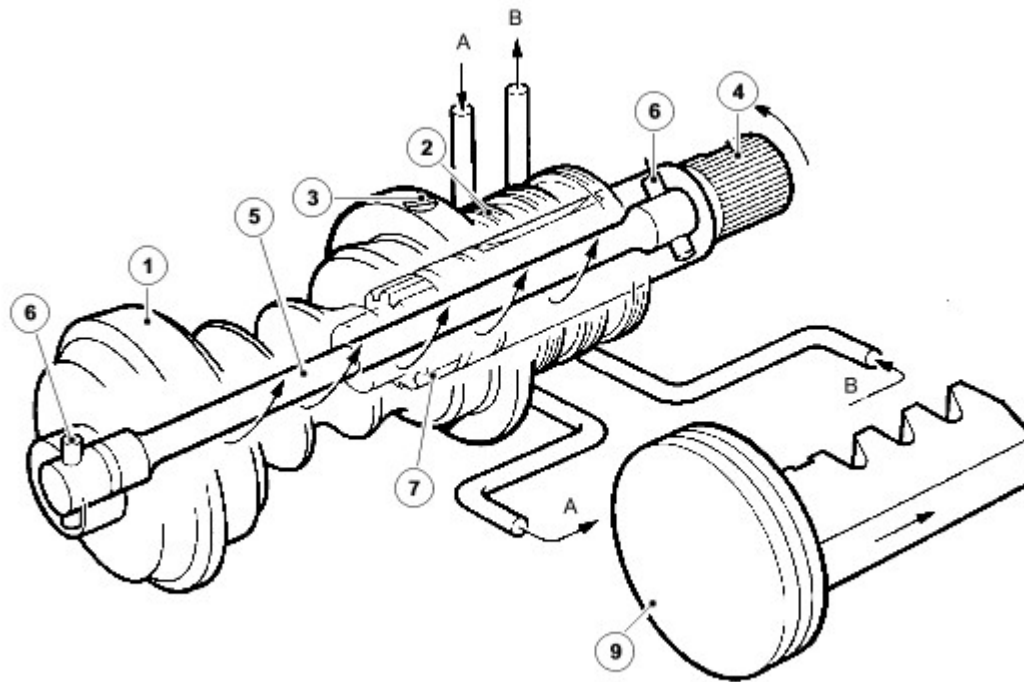
The rotary valve assembly comprises a worm (1), valve sleeve (2), input shaft (4) and torsion bar (5).

The valve sleeve is retained inside the worm by a trim screw (3), and incorporates valve ports in its inner bore. The input shaft is attached to the steering wheel via a steering shaft and steering column and incorporates valve ports in its outer diameter to align with those in the sleeve.

The torsion bar, which is secured to the worm and input shaft with pins (6) at each end, holds the valve ports in neutral alignment when there is no demand for assistance.

When there is no demand for assistance the torsion bar holds the input shaft and sleeve valve ports in neutral relationship to one another, allowing equal pump pressure (A) to both sides of the piston/rack (9). Any excess fluid flow from the pump returns to the reservoir via (B).

Rotary valve misaligned



RR3621M

When the steering wheel and input shaft is turned, steering resistance transmitted to the worm causes the torsion bar to be twisted and the valve ports to be misaligned for a right or left turn. The misalignment of the valve ports directs all fluid pressure A to one side of the piston only and allows displaced fluid B on the other side.

When demanding maximum assistance, any excessive fluid output from the pump due to high pump speed, will circulate through the regulator valve located in the pump unit, causing the temperature of the fluid and the pump to rise rapidly.



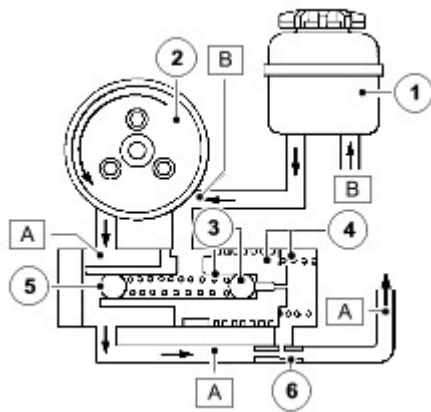
CAUTION: To avoid excessive fluid temperatures which could damage the oil seals, the steering must not be held on full lock for more than 30 seconds in one minute.

Only when the steering wheel, and the demand for assistance, is released, will the torsion bar return the valve to neutral, allowing the fluid to circulate through the reservoir where it is cooled.

In the unlikely event of mechanical failure of the torsion bar, a coarse splined connection (7) between the input shaft and worm, ensures steering control is maintained sufficient to allow the vehicle to be recovered.

