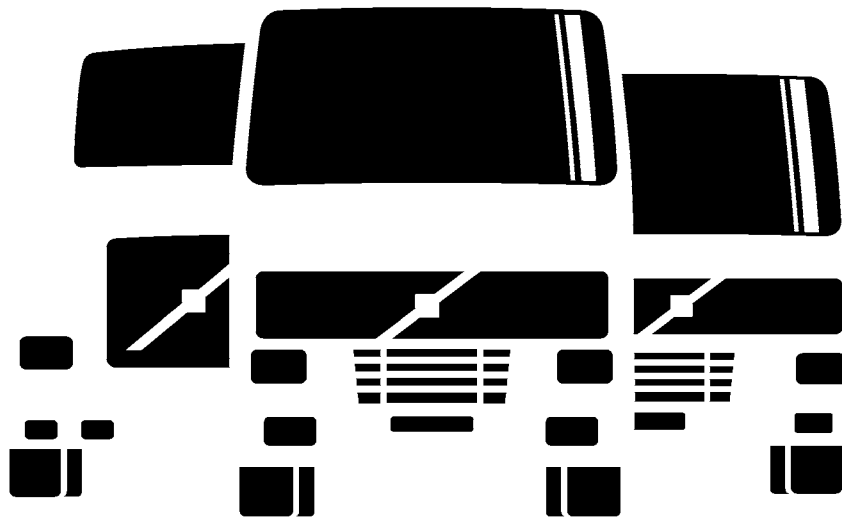


Service Manual Trucks

Group **640–500**

Steering System

VN/VHD



Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to March 2001.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Volvo Trucks North America, Inc.
Greensboro, NC USA

Order number: PV776-TSP153872

© 2001 Volvo Trucks North America, Inc., Greensboro, NC USA

All rights reserved. No part of this publication may be reproduced, stored in retrieval system, or transmitted in any forms by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Volvo Trucks North America, Inc..

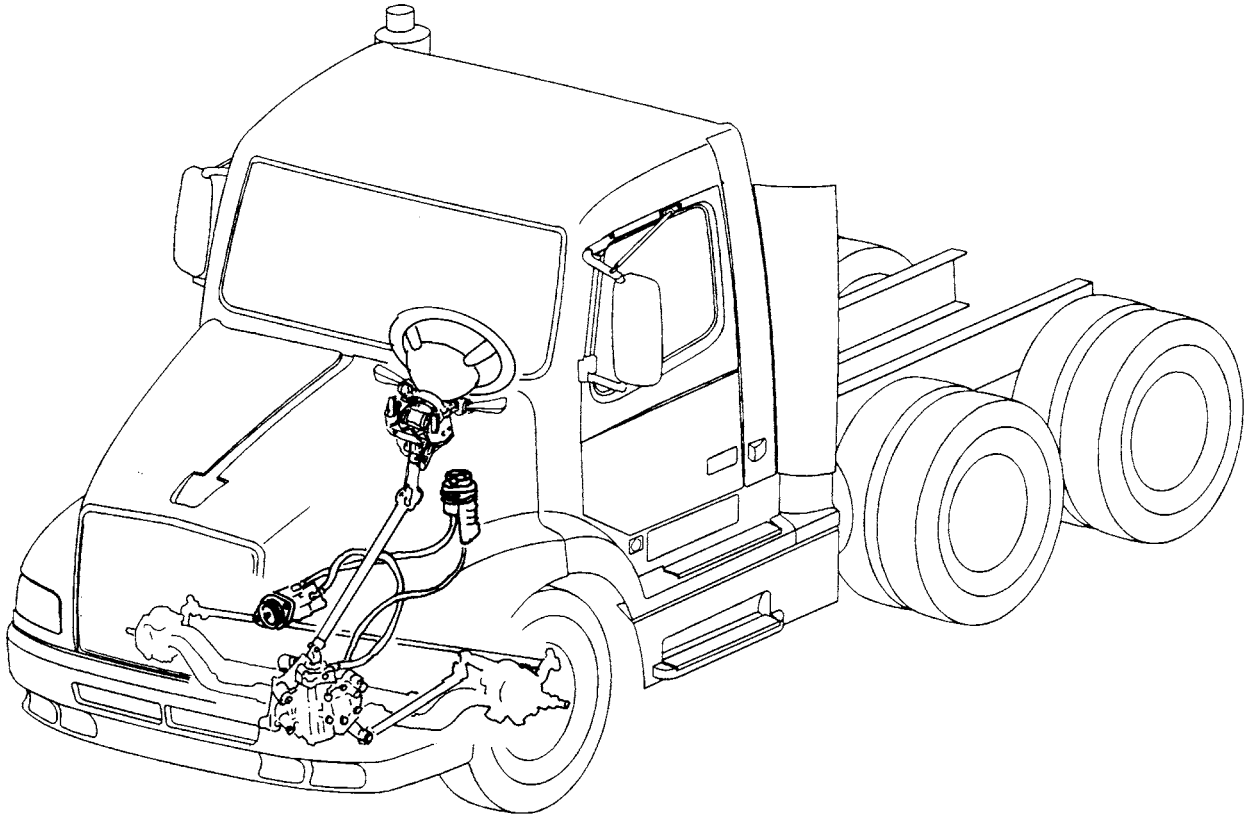
Contents

General	3	Service Procedures	31
Steering System	3	Steering Wheel, Replacement	31
Specifications	5	Steering Wheel, Replacement	32
Power Steering System	5	Steering Column, Replacement	36
Power Steering Gear	5	Steering Column, Overhaul	39
Power Steering Pump	5	Steering Column Adjustment Cable, Replacement ..	41
System	5	Steering Shaft, Replacement	44
Tightening Torques	6	Upper Steering Shaft, Replacement	47
Tools	7	Lower Steering Shaft, Replacement	47
Standard Tools	7	Steering Shaft Carrier Bearing, Replacement	48
Special Tools	7	Intermediate Steering Shaft, Replacement	49
Special Equipment	9	Steering Shaft Boot, Replacement	49
Design and Function	10	Steering Shaft Carrier Bearing Bracket, Replace- ment	50
Power Steering System	10	Power Steering Pump, Replacement	50
System Description	10	Power Steering Pump, Overhaul	52
Additional Maintenance Information	11	Steering Gear Relief Valve, Adjustment	54
Basic Operation	12	Steering Gear, Replacement	54
Power Steering Pump	12	Power Steering Fluid Filter, Replacement	57
Power Steering Gear	16	Power Steering Hydraulic Fluid, Changing	58
Oil Reservoir and Filter	20	Power Steering Hydraulic System, Bleeding	59
Steering Shaft	22	Power Steering System, Checking	60
Steering Column	23	Tilt Steering Column Cable, Adjustment	62
Steering Wheel	25	Input Shaft Seal, Replacement	63
Supplemental Restraint System (SRS)	26	Sector Shaft Seal, Replacement	66
Troubleshooting	29	Feedback	
Steering System Troubleshooting	29	Operation Numbers	
.....	30		

General

Steering System

This information covers the design, function, operation, and service procedures of the steering system hydraulic components used on the VN/VHD series vehicles.



W6000623

Specifications

Power Steering System

Power Steering Gear

Model	TRW TAS-65	Sheppard M100	ZF 8098
Type	Ball nut	Ball nut	Ball nut
Ratio	20.4:1	18.9:1	18.3:1
Steering wheel travel	4.5 turns	4.75 turns	5.1 turns
Maximum output torque (@ 2175 psi)	42,900 in-lb	43,050 in-lb	54,450 in-lb

Power Steering Pump

Engine	Volvo D12	Cummins M11	Cummins N14	Detroit Diesel Series 60	Caterpillar 3406E
Part No.	8071732	8081009	8081010	8081011	8081010
Rotation	cw	cw	ccw	cw	ccw
Drive type	gear	spline	spline	spline	gear
Displacement /rev (cm ³)	21	21	17	21	17

For all engines:

Oil type	Dexron II or Dexron III
Pressure output (max)	15.0 MPa (2175 psi)
Pressure output (min)	12.5 MPa (1800 psi)
Regulated Flow	16 liters/min (4.2 gpm)

System

Oil capacity	4.7 liters (1.25 gal)
--------------------	-----------------------

Tightening Torques

Steering Wheel

Steering wheel center bolt 85 ± 15 Nm (63 ± 11 ft-lb)

Note: Steering wheel center bolt is not to be reused

Steering Column

Upper steering column attachment bolts 15 ± 3.5 Nm (135 ± 30 in-lb)

Gas spring bolts 17 ± 3 Nm (150 ± 25 in-lb)

Steering Shaft

Steering shaft U-joint pinch bolts 60 ± 10 Nm (45 ± 7 ft-lb)

Steering Gear

Pitman arm retainer (Sheppard) as marked on retainer

Pitman arm pinch bolt (TAS) 400 ± 60 Nm (295 ± 45 ft-lb)

Pitman arm jam nut (ZF) 600 ± 50 Nm (445 ± 37 ft-lb)

Mounting bolts, steering gear 540 ± 90 Nm (400 ± 67 ft-lb)

Pitman arm/drag link 200 ± 30 Nm (148 ± 22 ft-lb)

Power Steering Pump

Housing bolts 45 ± 5 Nm (33 ± 4 ft-lb)

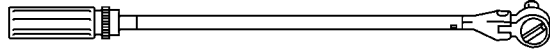
Lock nut, gear wheel (D12 only) 100 ± 10 Nm (75 ± 7 ft-lb)

Mounting bolts 46 ± 1 Nm (34 ± 1 ft-lb)

Tools

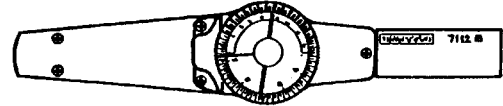
Standard Tools

Steering system maintenance requires the use of many tools that are part of a technician's normal tool set. In addition, the following tools are required to perform maintenance procedures on the steering system.



W0001220

Torque Wrench

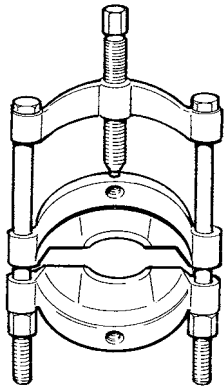


W0001232

Thermometer

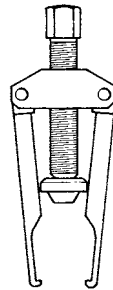
Special Tools

The following special tools are required for work on the steering system. The tools can be ordered from Volvo Truck.



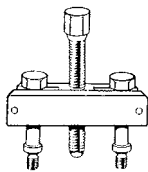
W0001253

9985433 Puller



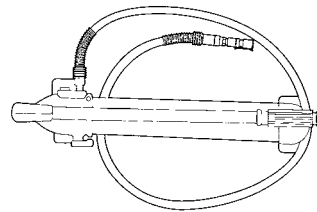
W0001255

9992658 Puller



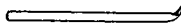
W0001257

9985434 Puller



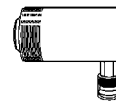
W0001258

9992670 Hydraulic Hand Pump



W0001239

9992327 Pry Bar



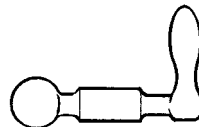
W0001247

9992671 Hydraulic Cylinder



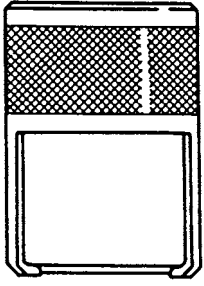
W0001254

9992619 Spindle



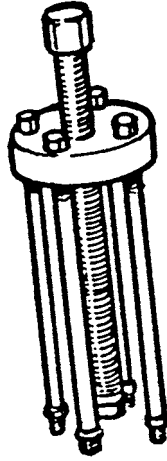
W0001256

9992672 Handle



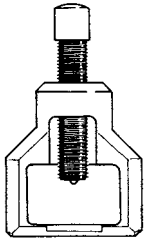
W0001260

9992681 Pitman Arm Puller



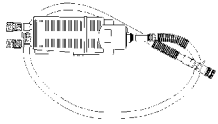
W0001259

9996519 Steering Wheel Puller



W0001240

9996201 Ball Joint Puller

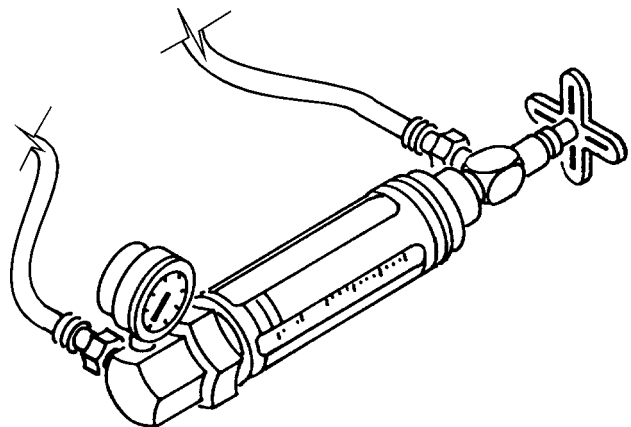


W0001249

9996222 Foot Pump

Special Equipment

The following special equipment is required for troubleshooting and repair of the steering system. This equipment can be ordered from Volvo Truck or from other tool and equipment distributors.



Flowmeter with Pressure Gauge

W0001236

Design and Function

Power Steering System

System Description

The steering system is a hydraulically operated control system comprised of a pump, steering gear, fluid reservoir, steering column, steering shaft, steering wheel, and interconnecting hoses.

The power steering pump is mounted to the engine and is driven by either a gear or a splined shaft. Pump rotation produces hydraulic pressure at approximately 17.2 MPa (2500 psi) for system operation.

The pump's high pressure output is directed through a hose to the steering gear. The steering gear uses the energy in the fluid to position a gear, called the sector shaft, so that a moveable arm, called the pitman arm, turns to produce changes in front wheel direction. The steering gear is mounted outboard the left side frame rail almost at the forward end.

Input to the steering gear comes from the steering wheel through the steering column and steering shaft. The steering column is positioned within the vehicle cab. It serves as the mounting for the steering wheel. The steering shaft is the portion of the steering system that transitions the system from inside the cab to the engine compartment. The shaft is a two piece telescoping unit with a universal joint welded to each end. One end is connected to the steering column within the cab, the other is connected to the steering gear.

Power steering fluid is supplied to the pump from the fluid reservoir. The reservoir is connected to the power steering pump and the steering gear through hoses. The fluid is returned to the reservoir from the steering gear. The reservoir has an internally mounted filter in the fluid return path. The reservoir, which is made of molded plastic, is strapped to an aluminum bracket. The bracket is bolted to the vehicle frame and serves as both a mounting device and a heat exchanger for the reservoir.

Additional Maintenance Information

The typical steering gear installed in the VN series was the Sheppard M100. That was changed to the TRW TAS65 in 1999. The only steering gear installed in the VHD series is the TRW TAS65 which is supplemented with a helper cylinder on the right side for heavy axle pressures and a second power steering box on very heavy axle pressures.

Specific maintenance procedures for the various steering gears, such as changing seals, or overhaul (and pitman arm removal and installation on the M100), are not included. Those procedures can be found in the respective vendor's manual for each steering gear. If routine maintenance or troubleshooting reveals that repair of the steering gear is necessary, refer to the appropriate vendor manual for maintenance instructions for that gear.

Vendor manuals for the two steering gears are available from Volvo. Refer to the following list for the appropriate manual.

TRW TAS 65	TAS Steering Gear Service Manual TAS SM WA 5M 3/94
Sheppard	Sheppard Power Steering Service Manual 1000400

Basic Operation

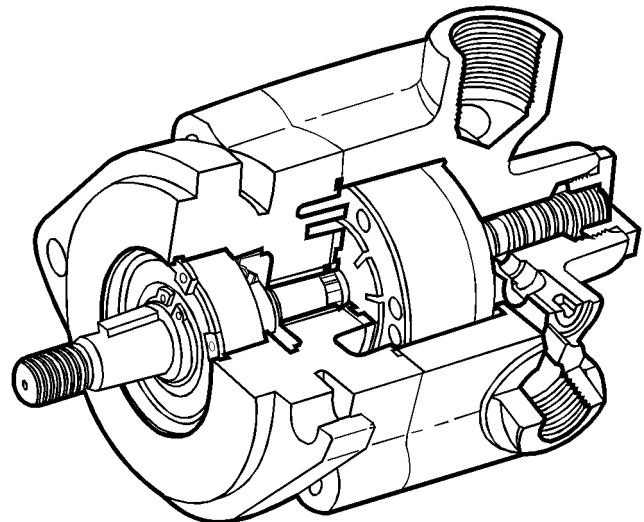
Under normal straight running circumstances, the steering system performs little work. Fluid from the reservoir flows to the pump which increases its pressure and delivers it to the steering gear. If the steering wheel is not positioned for a turn, the fluid pressure is equalized throughout the steering gear, so there is no movement of the sector shaft or the pitman arm attached to it.

When the driver turns the steering wheel, the steering gear changes the flow pattern of the incoming high pressure fluid so that there is a pressure difference across the steering gear's internal piston. That pressure difference forces the piston to move, which in turn rotates the sector shaft and the pitman arm. The pitman arm pulls or pushes the drag link to cause the vehicle to turn. When the steering wheel is returned to the straight ahead position, the fluid flow path changes to push the piston back to its straight running position, returning the sector shaft, pitman arm, and drag link to their neutral positions.

Power Steering Pump

The power steering pump converts mechanical energy supplied by the engine to hydraulic energy in the form of fluid flow and pressure. Fluid is supplied to the pump from the fluid reservoir and distributed at high pressure to the steering gear.

The pump is a vane type pump. Its rotor consists of a wheel and ten vanes that can slide in and out of the rotor. The rotor and vanes are housed in an oval shaped chamber. As the rotor spins, centrifugal force moves the vanes toward the outer edges of the chamber. When a vane is at the wide part of the chamber it scoops up hydraulic fluid. As a vane moves toward the narrow part of the chamber its fluid is forced toward the lower pressure region of the chamber outlet. Because the chamber is oval, each vane can scoop and deliver fluid twice during each rotation, doubling the pump capacity.



W6000631

Refer to the figure below. The pump also houses a control valve which regulates the oil flow and acts as a safety valve. In its rest position, the control valve is pressed to the left by a spring. When pump rotation begins, oil from the pump chamber flows through the delivery channel through an orifice out into the delivery line applying delivery pressure to the valve.

Because of the orifice, the pressure in the delivery channel is higher than in the space to the right of the valve. Thus pressure is pushing the valve to the right, compressing the spring. When pump speed is high enough, the valve moves over so that surplus pressure is relieved by oil passing the valve. That oil returns to the suction side of the pump. This valve action regulates the flow of oil. Since the pump typically is called on to supply less than its maximum capacity, the valve action is part of normal operation.

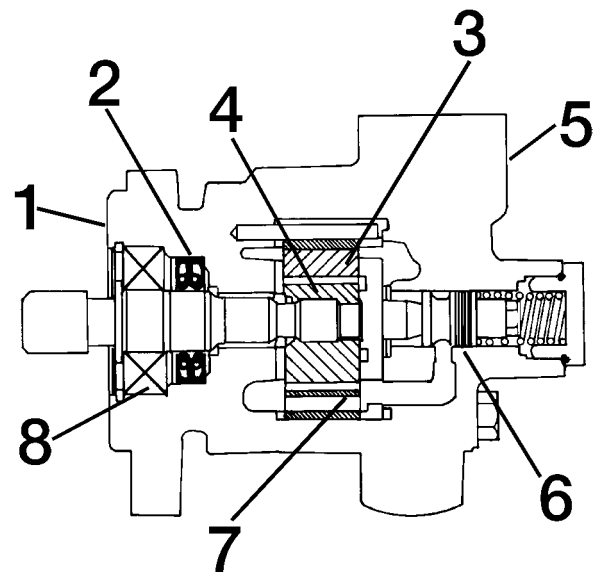
In the event that the fluid flow is blocked, such as when a wheel is being forced against a curb or stuck in a rut, the pressure in the delivery line increases to equalize the pressure on both sides of the control valve. The spring then pushes the valve to the left closing off the excess flow return causing the pressure to rise. The spring force on the pressure valve ball is overcome to let fluid through to the suction side through a return hole.

The pressure remains at maximum until the wheel obstruction is removed or the steering wheel is released. While the pressure valve is open there is only a small volume of fluid recirculating. Due to its high pressure, the temperature of the recirculating fluid increases rapidly. If a high temperature condition continues for more than approximately 5 seconds there is risk of breakdown of the fluid's lubricating properties, which could cause severe pump damage.

To help prevent an over-temperature condition, steering gear has off-loading valves to minimize excess mechanical loads and to allow a larger volume of fluid to recirculate, thereby minimizing the rate of temperature buildup.

The hydraulic pump is driven either by a gear or an eleven tooth, splined shaft depending on the engine on which it is installed. The splined axle drive is used on all engines except Volvo and CAT 3306.

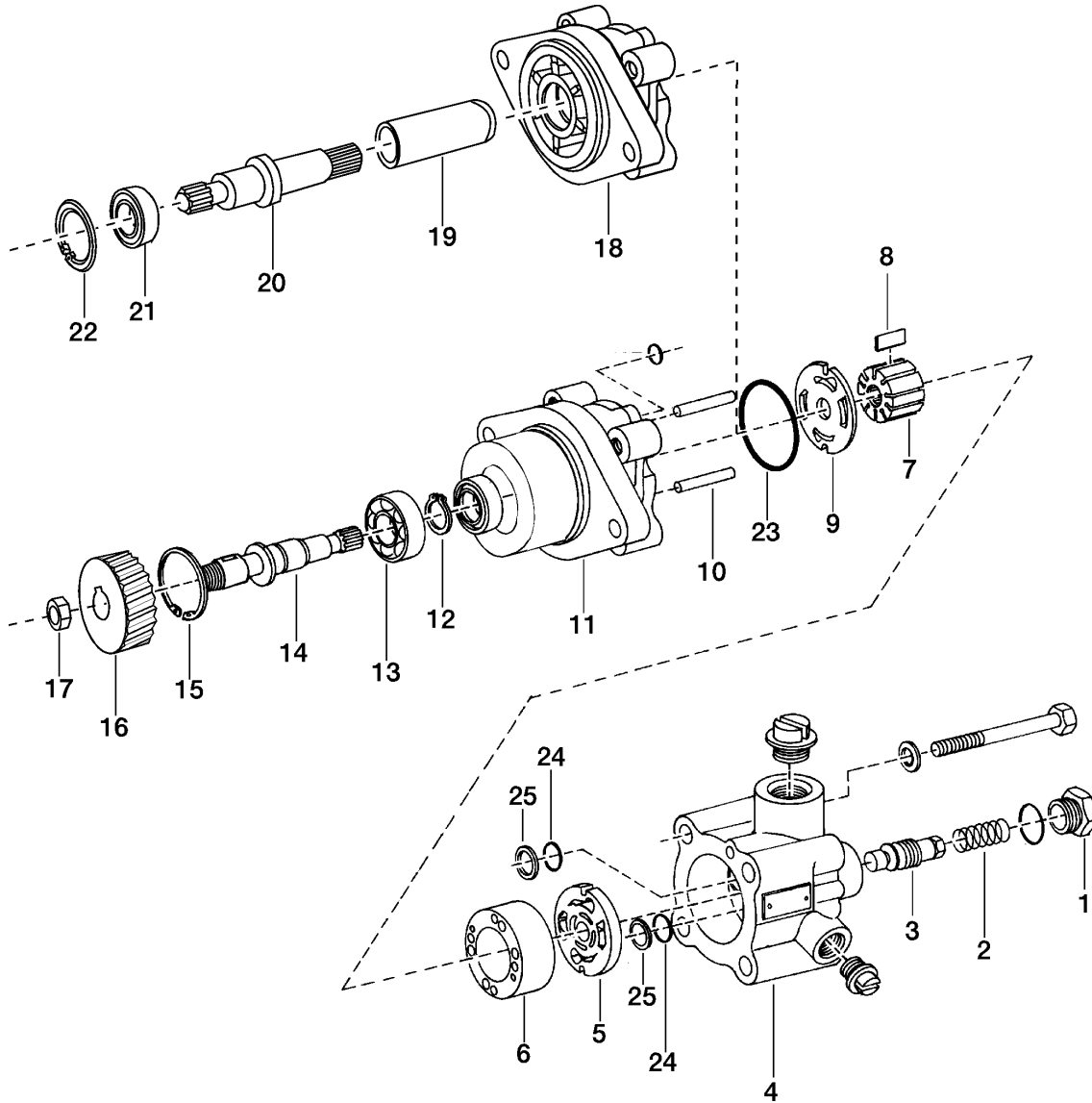
A splined axle drive does not generate excessive axial forces, therefore the drive end bearing and housing has a bushing in place of the ball bearing. These pumps are designated the LF series by LuK. Pumps designed for axial and radial drive forces (gear attached to pump) are designated the VT-series pumps.



- | | | |
|-----------|------------------|------------------------|
| 1) Flange | 4) Rotor | 7) Orifice |
| 2) Seal | 5) Housing | 8) Bearings or bushing |
| 3) Vane | 6) Control valve | |

W6000795

Power Steering Pump, Exploded View



W6000798

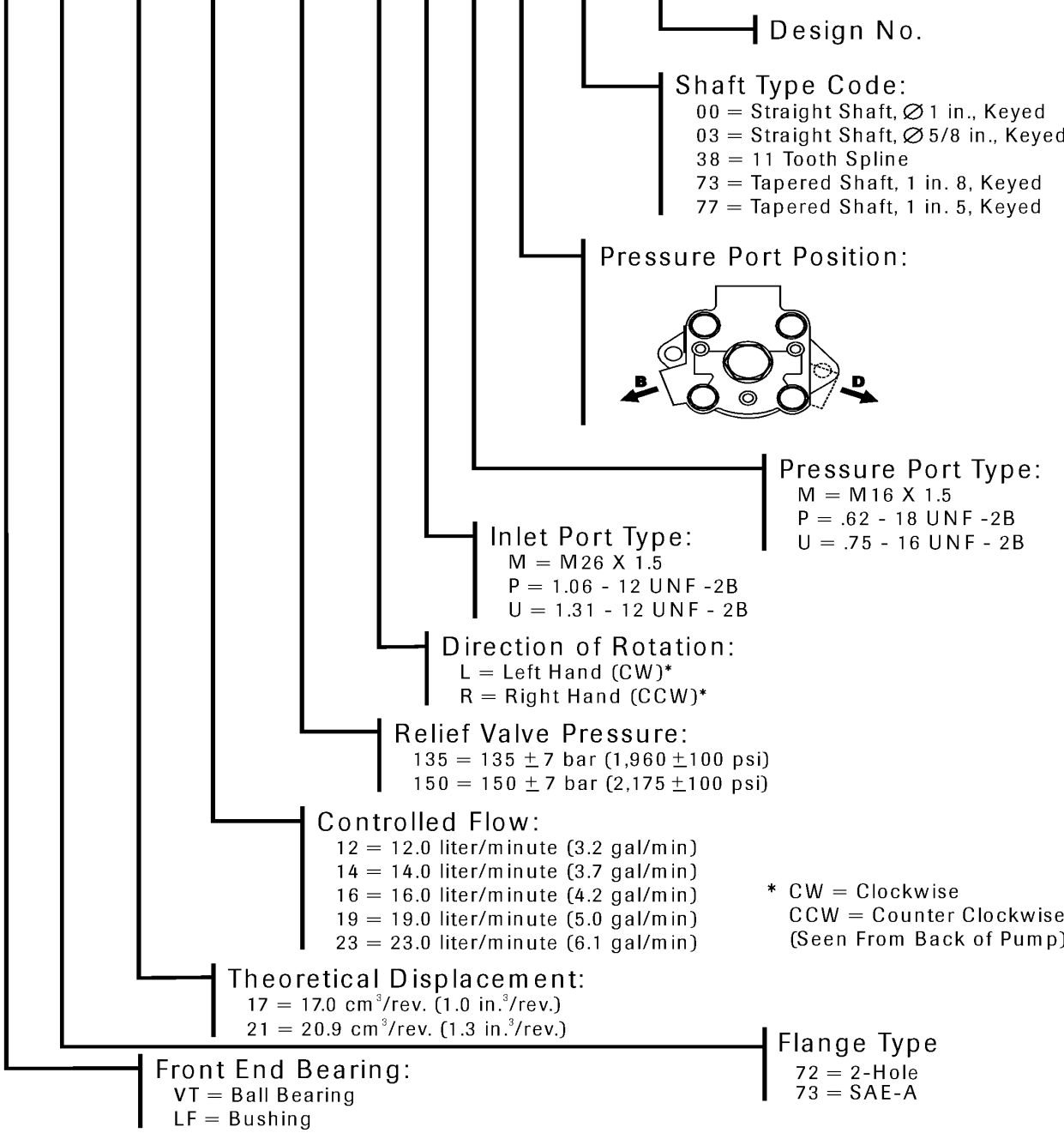
- 1 Plug
- 2 Spring
- 3 Control valve
- 4 Housing
- 5 Wear plate
- 6 Casing ring
- 7 Rotor
- 8 Vane
- 9 Wear plate

- 10 Dowel pin
- 11 Flange
- 12 Retaining ring
- 13 Bearing
- 14 Shaft
- 15 Retaining ring
- 16 Gear
- 17 Lock nut

- 18 Flange
- 19 Bushing
- 20 Shaft
- 21 Seal
- 22 Retaining ring
- 23 O-ring
- 24 O-ring
- 25 Backup ring