Pump and regulator valve operation

No demand for assistance



J6292

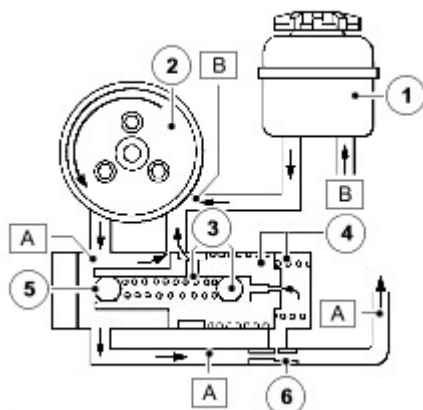
Item	Part Number	Description
1.		Reservoir
2.		Pump
3.		Pressure control ball valve and spring
4.		Flow control valve and spring
4.		Press fit plug (ball bearing)
5.		Restrictor

The pump which is belt driven from the engine is an eccentric roller type and also houses the pressure regulator and flow control valve. The pressure is controlled by a spring loaded ball valve (3) which is housed inside the flow control valve piston (4).

With no demand for assistance the rotary valve in the steering box acts as a pressure relief valve, allowing fluid (A) to flow freely through the steering box and back to the reservoir and pump inlet (B).

When the steering is turned, the rotary valve effectively stops all fluid flow through the steering box, thus causing an increase in pressure (A). This increase in pressure is felt in the flow control valve spring chamber where, at a pre-determined pressure the relief valve (3) will open and allow the pressure to escape. The fall in pressure in the flow control spring chamber, allows the flow control valve to move to the right, which in turn allows pump output (A) to escape directly into the pump inlet (B).

Assistance demanded



J6293

As soon as the steering wheel is released after making a turn, the system reverts to the condition seen in J6292 and the road wheels are returned to the straight ahead position by the mechanical steering geometry.

In the event of any hydraulic failure, steering control, though heavy, will be maintained through the mechanical components in the steering box.

Steering System

Symptom Chart

Insufficient power assistance

Possible Source(s):

- Fluid leaks

Action(s) to take:

- Check for leaks, top-up reservoir.

Possible Source(s):

- Incorrect system pressures

Action(s) to take:

- Carry out pressure test.

Possible Source(s):

- Power steering pump drive belt

Action(s) to take:

- Check for contamination and/or correct tension.

Excessive kickback through steering wheel

Possible Source(s):

- Faulty steering damper

Action(s) to take:

- Replace steering damper

Possible Source(s):

- Looseness or free play in steering linkage

Action(s) to take:

- Check steering linkage and replace worn or faulty components.

Possible Source(s):

- Looseness or worn bushes in front suspension

Action(s) to take:

- Check suspension and replace worn or faulty components.

Possible Source(s):

- Swivel hub resistance incorrect

Action(s) to take:

- Check swivel pin bearing pre-load.

Fluid leaks from steering box

Possible Source(s):

- Excessive system pressure

Action(s) to take:

- Replace power steering pump. If problems persist, overhaul the steering box.

Power steering fluid leaks

Possible Source(s):

- Incorrect fluid level.

Action(s) to take:

- Refill or drain to the correct level.

Possible Source(s):

- Leak from hoses and/or joints.

Action(s) to take:

- Slacken and re-torque unions. Replace faulty pipes or hoses.

Possible Source(s):

- Fluid escaping from filler cap.

Action(s) to take:

- Bleed power steering system.

Possible Source(s):

- Worn or damaged seal in steering system component.

Action(s) to take:

- Replace faulty seal(s).

Insufficient power assistance

Possible Source(s):

- Incorrect tire pressures or incorrect type of tire

Action(s) to take:

- Adjust tire pressures and/or replace tires.

Possible Source(s):

- Low fluid level or air locks in the system

Action(s) to take:

- Top-up fluid level, bleed the fluid system.

Possible Source(s):

- Incorrect system pressures.

Action(s) to take:

- Check system pressures and bleed system. If fault persists, replace power steering pump and/or overhaul steering box.

Stiff or heavy steering

Possible Source(s):

- Incorrect type of tire or incorrect pressure.

Action(s) to take:

- Fit correct tires or inflate to correct pressure.

Possible Source(s):

- Universal joint incorrectly aligned or seized.

Action(s) to take:

- Free off or replace universal joint, align correctly.

Possible Source(s):

- Steering box incorrectly adjusted.

Action(s) to take:

- Adjust steering box.
[Steering Gear Adjustment](#)

Possible Source(s):

- Steering ball joints seized.

Action(s) to take:

- Replace seized components.

Possible Source(s):

- Swivel pins require lubrication or bearing preload resetting.

Action(s) to take:

- Lubricate swivel pins or set bearing preload.

Possible Source(s):

- Steering box worn or seized.