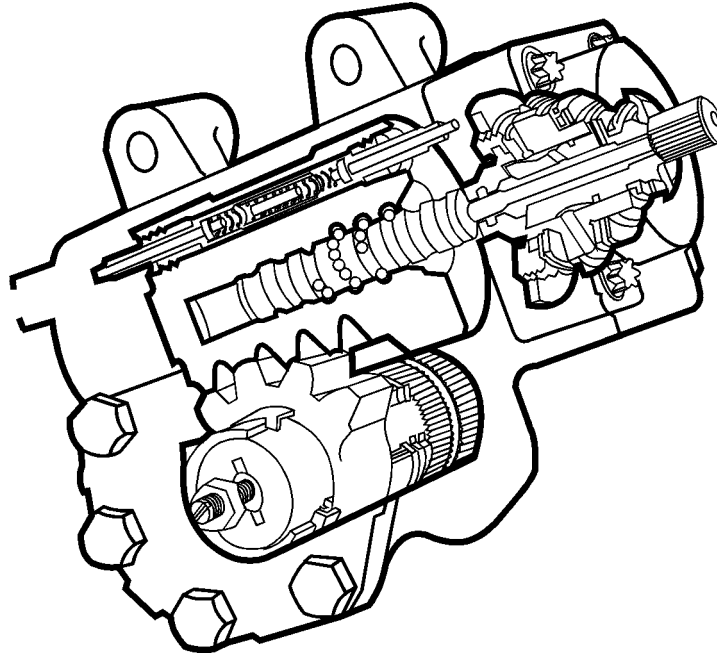
Power Steering Pump Model Number Designations

XXXX-XX-XX-XXX-X-X-X-X-XX-10



v640596
 W6000866

Power Steering Gear



Typical steering gear

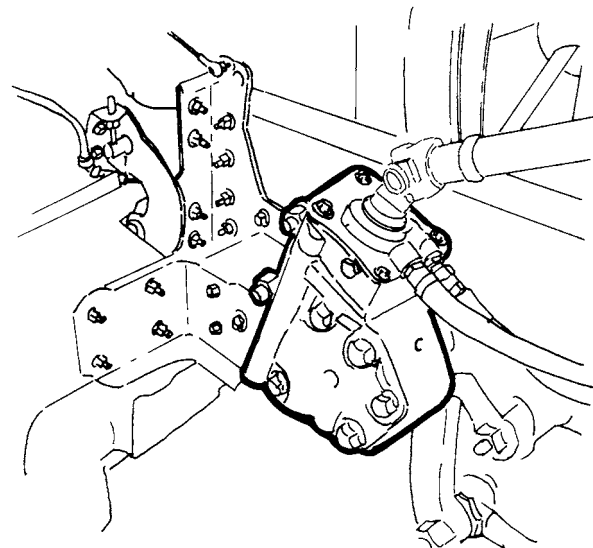
W6000867

The steering gear consists of an input shaft, a worm shaft, a torsion bar, a control valve, a piston, a sector shaft, and plunger or poppet valves. The gear also has a pitman arm attached to the sector shaft. All of the components except the pitman arm are located within the gear housing.

The input shaft and the worm shaft are connected by the torsion bar which is pinned to both shafts. The control valve is fixed to the upper part of the worm shaft. The threaded portion of the worm shaft is inserted into the piston. Contact between the worm shaft and piston is through a set of recirculating balls.

The steering gear receives high pressure hydraulic fluid from the pump. The input shaft rotates in the same direction as the steering wheel. When the input shaft is turned, the ports in the control valve line up to direct the high pressure fluid to the inside or outside of the piston causing rotation of the sector shaft and thus movement of the pitman arm.

Detailed operation of the steering gear is described later in this chapter.

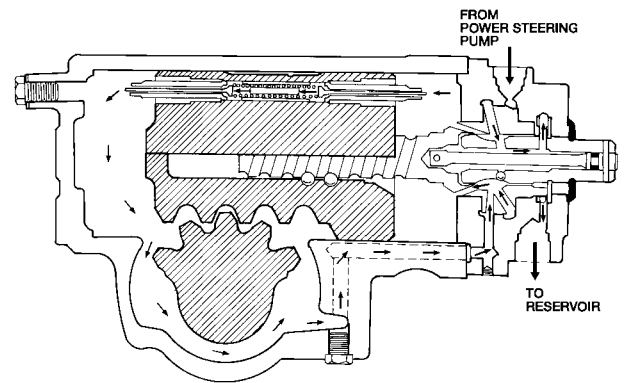


Steering gear mounted on frame

W6000800

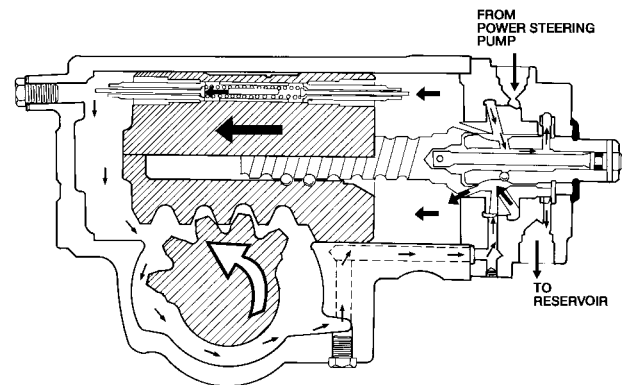
Steering Gear Function

Under straight driving, high pressure fluid flows from the pump to the steering gear. The fluid flows through the drilled ports in the control valve and the worm shaft and around the piston. Since pressure is equalized throughout the gear, both poppet valves are open, allowing free movement of fluid to the other side of the piston to the discharge ports in the worm shaft and control valve.



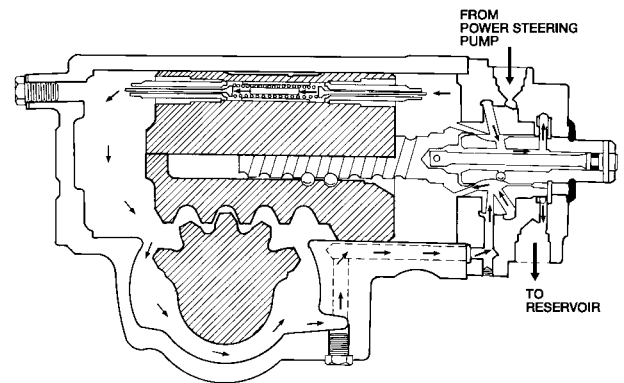
W6000633

As the steering wheel is turned clockwise, the steering gear input shaft turns. This movement causes the torsion bar and worm shaft to turn as well, since the torsion bar is pinned to both the input shaft and the worm shaft. The worm shaft attempts to move the piston, but the piston resists because the force required to turn the sector shaft is greater than that supplied by the worm shaft. As a result, the torsion bar twists. This causes the ports and channels in the control valve and worm shaft to align and apply the high pressure fluid to the upper end of the piston, causing the lower poppet valve to close. Now there is a pressure differential between the upper end and the lower end of the piston, causing it to move toward the rear of the housing. The rearward motion of the piston rotates the sector shaft, which moves the pitman arm toward the steering axle, causing a right turn.



W6000634

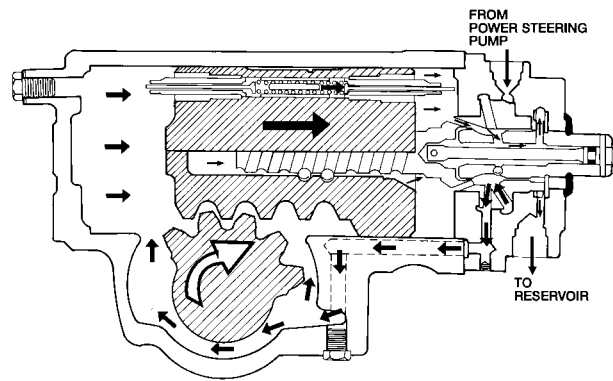
As the steering wheel is returned to its normal position, the lower poppet valve reopens and the steering gear pressures are equalized again. The piston is forced back to the neutral position due to hydraulic fluid flow in the opposite direction and the force from the mechanical steering system (if the vehicle is in motion).



W6000633

As the steering wheel is turned counterclockwise, the process is the same as for clockwise except that the ports and channels in the control valve and worm shaft align to apply the high pressure fluid to the outside of the piston, causing the upper poppet valve to close. Now there is a pressure differential between the inside and the outside of the piston causing it to move toward the front of the housing. The forward motion of the piston rotates the sector shaft, which moves the pitman arm away from the steering axle, causing a left turn.

To prevent damage to other steering components when the steering system is at an extreme position, the poppet valve stems extend beyond the poppet sleeves. As the piston nears full travel the poppet valve stem will contact either the end of the cylinder bore (upper poppet during left turn) or the fixed stop bolt (lower poppet during a right turn). When the poppet stem contacts the end of the bore (or the end of the bolt) that poppet valve opens relieving the pressure from the high side just enough to stop the gear from trying to turn beyond its limits. This protects the steering gear as well as the pump because the piston is prevented from contacting the end of the cylinder bore.



W6000635

Steering Geometry

For a vehicle to have good road characteristics and correct steering without steering wheel vibrations, it is important that all the parts of the steering system are correctly adjusted in relation to one another.

The steering gear center position should always be checked after replacement of the steering gear, front spring, pitman arm, or drag link. It should also be checked any time the vehicle exhibits unstable steering or pulling.

In its center position the steering gear has a so-called **pressure point** (center torque between sector shaft and piston). The torque across the center point dampens any small vibrations when driving straight ahead.

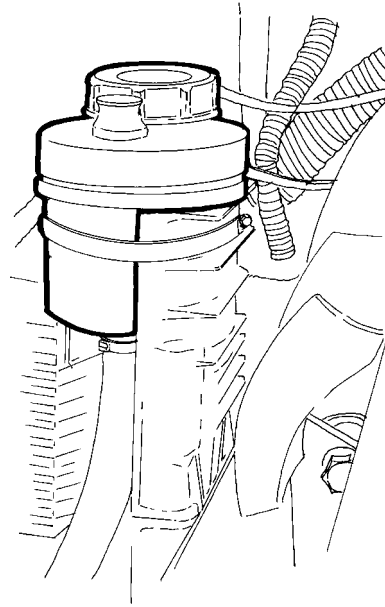
The **unloading valves**, or relief valves, should always be checked and adjusted after the curve angles (wheel stops) have been set and before or in conjunction with checking the hydraulic function.

Oil Reservoir and Filter

The fluid reservoir contains the power steering fluid for the system. It holds approximately 0.75 liters (21 oz.) of hydraulic fluid. The reservoir is mounted to an aluminum bracket that is bolted to the left side frame rail. The bracket is designed to support the reservoir as well as aid in heat dissipation. Only Dexron II® or Dexron III® steering fluid may be used.

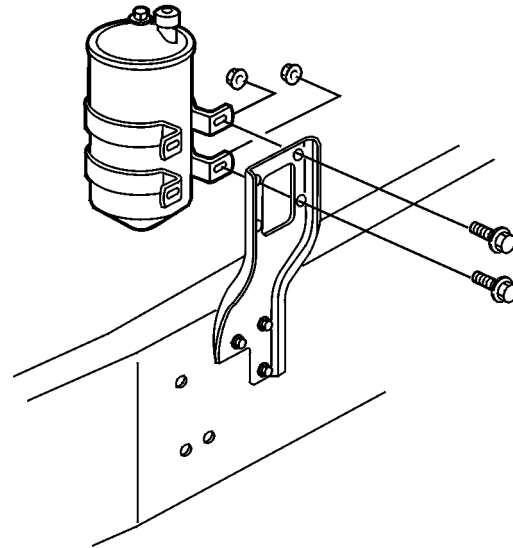
There is a filter mounted inside the reservoir in the return path from the steering gear. The filter is in the return line to avoid creating a restriction in the pump suction line. The filter is held in place by a yoke and a spring which exert pressure on the upper cover. In the event that the filter becomes clogged, the filter pressure relief function will ensure fluid flow and prevent rupture of the filter. When fluid pressure is high enough to overcome the spring force, the filter lifts off the guide at the bottom of the reservoir and unfiltered oil will flow into the reservoir.

The reservoir is mounted such that it is at the highest point in the system so that any air in the system will flow toward it.



W6000632

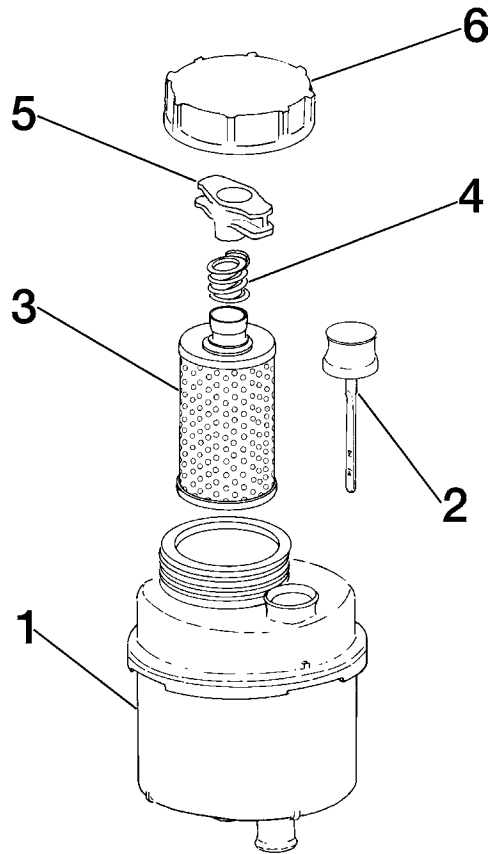
VN Fluid Reservoir



W6001419

VHD Fluid Reservoir

Fluid Reservoir, Exploded View



- 1 Reservoir
2 Dipstick
3 Filter

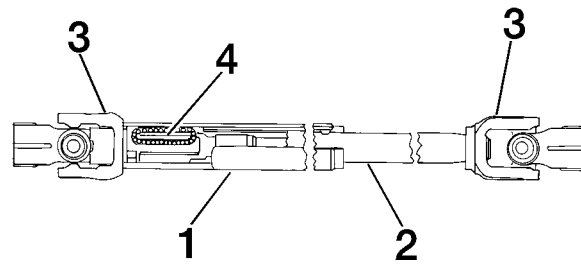
- W6000799
4 Spring
5 Locking device
6 Cap

Steering Shaft

The steering shaft is the component that connects the steering gear to the steering column inside the cab. The steering shaft consists of two tubes. The upper tube (2) fits inside the lower tube (1), and has a circulating ball mechanism (4) at its lower end. The balls recirculating reduces wear and isolates much of the vehicle vibration from the steering column and steering wheel.

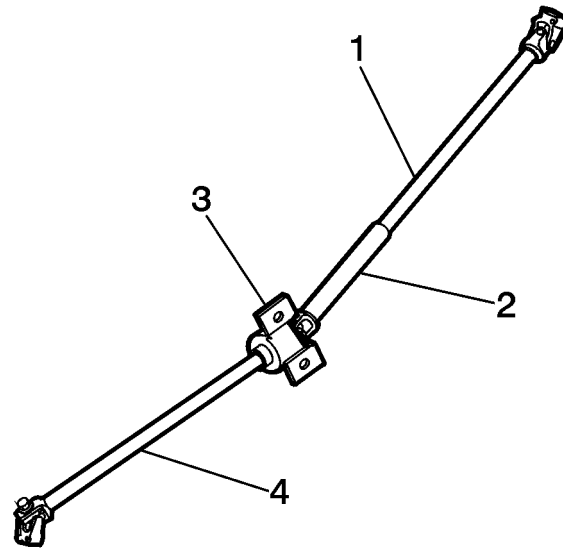
The upper end of the lower shaft and all of the upper shaft is housed in a rubber boot that keeps dirt and moisture out of the shafts and out of the cab.

Each end of the steering shaft has a universal joint (3) that fits on the spline of the steering column and the steering gear. The steering shaft is easily removed by loosening the pinch bolt on each universal joint and prying the U-joint off the serrated end of the steering gear or steering column.



W6000628

VN and VHD (Axle Back) Steering Shaft

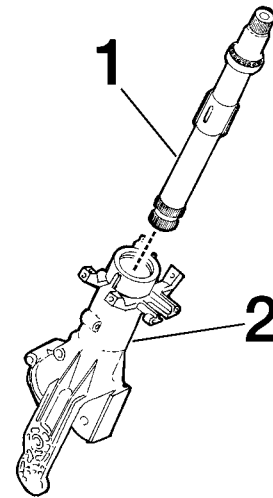


W6001420

VHD Steering Shaft

Steering Column

The steering column (1) is located inside the vehicle cab. It is housed in an aluminum housing (2) which is connected to the vehicle cab through the adjustment mechanism. The column is supported at each end by ball bearings and held in place by retaining clips. Both ends of the column are splined. The upper spline connects to the steering wheel. The lower end is connected to the steering shaft.

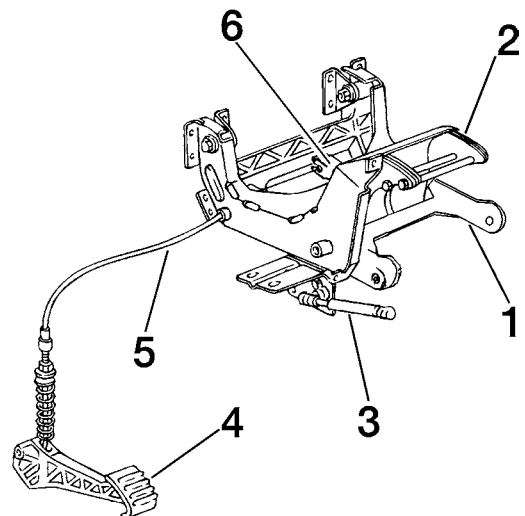


W6000627

Column Adjusting Mechanism

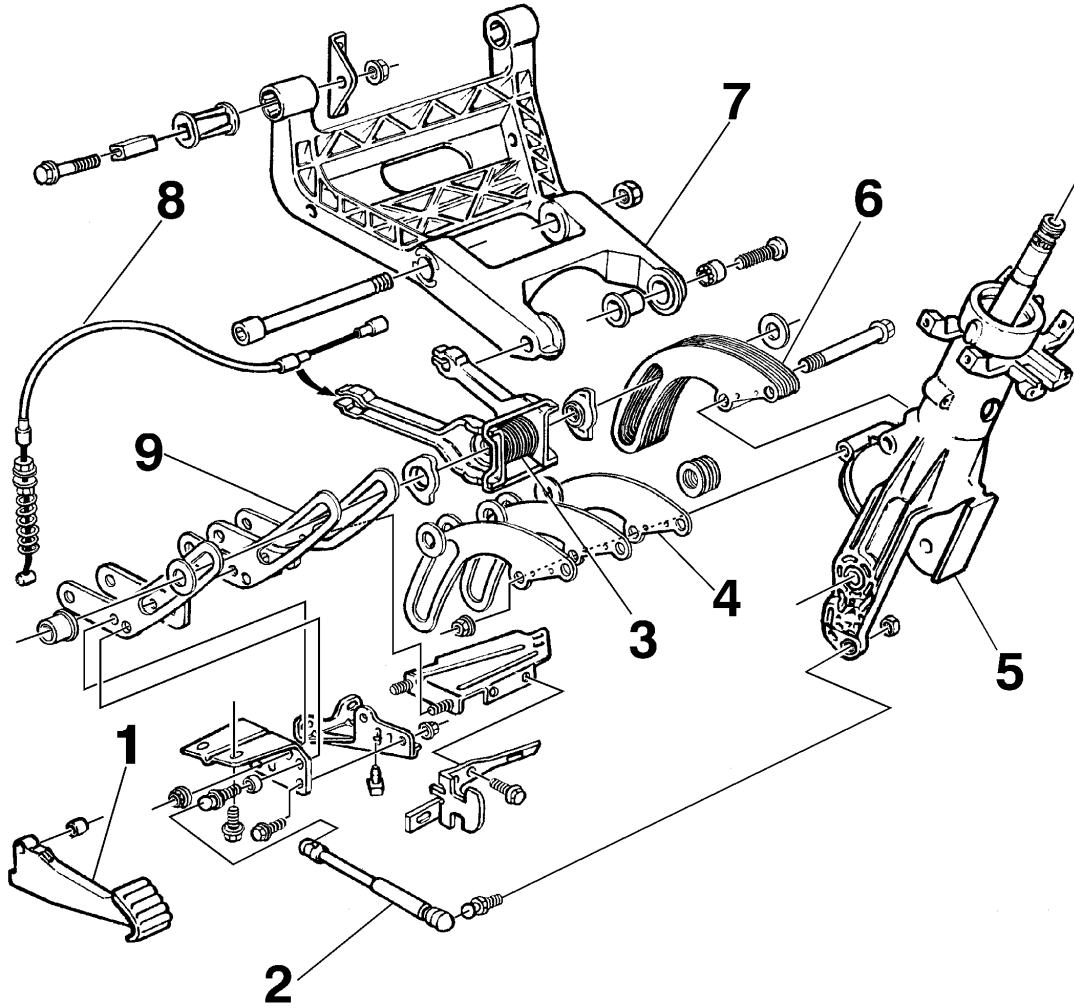
The steering column adjustment mechanism allows the driver to set the steering wheel height and angle to a more comfortable position. A bearing arm (1) is connected to the cab, where it swivels to provide the vertical motion. The steering column is attached to a set of friction plates (2) and to the bearing arm. The friction plates slide forward and back to provide the angular adjustment.

Column motion is slowed and smoothed by a gas spring (3) which is attached to the bearing arms and the steering column housing. In order to adjust the steering wheel position, the driver presses the foot pedal (4) which pulls the cable (5) down against a spring. The other end of the cable pulls two parts of a disc assembly together to release the pressure on the friction plates, which allows the column to move.



W6000801

Steering Column Adjustment Mechanism, Exploded View



- | | | | |
|---|-----------------|---|-----------------|
| 1 | Pedal | 6 | Friction plates |
| 2 | Gas spring | 7 | Bearer arm |
| 3 | Disc assembly | 8 | Adjuster cable |
| 4 | Friction plates | 9 | Support plates |
| 5 | Column housing | | |

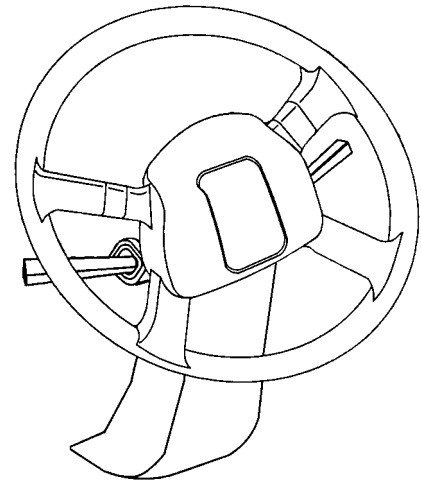
W6000796

Steering Wheel

The steering wheel is typical for heavy trucks, however on the VN/VHD series vehicles the splined upper end of the steering column is cylindrical, not tapered. This means that a wheel puller is no longer required to remove the steering wheel. The wheel is held firmly in place by a bolt that is coated with adhesive.

When the vehicle is in a forward position, the steering wheel should be straight-ahead at $\pm 4^\circ$. To alter the steering wheel alignment refer to "Steering Shaft, Replacement" page 44.

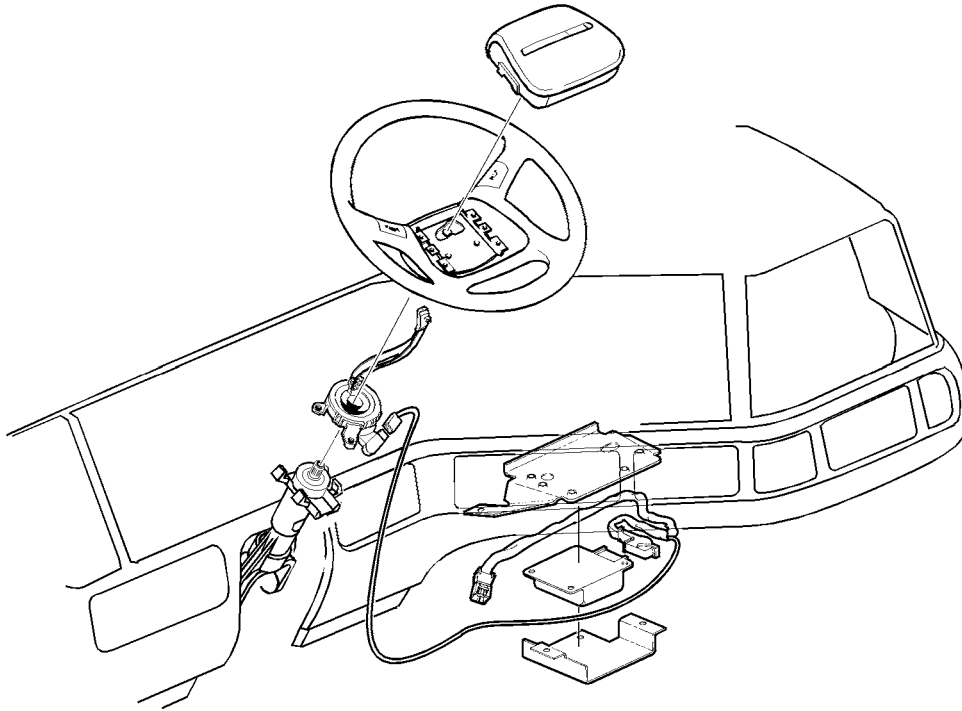
Note: Although a puller is not required for removal of the steering wheel, puller 9996519 can be used for easier steering wheel removal.



W6000626

Supplemental Restraint System (SRS)

Note: The SRS is not standard on all VN/VHD series vehicles.



W8001291

General

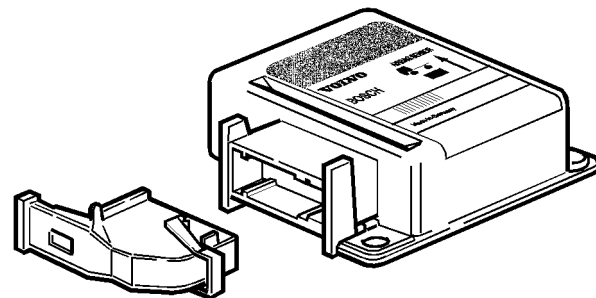
The Supplemental Restraint System (SRS) is a personal safety device that works in conjunction with the driver's safety belt. It consists of an airbag that will automatically deploy and inflate in the event of a rapid vehicle deceleration such as would occur in a collision.

The components of the SRS include an electronic control unit (ECU), a contact reel, and an airbag module. With the exception of the ECU, all of the components are mounted on the steering system.

Electronic Control Unit (ECU)

The ECU is an electronic sensing device that monitors the rate of deceleration of the vehicle. It determines whether or not the vehicle is in a collision situation by sensing if the vehicle is slowing rapidly enough and for long enough to require deployment of the airbag to protect the driver. The ECU is mounted on a special shelf that is welded to the cab to allow it to properly sense the cab deceleration rate.

The sensing circuits are designed such that a deceleration that is too slow (such as locking up the brakes) or that is too short duration (such as bumping into another vehicle while slowly rolling forward) will not cause the airbag to be deployed. The deceleration must be rapid and must be for an extended period of time, such as in a collision at driving speed with a stopped vehicle.

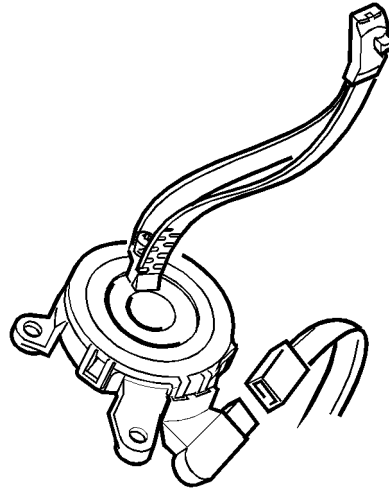


T8006850

Contact Reel

The electrical signal from the ECU is transmitted to the airbag module through a device called the contact reel. The contact reel is mounted on top of the steering column housing. It utilizes a coiled ribbon harness to allow for multiple rotations of the steering wheel. Proper positioning of the parts of the contact reel is crucial to its operation. Care must be used when removing the steering wheel to ensure the contact reel orientation is not disturbed.

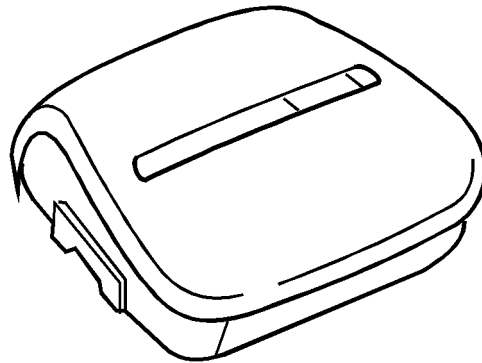
For further information on maintenance of the contact reel and other SRS components, refer to Group 88 Supplemental Restraint System (SRS) service information.