Action(s) to take:

- Overhaul steering box.

Light steering/excessive free play

Possible Source(s):

- Incorrectly adjusted steering box

Action(s) to take:

- Adjust steering box.
[Steering Gear Adjustment](#)

Possible Source(s):

- Worn panhard rod or radius arm bushes. Check condition of ball joints and the lower steering column shaft universal joint for wear.

Action(s) to take:

- Replace worn/faulty components.

Steering vibration

Possible Source(s):

- Balance of road wheel, condition/specification of tires.

Action(s) to take:

- Balance wheels, replace faulty or incorrect specification tires.

Possible Source(s):

- Faulty steering damper.

Action(s) to take:

- Replace steering damper.

Possible Source(s):

- Worn/alignment of universal joints.

Action(s) to take:

- Replace worn components, align joints correctly.

Possible Source(s):

- Worn steering linkage ball joints, including steering box and tie rod.

Action(s) to take:

- Replace worn or damaged components.

Possible Source(s):

- Worn suspension bushes. Incorrectly tightened fixings.

Action(s) to take:

- Replace worn or damaged components. Ensure all fixings are tightened to correct torque with vehicle wheels on the ground.
- If problem persists, fit the following damper kits:

Possible Source(s):

- Incorrectly adjusted power steering box.

Action(s) to take:

- Adjust steering box.
[Steering Gear Adjustment](#)

Possible Source(s):

- Excessive hub bearing end-float.

Action(s) to take:

- Check condition of hub bearings and adjust end-float as necessary.

Possible Source(s):

- Swivel joints incorrectly set.

Action(s) to take:

- Adjust swivel pin bearing preload.

Possible Source(s):

- Steering geometry out of specification.

Action(s) to take:

- Carry out full steering geometry check.

Steering veer - not under braking

Possible Source(s):

- Unevenly worn or faulty front tires.

Action(s) to take:

- Inspect tires. Swap position (left to right) of front tires. If vehicle veers in opposite direction, replace tires. If problem solved, leave tires in new positions.

Possible Source(s):

- Steering box not centralised.

Action(s) to take:

- Centralise steering box.
[Steering Gear Centralization](#)

Steering veer - under braking

Possible Source(s):

- Air in brake system

Action(s) to take:

- Carry out bleeding procedure.
[Brake System Bleeding \(70.25.02\)](#)

Possible Source(s):

- Brake pads glazed

Action(s) to take:

- Remove glaze or replace brake pads.

Possible Source(s):

- Swivel pin bearing preload incorrectly set

Action(s) to take:

- Adjust swivel pin bearing preload.

Stability**Possible Source(s):**

- Vehicle overloaded or load incorrectly positioned.

Action(s) to take:

- Check vehicle loading parameters in Owner Handbook.

Possible Source(s):

- Rear trailing link/chassis bushes worn.

Action(s) to take:

- Replace worn components.

Possible Source(s):

- Worn front and rear shock absorbers.

Action(s) to take:

- Replace worn components.

Possible Source(s):

- Faulty steering damper.

Action(s) to take:

- Replace steering damper.

Possible Source(s):

- Road wheels out of balance.

Action(s) to take:

- Balance the road wheels.

Excessive noise**Possible Source(s):**

- Incorrect fluid level.

Action(s) to take:

- Refill or drain to the correct level.

Possible Source(s):

- Hoses fouling vehicle body.

Action(s) to take:

- Re-route hoses away from vehicle body.

Possible Source(s):

- PAS drive belt tension

Action(s) to take:

- Re-tension drive belt.

Possible Source(s):

- Air in power steering system.

Action(s) to take:

- Bleed power steering system.

Possible Source(s):

- Faulty steering box and/or pump.

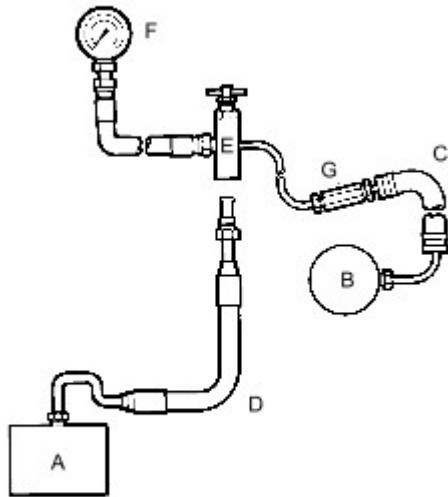
Action(s) to take:

- Replace faulty components.

POWER STEERING SYSTEM TEST

NOTE:

If steering lacks power assistance. Check pressure of hydraulic pump before fitting new components. Use fault diagnosis chart to assist in tracing faults.