T8006881

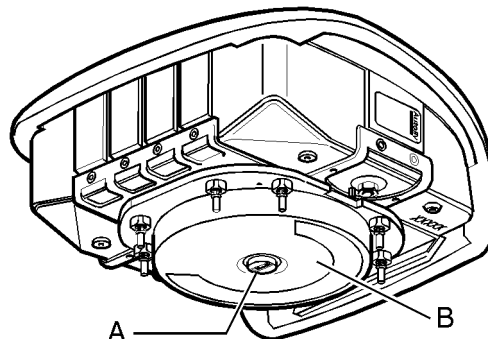
Airbag Module

The airbag module is mounted on the steering wheel. It consists of a detonator, gas generator, and the airbag. The airbag is folded up and is positioned above the gas generator. A fully inflated bag has a volume of approximately 67 liters. The airbag is made of a strong polyamide weave. There are two evacuation holes in the bag so that it collapses to absorb the energy from the forward movement of the driver.



T8006851

The detonator (A) causes a rapid reaction of the contents of the gas generator (B) to produce enough gas to inflate the airbag. The gas generator is an enclosed unit, filled with a propellant which forms a harmless gas.



T8006856

SRS Maintenance

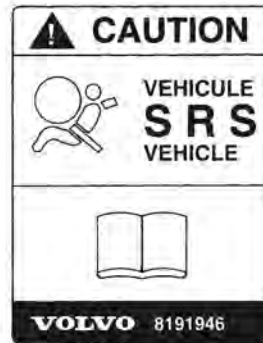
Additional care must be taken when performing maintenance on a steering system on a vehicle that is equipped with an airbag. Before any maintenance begins please refer to “Steering Wheel, Replacement” page 32.

SRS Identification

A vehicle equipped with SRS can be identified by the presence of the following decals.



1



3



2



4

- 1) Driver's sun visor
 2) Driver's side B-pillar or Driver's sun visor

W6001401

- 3) Steering shaft
 4) Windshield

Troubleshooting

Steering System Troubleshooting

The troubleshooting tables are intended only as a guide to assist the technician in discovering the possible cause of a vehicle steering problem. The tables are not intended to cover all the possible problems in the steering system or their exact remedy. The tables should not be used in place of good troubleshooting technique and experience, but as a time saving tool to help locate possible causes and possible cures of steering problems.

Complaint	Possible Cause	Remedy
Steering heavy in both directions	Fluid level too low and/or air in power steering system.	Add oil and bleed steering system. Check for leakage. Check the pump drive shaft seal.
	Incorrect oil in power steering system.	Change the oil.
	Steering shaft universal joints binding.	Replace steering shaft.
	Abnormally large resistance in wheel suspension.	Check and correct tire pressure. Ensure steering knuckles do not bind.
	Insufficient pressure and oil flow in power steering pump.	Check hydraulic function. Overhaul power steering pump.
	Excessive internal leakage in steering gear.	Overhaul steering gear.
Steering heavy in one direction	Unloading too early.	Check and adjust unloading mechanism.
	Incorrectly adjusted and/or faulty valves or seals in steering gear.	Overhaul steering gear.
Steering heavy with rapid steering wheel turns	Insufficient pressure and oil flow in power steering pump.	Check hydraulic function. Overhaul power steering pump.
	Air in power steering system.	Check and correct leakage. Check and/or replace pump driveshaft seal.
Steering wheel has stiff return to neutral after steering	Abnormally large resistance in wheel suspension.	Check and correct tire pressure. Ensure steering knuckles do not bind.
	Too little camber.	Adjust camber.
	Excessive friction or dirt in steering shaft or steering column components.	Clean, repair, or replace components as necessary.

Complaint	Possible Cause	Remedy
Difficult to maintain straight course	Fluid level too low and/or air in power steering system.	Add oil and bleed steering system. Check for leakage.
	Incorrect tire equipment.	Ensure front wheels have same type tires on both wheels.
	Steering incorrectly adjusted.	Adjust steering center position.
	Pressure point incorrectly adjusted.	Adjust steering gear pressure point.
	Excessive play in steering shaft U-joints or steering rod ball joints.	Replace steering shaft or steering rod ball joints.
	Loose steering gear mounting bolts.	Tighten bolts to correct torque.
	Incorrect toe setting.	Adjust toe.
	Stiff kingpins.	Replace kingpins and their bushings.
Impact felt in steering wheel	Fluid level too low and/or air in power steering system.	Add oil and bleed steering system. Check for leakage.
	Steering gear mounting bolts loose.	Tighten bolts to the correct torque.
	Steering gear pressure point setting incorrect.	Adjust pressure point.
	Excessive play in steering shaft U-joint(s).	Replace steering shaft.
	Excessive play in steering rod ball joints.	Replace worn ball joints or steering rods.
	Faulty shock absorbers.	Replace shock absorbers.
	Fault in steering gear.	Repair/replace steering gear.
Vibration in steering wheel	Imbalance in front wheels or front brake drums.	Balance front wheels and front brake drums.
Unusual noise in power steering system	Fluid level too low and/or air in power steering system.	Add oil and bleed steering system. Check for leakage.
	Incorrect fluid in power steering system.	Change power steering fluid.
	Fault in power steering pump.	Repair/replace power steering pump.
	Fault in steering gear.	Repair/replace steering gear.
Steering wheel turns by itself to one stop or the other	Control valve mechanism in steering gear faulty.	Repair/replace steering gear.

Service Procedures

6411-03-02-01 Steering Wheel, Replacement

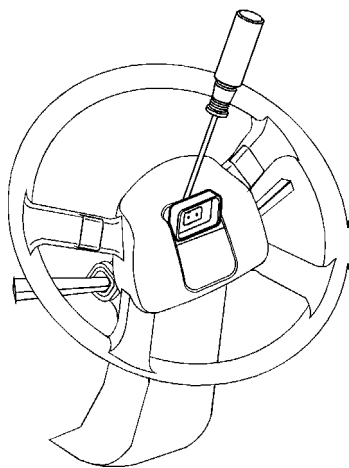
Without SRS

Removal



Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

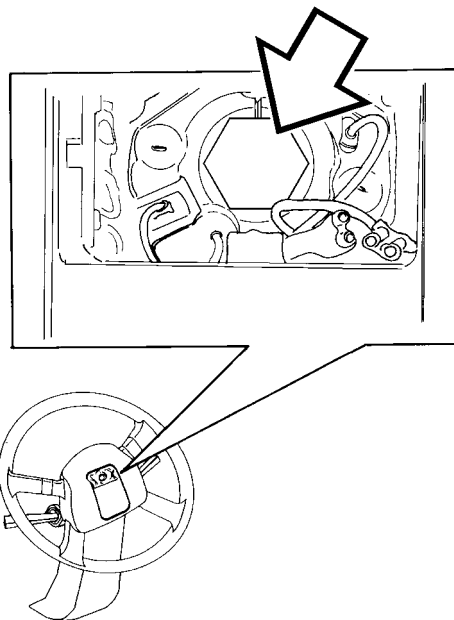
1



W3000789

Remove the horn button from the steering wheel.

2



W6000872

Remove the bolt in the center of the steering wheel. Discard the bolt.

Note: The steering wheel center bolt must not be reused. The bolt must be replaced with a new original equipment bolt when the steering wheel is installed.

3

Pull the steering wheel off the steering column by hand. If the wheel will not come off by hand, use puller 9996519 to remove the wheel.

9996519

4

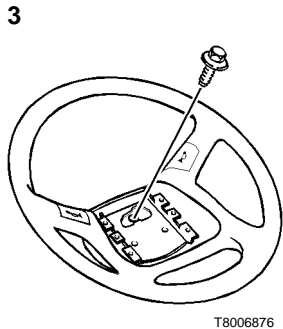
Disconnect the wires for the horn.

Installation

Note: Ensure the steering system is aligned prior to installing the steering wheel.

1
Place the steering wheel on the steering column.

2
Connect the wires for the horn.



Install a **new** original equipment bolt and washer in the center of the steering wheel and torque to 85 ± 15 Nm (63 ± 11 ft-lb).

3176564
 85 ± 15 Nm
 63 ± 11 ft-lb

4
Install the horn button.

6411-03-02-01 Steering Wheel, Replacement

With SRS

Removal

1



DANGER

The battery must not be connected when the airbag module is being removed or installed. Failure to disconnect the battery could result in premature activation of the SRS, causing serious personal injury.



CAUTION

Before beginning this procedure, disconnect any ground cables connected to the battery (such as engine ECU, satellite system, etc.). Disconnect those grounds **first** to avoid damaging electrical components. Then disconnect battery negative and positive terminals disconnect the ground terminal first.



CAUTION

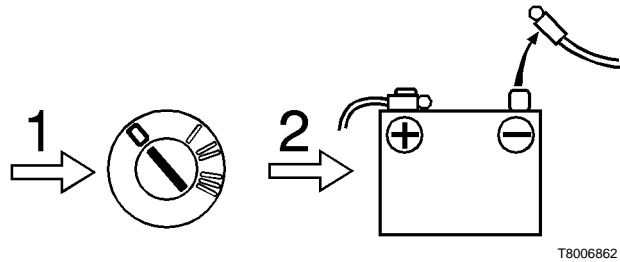
Possible equipment damage. The orientation of the contact reel to the center position of the steering gear must be maintained at all times. The steering wheel must be held in the center position anytime the steering column and the steering gear are not connected by the steering shaft. Failure to maintain proper contact reel orientation could result in breakage of the ribbon harness rendering the SRS inoperable.

Ensure the steering wheel is centered and the vehicle front wheels are pointing straight ahead.

2

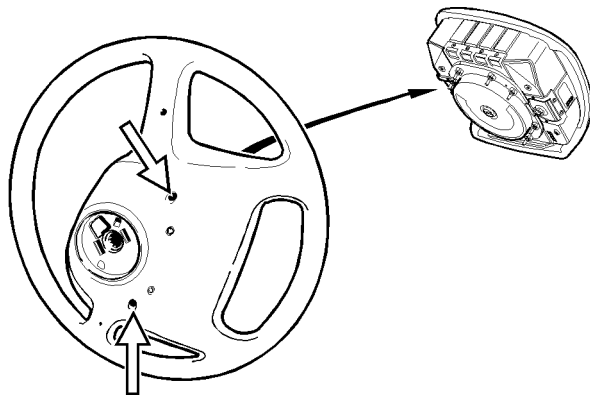
Secure the steering wheel in position. If steering wheel has a locking device, turn the ignition switch to off, otherwise, strap the wheel in position.

3



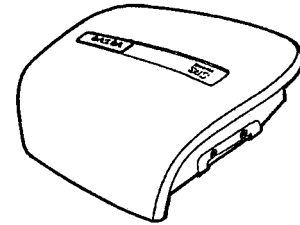
Turn the ignition switch off and disconnect the negative battery terminal.

4



Remove the airbag module by removing the two bolts underneath the steering wheel. Disconnect the connector and lift off the airbag module.

5



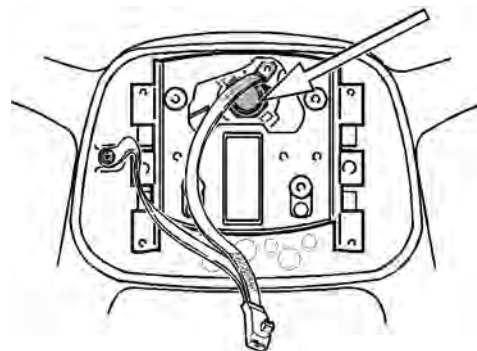
W6001430

DANGER

Always store a non-deployed airbag module with the metal (underneath) side down and in a place where it will not be handled carelessly. This is to reduce the chances of the airbag being projected from its storage position if accidentally deployed, which could cause serious personal injury or death.

Store the non-deployed airbag module in a secure place.

6



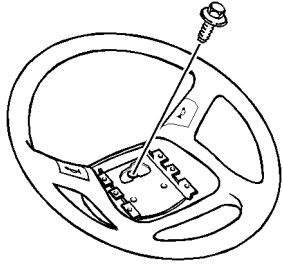
T8006875

Loosen the bolt in the center of the steering wheel. **Do not remove the bolt at this time.**

7

Ensure the vehicle steer wheels are pointing straight ahead. Verify the steering gear is centered by observing proper orientation of the timing marks.

8

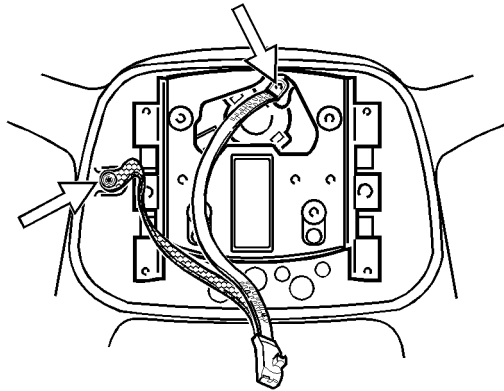


T8006876

Remove the bolt from the center of the steering wheel. Discard the bolt.

Note: The steering wheel center bolt must not be reused. The bolt must be replaced with a new original equipment bolt when the steering wheel is installed.

9



T8006878

Remove the screw in the end of the plastic band and screw it firmly to the contact reel (the screw must always remain in the plastic band). The contact reel is now secured in its position.

Note: The steering wheel must never be turned when the contact reel is secured.

10

Lift off the steering wheel without turning it. If the wheel will not come off by hand, use puller 9996519 to remove the wheel. Allow the cable and plastic band to pass through the hole in the steering wheel.

9996519

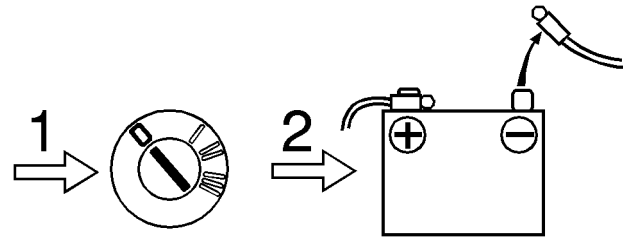
11

Disconnect the wires for the horn.

Installation

Note: Ensure the steering system is aligned prior to installing the steering wheel.

1



T8006862

Turn the ignition switch OFF and disconnect the negative battery terminal.

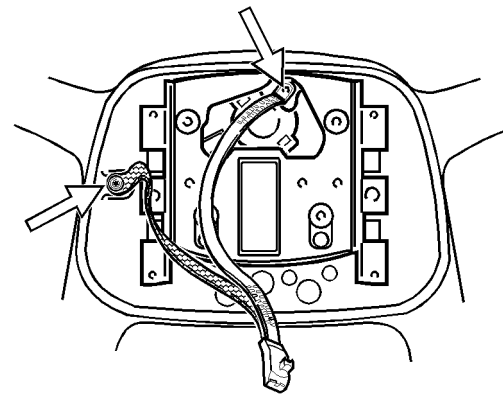
2

Place the steering wheel on the steering column. Feed the cable and plastic band through the hole in the steering wheel.

3

Connect the wires for the horn.

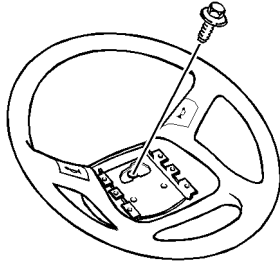
4



T8006878

Remove the screw from the contact reel to the blind hole in the steering wheel. Ensure the screw stays in the plastic band.

5



T8006876

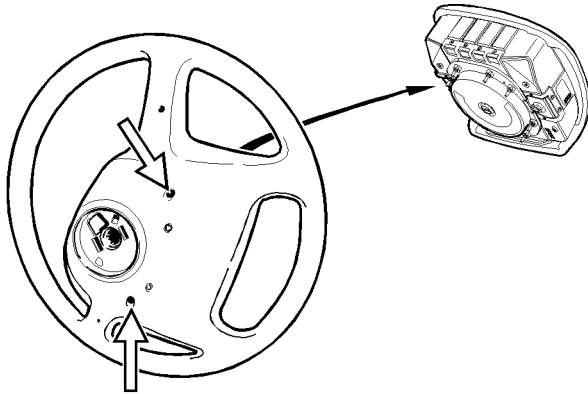
Install a **new** bolt in the center of the steering wheel and torque to 48 ± 7 Nm (35 ± 5 ft-lb).

979924
 48 ± 7 Nm
 (35 ± 5 ft-lb)

6

Connect the contact reel cable to the airbag module and place the module on the steering wheel.

7



T8006874

Install the airbag on the steering wheel. Tighten the left hand bolt first. Torque the bolts to 10 ± 2 Nm (90 ± 18 in.-lb.).

10 ± 2 Nm
 (90 ± 18 in.-lb)

8

Close the cab windows. Turn the ignition switch to ON. Ensure no one is in the cab. Close the cab doors.

9

! WARNING

Personal injury hazard. It is important to be sure that no one is in the cab during this procedure step. The air bag could deploy causing serious injury.

! CAUTION

If there are other ground cables to be connected to the battery (such as engine ECU, satellite system, etc.), connect the battery ground cable **first**, then connect those grounds. Electronic modules may be damaged when additional grounds are connected/disconnected without the main battery ground connected. Always reconnect the main battery ground **first**.

! CAUTION

In vehicles with a Supplemental Restraint System (SRS), turn the ignition switch ON before connecting the battery. Failure to do so may result in permanent damage to the instrument cluster or other electronic circuits on the vehicle. Check for fault codes after repairs are complete.

Connect the negative battery lead.

6412-03-02-04 Steering Column, Replacement

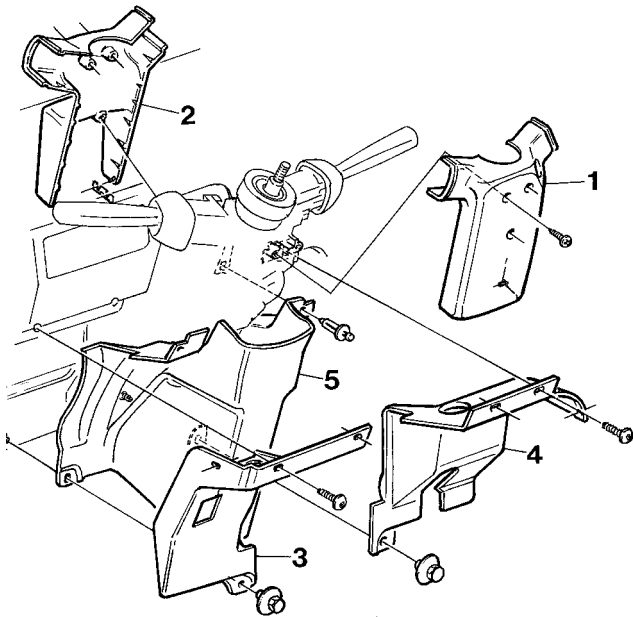


Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Removal

1
Remove steering wheel in accordance with the appropriate service procedure. See "Steering Wheel, Replacement" page 31 and "Steering Wheel, Replacement" page 32.

2



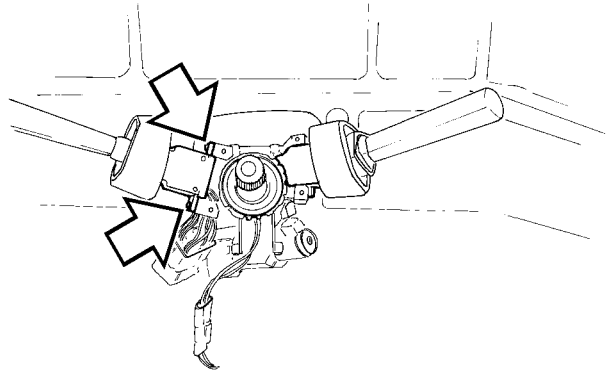
T8006351

Remove the covers from around the steering column and above the pedals in the order shown.

Note: Use caution when pulling center panel off of push lock clips.

3
Pull the floor mat back.

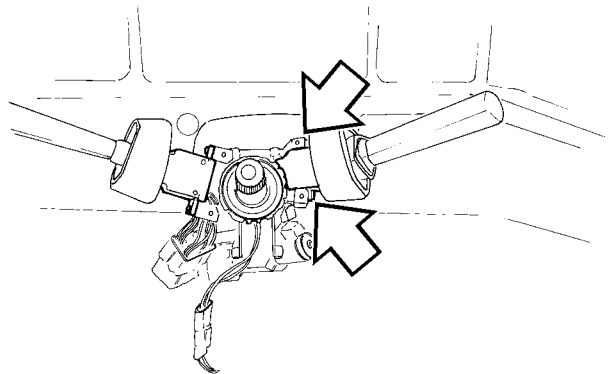
4



W6000648

Remove the turn signal switch screws. Disconnect and remove the switch.

5



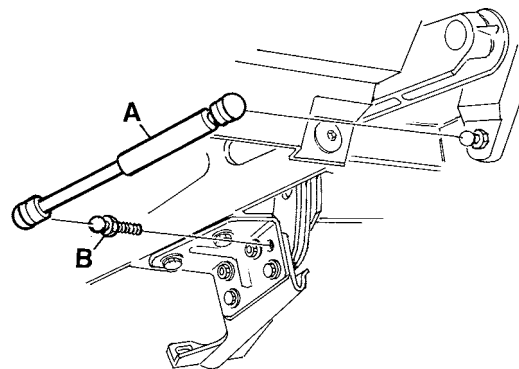
W6000647

Remove the windshield wiper switch screws. Disconnect and remove the switch.

6

Extend the steering column as far out as possible.

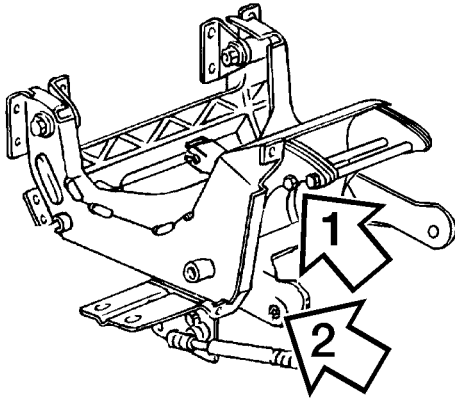
7



T6006167

Disconnect the gas spring (A) from the gas spring bolt (B).

8



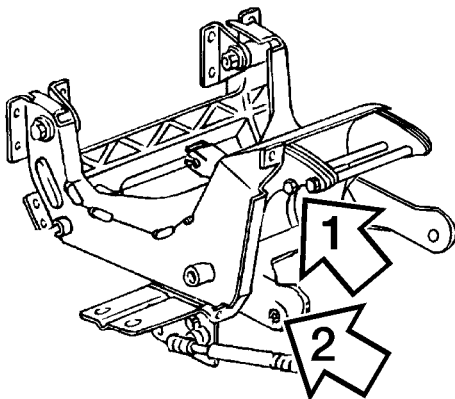
W6000650

Remove the steering column pivot screws (2).

9

Pull the column forward until both steering column attachment bolts are clear of the dash.

10



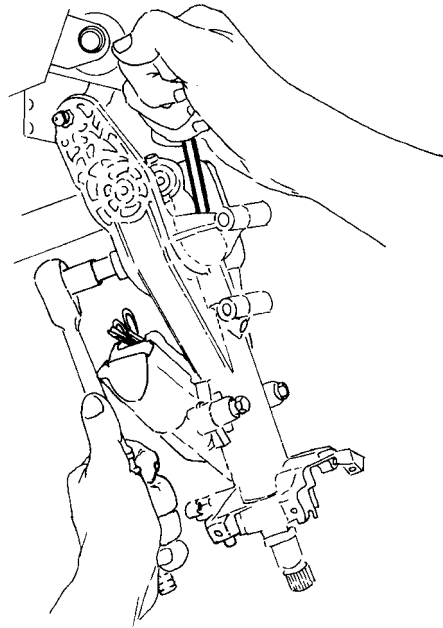
W6000650

Remove both upper steering column attachment bolts (1).

11

Rotate the steering column until the upper shaft points toward the cab floor.

12



W6000649

Loosen the steering shaft upper end U-joint pinch bolt. Pry the U-joint off the steering column.

13

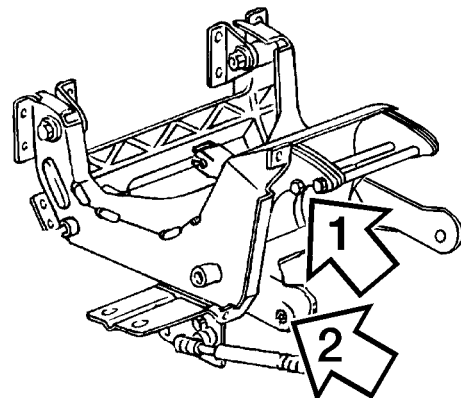
Remove the column.

Installation

1

Place the steering column housing on the adjustment mechanism.

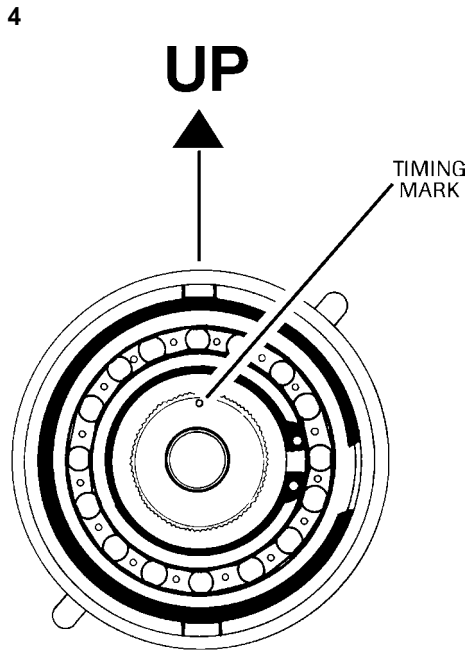
2



W6000650

Install upper steering column bolts (1). Torque bolts to 15 ± 3.5 Nm (135 ± 30 in.-lb.).

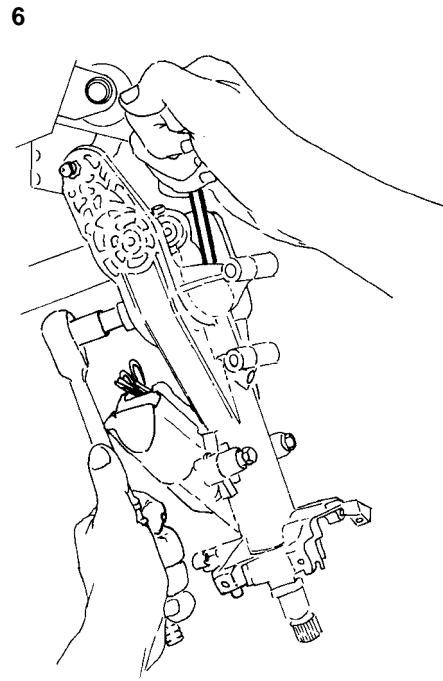
3
Ensure the vehicle front wheels are pointing straight ahead. Also ensure the timing marks on the steering gear housing are aligned.



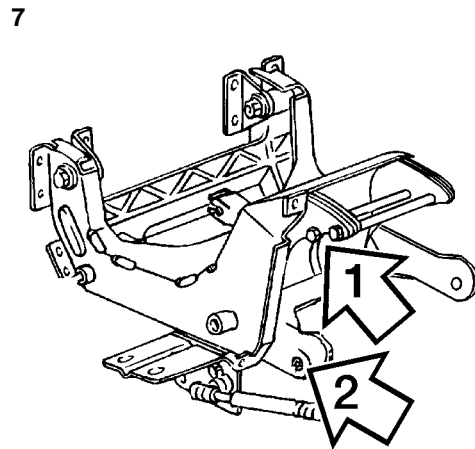
W6000865
Ensure the timing mark on the steering shaft is pointing toward the top of the column housing.

5
Replace the steering shaft upper U-joint pinch bolt with a new original equipment bolt. Apply locking fluid to the bolt.

6782610
971086



W6000649
Connect the steering shaft to the steering column. Torque the pinch bolt to 60 ± 10 Nm (45 ± 7 ft-lb).



W6000650
Install the column pivot screws (2).

8

Attach the gas spring to its bolt on the column housing.

9

Attach the turn signal switch and wiper control switch. Connect the wires for the switches.

10

Install the steering column covers in the reverse order from removal. See "Steering Wheel, Replacement" page 31 and "Steering Wheel, Replacement" page 32.

11

Install the steering wheel in accordance with the appropriate service procedure.

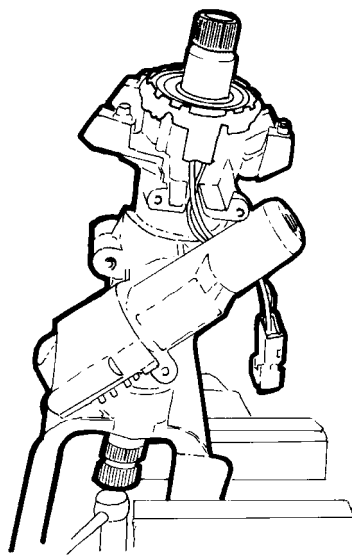
6412-04-04-01 Steering Column, Overhaul



WARNING

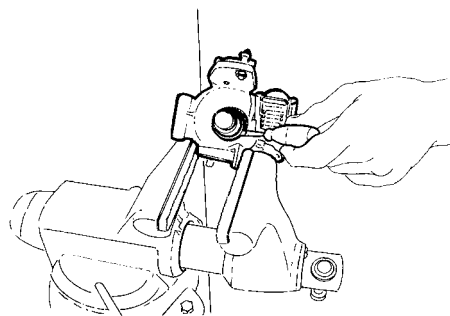
Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

Disassembly

1

W6000646

Place the steering column housing in a vice.

2

W6000652

Remove the retaining ring from the lower end of the column.