RR3959M

A. Steering box B. Steering pump C. Existing hose, steering box to pump D. Hose LRT-57-030 E. Test adaptor LRT-57-001 F. Pressure gauge LRT-57-005 G. Thread adaptor LRT-57-004 H. Thread adaptor LRT-57-022 1. A hydraulic pressure gauge and test adaptor is used to test the power steering system. This gauge is able to measure 140 kgf/cm². The maximum power steering system pressure is 77 kgf/cm².

2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm². It is important to realise that pressure on gauge is same pressure being exerted upon steering wheel. When testing, turn steering wheel gradually while reading pressure gauge.

3. Check and maintain maximum fluid level of reservoir.

4. Examine power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.

5. Check steering pump drive belt tension and renew belt if necessary.

6. Assemble test equipment and fit to vehicle, as shown in RR3959M.

7. Open tap of adaptor.

8. Bleed system, take care not to overload pressure gauge.

9. With system in good condition, pressures should be:

▶ (A) Steering wheel held on full lock and engine running at 1,000 rev/min, 70 to 77 kgf/cm².

(A) Steering wheel held on full lock and engine running at 1,000 rev/min, 70 to 77 kgf/cm².

▶ (B) Steering wheel held on full lock and engine idling, 28 kgf/cm².

(B) Steering wheel held on full lock and engine idling, 28 kgf/cm².

▶ Checks should be carried out on both full lock positions.

Checks should be carried out on both full lock positions.



CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

10. Release steering wheel and with engine idling. Pressure should read below 7 kgf/cm².

11. If pressures differ to those given a fault exists.

12. To determine if fault is steering box or pump. Close adaptor tap for a maximum five seconds.

13. If gauge does not register specified pressure, pump is faulty.

14. Fit a new pump, bleed system and repeat test. If low pressure or a substantial imbalance exists, fault is in

steering box valve and worm assembly.

STEERING DAMPER

NOTE:

The power steering system, as well as reducing the effort required to manoeuvre the vehicle when parking, also helps to dampen any deflections of the road wheels, being transmitted back to the steering wheel. When operating the vehicle off road, the road wheels are often deflected by ruts and boulders causing the steering wheel to turn left and right. This phenomenon is known as 'steering kickback'. To subdue the effects of 'steering kickback', a hydraulic damper is fitted in the steering linkage between the track rod and the differential casing. The damper, which offers the same resistance in extension and compression, is sealed for life.

- 1 . Inspect damper for casing damage or leaks.
- 2 . Clamp one end of the damper horizontally in a vice using soft jaws. Compress and extend the unit by hand. Resistance should be equal in both directions.
- 3 . If it is felt that the unit is outside acceptable limits, fit a new steering damper.

VISUAL AND SAFETY CHECKS



WARNING: Before taking vehicle out on the public highway for road test, it is important that the following basic visual checks are carried out to ensure that the vehicle complies with legal requirements.

1 . NOTE:

This information refers to standard tyres fitted as original equipment.

Check and adjust tyre pressures.

- 2 . Check condition of tyres. Inspect for signs of uneven wear, damage and feathering.
- 3 . Check tread depth. Ensure that the tyre make, type and general condition are common across each axle.
- 4 . Check wheel rims for signs of damage and excessive run out.

ROAD TEST PROCEDURE

General steering/handling problems can usually be classified into one of the categories listed and ARE GENERALLY RELATED TO THE AGE, CONDITION AND USE OF THE VEHICLE.



WARNING: Ensure that all road tests are conducted by suitably qualified drivers in a safe and legal manner, and where local traffic conditions allow.

- 1 . Carry out visual and safety checks.
- 2 . Confirm general nature of complaint with customer, simulating where possible the conditions under which the problem occurs. Carry out following road test procedure to establish the problem.
- 3 . Steering load assessment - drive at 16 km/h (10 mph). Put 90° turn input into steering wheel, check self centering. The self centering should be equal on each lock but not necessarily return to exactly straight ahead without assistance from the driver.
- 4 . Steering assessment - drive at 64 km/h (40 mph) on a straight FLAT road (no camber), check for steering veer. The vehicle should follow a straight path with NO tendency to follow a curved path. If vehicle veers towards the kerb, vehicle may be 'camber sensitive'. A small amount of veer in direction of camber is acceptable.
- 5 . Directional stability assessment - drive at 112 km/h (70 mph) or maximum legal speed on a straight flat road. Carry out a normal lane change. Vehicle should quickly settle into a new straight path.
- 6 . Braking assessment (medium effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply steady medium braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.
- 7 . Braking assessment (full effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply full braking effort, noting

any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.

8 . If the symptom described by the customer is stiff steering or steering niggles, carry out stiff steering procedure. If not, proceed with basic checks and adjustments.