3

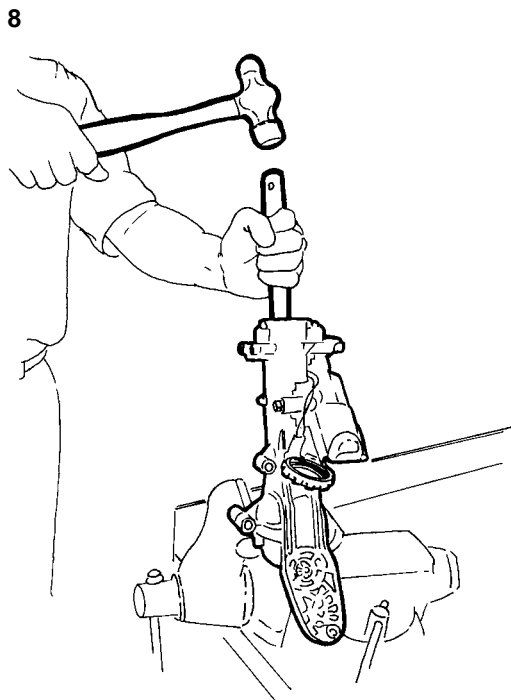
Pull the lower bearing from the housing.

4
Remove the column from the housing.

5
Remove the seal.

6
Remove the retaining ring from the upper end of the housing.

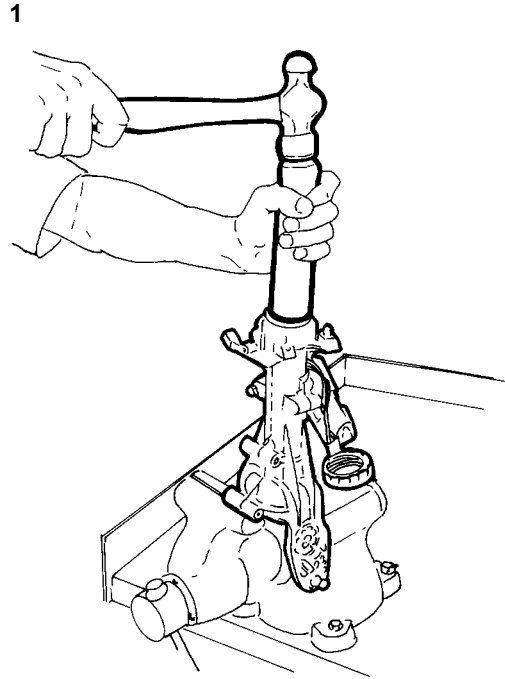
7
Rotate the housing in the vice so that the lower end points up.



Using a suitable drift, drive the upper bearing out of the housing.

W6000655

Assembly



W6000654

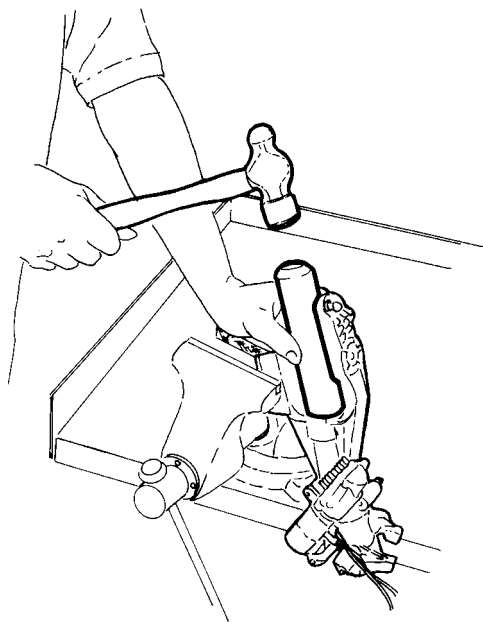
Using a suitable drift, press a new upper bearing into the housing.

2
Install the retaining ring in the groove at the upper end.

3
From the lower end, press a new seal into the housing.

4
Install a new bearing on the column. Press it on with a drift.

5



W6000653

Install the column in the lower end of the housing. Press the column in until the bearing is below the groove for the retaining ring.

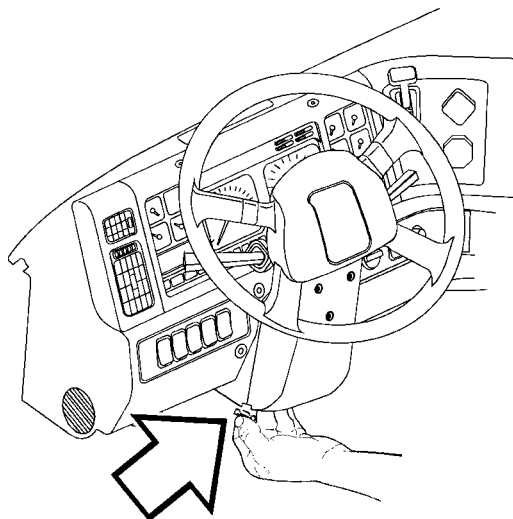
6

Install the lower retaining ring in the housing.

6412-03-02-03 Steering Column Adjustment Cable, Replacement

Removal

1



W3000655

DANGER

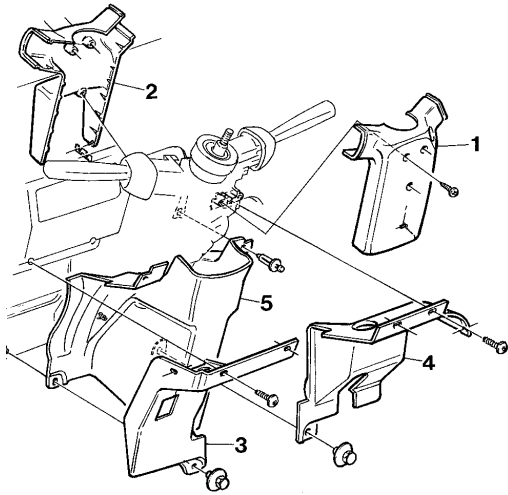
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

DANGER

DO NOT attempt to adjust the tilt steering column by tightening or loosening the screw joint. Adjustments must be made **ONLY** from the cable at the foot pedal. Adjustments attempted at any other location may affect the safety features of the steering column, resulting in an accident and/or serious personal injury or death.

Remove the push clips from the bottom of the front and rear upper steering column covers.

2



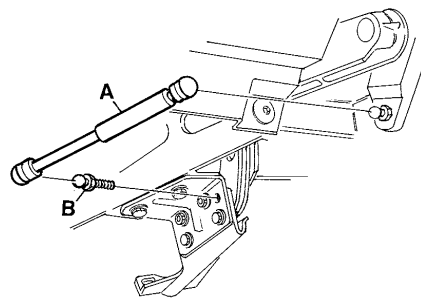
T8006351

Remove the torx screws from the steering wheel covers and remove the covers in the order shown. Disconnect the ventilation hose and the diagnostics connector from the left side cover.

3

Pull back the floor mat.

4



T6006167

Remove gas spring (A). Remove the gas spring bolt (B) from the bracket.

5

Remove the forward grab handle.

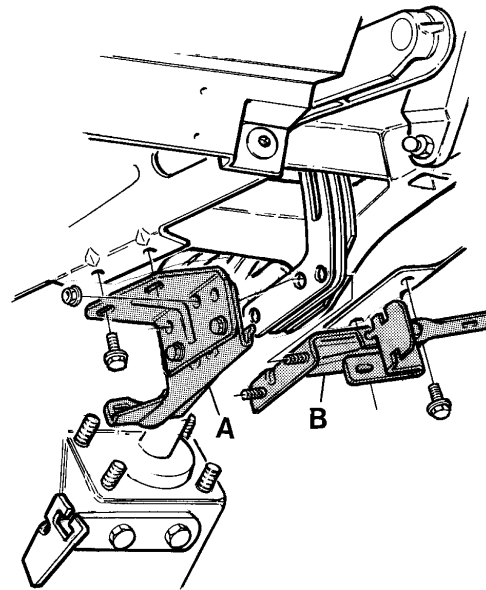
6

Remove side kick panel.

7

Remove the plastic clamps holding the air lines and electric cables. Label and disconnect 4 air lines and 2 air fittings to provide access to the pedal.

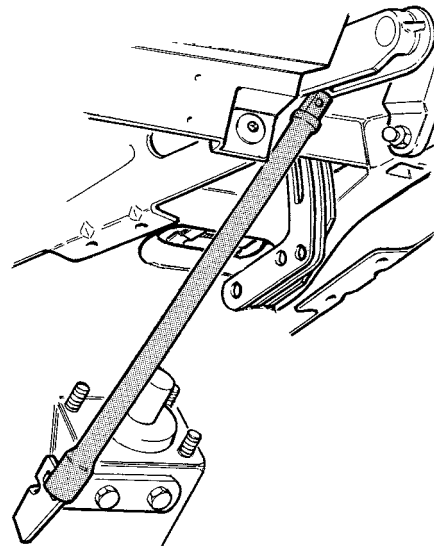
8



T6006168

Remove brackets (A and B) for the steering wheel adjustment pedal plate.

9



T6006174

Lift the steering wheel upwards and place a long extension between the steering column housing and the clutch pedal spring anchorage.

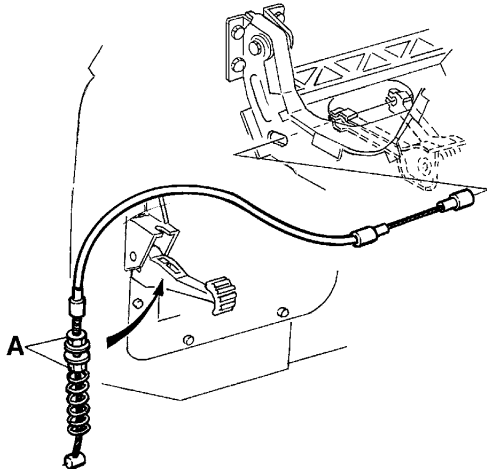
10

Remove the two bolts that hold the pedal in place. Remove the pedal.

11

Remove the cable from the locking device forks. Pull the cable out of the cab.

12



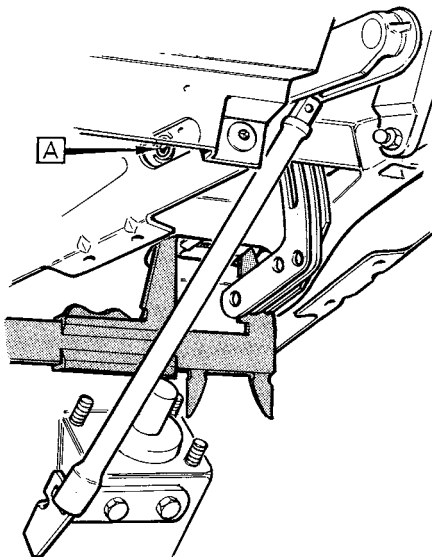
T6006169

Loosen nuts (A) which hold the cable to the pedal plate. Remove the cable from the pedal.

13

Remove the spring from the cable for transfer to the new cable.

14



T6006173

Using a caliper, verify the distance between the locking device forks is 59 ± 1 mm (2.32 ± 0.04 in.). If necessary, adjust the distance by turning adjusting bolt (A).

Installation

1

Run the new cable through the steering column bracket. Install the new cable in the locking device forks. Install the pedal plate brackets.

2

Attach the cable to the pedal.

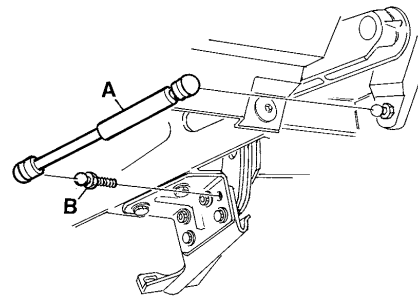
3

Install the pedal. Ensure the spacer is in place and install the mounting bolt. Torque the bolt to 24 ± 4 Nm (18 ± 3 ft-lb).

4

Tighten the pedal adjusting nuts.

5



T6006167

Apply locking fluid to the gas spring bolt (B). Install the bolt and torque it to 17 ± 3 Nm (150 ± 25 in-lb). Install the gas spring (A).

6

Check that the adjustment mechanism operates properly.

7

Install fittings removed and reconnect the air lines.

8

Install the plastic clamp on the air lines and electric cables.

9

Install the side kick panel.

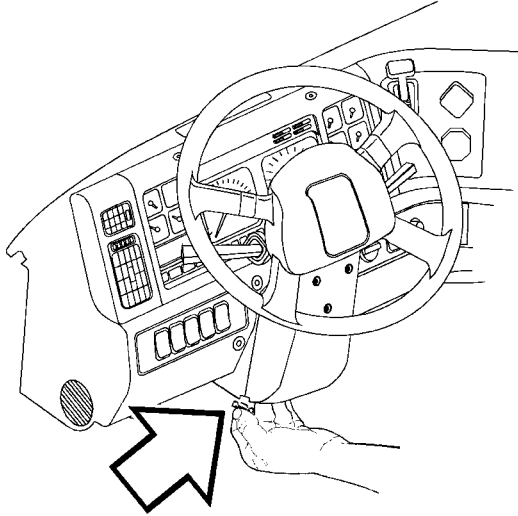
10

Install the grab handle. Torque the bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

11

Install the steering wheel covers in the reverse order of removal and tighten the torx screws.

12



W3000655

Install the push clips on the front and rear upper steering column covers.

6412-03-02-02

Steering Shaft, Replacement



DANGER

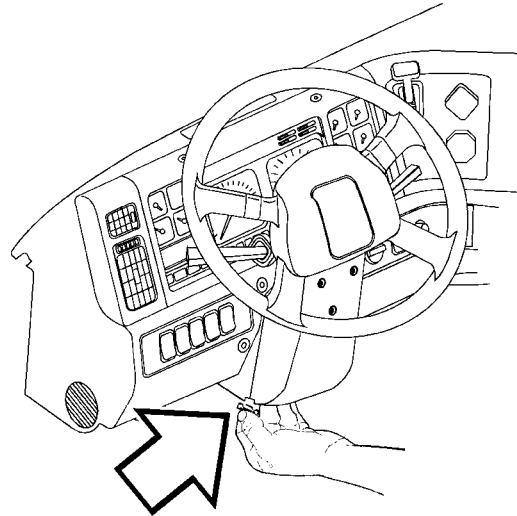
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Removal

1

Ensure the vehicle front wheels are pointing straight ahead.

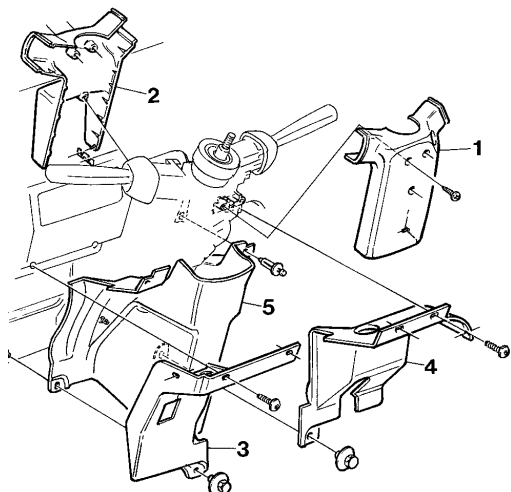
2



W3000655

Remove the push clips from the bottom of the front and rear upper steering column covers.

3



T8006351

Remove the covers from around the steering wheel in the order shown.

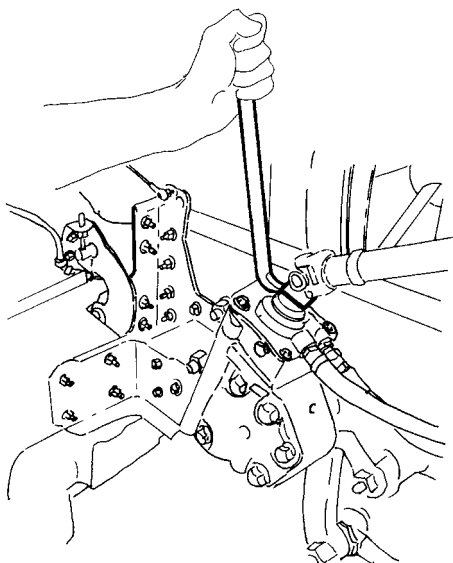
4

Loosen the pinch bolt on the steering shaft upper U-joint. Pry the U-joint off the steering column.

5

Remove the bolts from the shaft boot in the engine compartment.

6



W6000659

CAUTION

Possible equipment damage. Some steering gears have a plastic ring on the input shaft that acts as both an timing ring and a dirt cover. Use care not to damage the ring when prying the U-joint off the steering gear. Failure to use care could damage the plastic ring.

Remove the pinch bolt on the steering shaft lower U-joint. Pry the U-joint off the steering gear.

7

Pull the shaft and boot out of the cab from the engine compartment side.

8

Cut the tie strap off the end off the shaft boot. Slide the plastic shroud out of the boot.

9

Cut the tie straps off the plastic shroud.

Installation

1

Replace the pinch bolts on each end of the steering shaft with a new original equipment bolt.

6782610
971086

2

Ensure the felt strip is at the lower end of the shroud. Holding the shroud halves together on the new shaft, install a tie strap at each end of the shroud.

3

Install the shaft and boot in from the engine compartment side.

4

Line up the color coded alignment mark on the steering column shaft with the center mark on the casting.

5

Install the steering wheel.

6

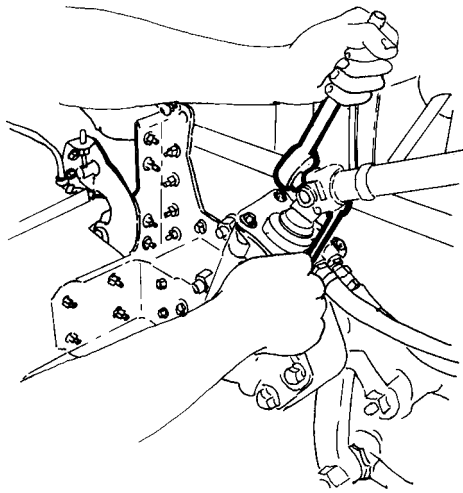
Connect the shaft upper U-joint to the steering column. Tighten the pinch bolt to 60 ± 10 Nm (45 ± 7 ft-lb). The pinch bolt is perpendicular to the steering column shaft.

7

Ensure the steering wheel is centered.

8

Visually align the front end tires.

9

W6000657

Connect the shaft lower U-joint to the steering gear input shaft. Tighten the pinch bolt to 60 ± 10 Nm (45 ± 7 ft-lb).

60 ± 10 Nm
(45 ± 7 ft-lb)

10

Detach the lower steering shaft from the the steering gear by loosening or removing the bearing bolts.

11

Perform a final alignment of the lower steering shaft.

Note: Note and correct any tightness in the steering mechanism.

12

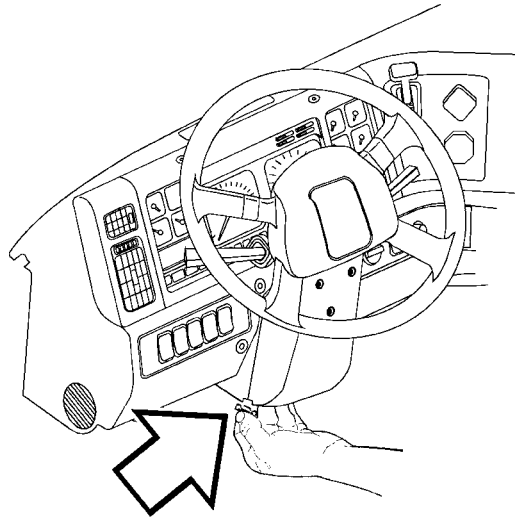
Reattach the lower shaft to the gear and remount the bearing to the support.

13

Install and tighten the bolts in the steering shaft boot.

14

Install the steering column covers in the reverse order from removal and tighten the torx screws.

15

W3000655

Install the push clips on the front and rear upper steering column covers.

6412-03-02-08 Upper Steering Shaft, Replacement

Removal

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Remove the three torx screws from the steering shaft boot tie-down bracket.

3

Remove the three torx screws in the upper steering column panel cover, and then remove the cover.

4

Roll the floor cover toward the driver seat and remove the two plastic nuts securing the left lower dash panels to the floor pan.

5

Remove the three torx screws securing the left lower dash panels to the upper dash panel.

6

Push the vent through the hole in the panel to the left to allow enough room to remove the lower steering column panel and remove the panel.

7

Rotate steering wheel until spline bolt is accessible, mark splines and remove the spline bolt.

8

Remove the shaft from the vehicle.

Installation

1

Using the assistance of another technician to help align the shaft, install the replacement upper steering shaft, start and tighten bolt.

2

Install the complete lower left dash panel assembly and lower steering column panel.

3

Install the upper steering column cover panel.

4

Install the six torx screws in the steering shaft boot.

6412-03-02-09 Lower Steering Shaft, Replacement

Removal

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Remove the two carrier bearing mount bolts.

3

Remove the power steering gearbox shaft spline bolt, mark spline and the yoke assembly.

4

Remove the lower shaft yoke assembly from the gearbox splines.

5

Remove the lower shaft spline bolt at the intermediate shaft yoke assembly, then remove the lower shaft from the vehicle.

Installation

1

Align the lower replacement shaft yoke splines with the gearbox splines and start the spline bolt.

2

Align the lower replacement shaft splines with the intermediate shaft yoke assembly and start the spline bolt.

3

Start and tighten the two carrier bearing mount bolts.

4

Tighten the gearbox spline bolt.

5

Tighten the lower shaft spline bolt.

6419-03-02-08

Steering Shaft Carrier Bearing, Replacement

Removal

1**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Remove the two carrier bearing mount bolts

3

Remove the lower shaft spline bolt at the intermediate shaft yoke assembly and separate the lower shaft from the intermediate shaft.

4

Remove the carrier bearing stop and remove the carrier bearing.

Installation

1

Install the replacement carrier bearing assembly and install the bearing stop.

2

Align the lower and intermediate shaft splines and start the spline bolt.

3

Start and tighten the two carrier bearing bolts.

4

Tighten the lower shaft spline bolt.

6412-03-02-10 Intermediate Steering Shaft, Replacement

Removal

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Remove the lower shaft spline bolt at the intermediate shaft yoke assembly and separate the lower shaft from the intermediate shaft.

3

Remove the six torx screws from the shaft boot tie-down bracket.

4

Mark and remove the intermediate shaft.

5

Uninstall the boot from the removed intermediate shaft and reinstall the boot on the replacement shaft.

6

Align the splines at the upper steering shaft and slide upward enough to align the splines with the lower shaft.

7

Start and tighten the spline bolt.

8

Install the six torx screws in the steering shaft boot.

6419-03-02-07 Steering Shaft Boot, Replace- ment

Removal

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Remove the lower shaft spline bolt at the intermediate shaft yoke assembly and separate the lower shaft from the intermediate shaft.

3

Remove the six torx screws from the steering shaft boot tie-down bracket.

4

Mark and remove the intermediate shaft.

5

Remove the boot from the old intermediate shaft.

Installation

1

Install the replacement steering shaft boot.

2

Align the splines at the upper steering shaft and slide upward to align the splines to the lower shaft.

3

Start and tighten the spline bolt.

4

Install the six torx screws in the replacement steering shaft boot.

6419-03-02-06 Steering Shaft Carrier Bearing Bracket, Replacement

Removal

1



Before working on a vehicle, set the parking brakes, place the transmission in neutral and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Park the vehicle on a level surface with the transmission in neutral and the front wheels chocked.

2

Unlatch and raise the hood.

3

Remove the left side inner fender.

4

Remove the two steering shaft, carrier bearing and mount bolts.

5

Remove the four steering shaft, carrier bearing, and mount bracket bolts.

Installation

1

Install the replacement steering shaft, carrier bearing and mount bracket.

2

Mount the steering shaft carrier bearing on the replacement mount bracket.

3

Install the left side inner fender.

6453-03-02-01 Power Steering Pump, Replace- ment

Removal



Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.



Component damage may occur if the cleanliness of the hydraulic system is not maintained. The area around any component to be disconnected should be cleaned prior to disconnecting. Used hydraulic fluid should never be put into the hydraulic system. Failure to follow these precautions could result in damage to the steering system hydraulic components.

1

Disconnect the two fluid lines from the pump.

2

Drain the power steering fluid.

Note: Dispose of used power steering fluid according to State and Local regulations.

3

Remove the two mounting bolts and pull the pump off the engine.

4

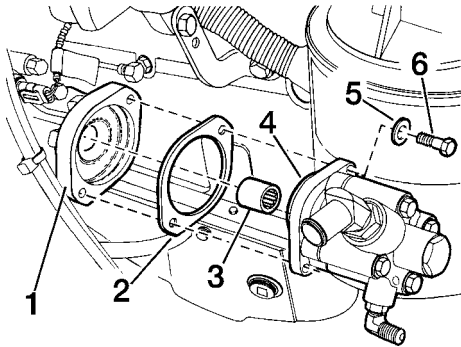
Clean the gasket surfaces on the engine and on the pump.

Installation

1

If necessary, transfer the fluid fittings from the pump removed or install new fittings on the pump to be installed. Ensure the fittings are properly oriented.

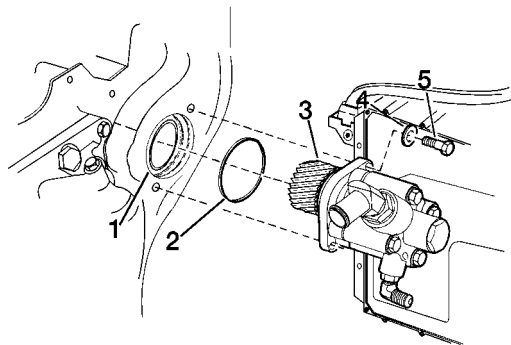
2



Spline driven pump
 1) Engine flange 4) Pump flange
 2) Gasket 5) Washer
 3) Drive coupler 6) Mounting bolt

If pump shaft is splined, ensure there is a circlip installed in the drive coupler and the drive coupler is placed in the engine.

3



Gear driven pump
 1) Mounting hole 4) Pump flange
 2) O-ring 5) Mounting bolt
 3) Drive gear

For spline driven pumps, place a gasket on the pump. For gear driven pumps, install an O-ring on the pump.

4

Install the pump on the engine. Torque bolts to 46 ± 1 Nm (34 ± 1 ft-lb).

5

Connect the two fluid lines to the pump. Using a tie strap the fluid lines together to prevent them from rubbing on the frame.

6

Fill the reservoir with power steering fluid and bleed the system in accordance with the hydraulic system bleeding service procedure. Verify there is no leakage in the system.

6453-04-04-01 Power Steering Pump, Overhaul

WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

CAUTION

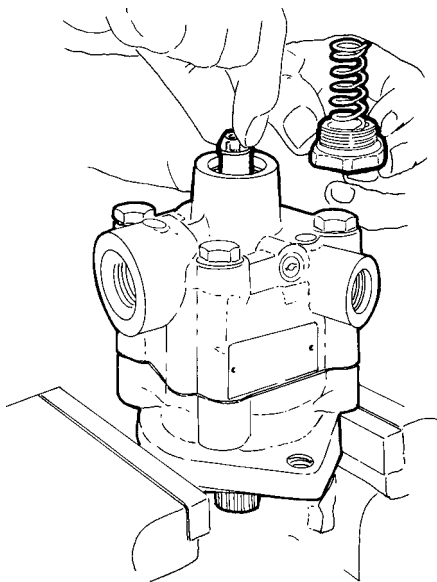
Possible component damage. Strict cleanliness must be observed when performing power steering pump maintenance. Dirt in the hydraulic system can damage the power steering pump or steering gear.

CAUTION

Possible component damage. All power steering pump components must be lubricated with power steering fluid during assembly. Failure to lubricate pump components could result in pump damage when it is operated.

Note: Refer to "Power Steering Pump Model Number Designations" page 15 for additional pump component nomenclature.

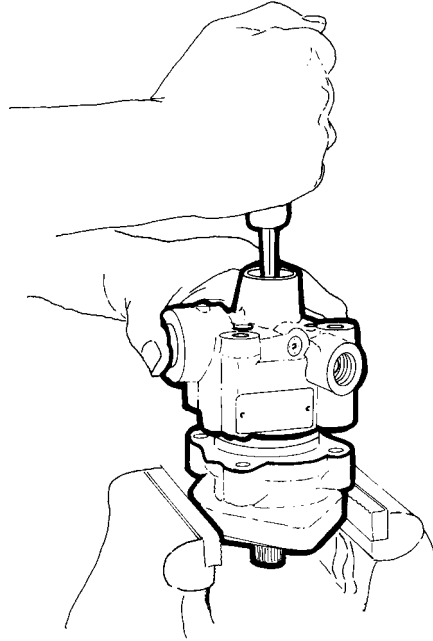
1



W6000794

Remove the plug, spring, and control valve from the control valve port.

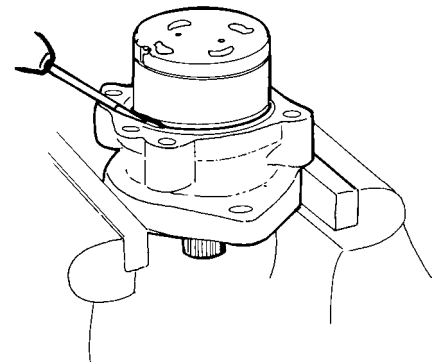
2



W6000791

Remove the four housing bolts. Separate the housing from the flange.

3



W6000792

Remove the cartridge from the housing.

4

Remove the large snap ring from the shaft bearing and remove the shaft from the flange.

5

Remove the small snap ring from the shaft and remove the bearing from the shaft.

6

Remove the shaft seal from the flange.

7
Separate the parts of the cartridge.

8
Thoroughly clean all parts of the pump.

9
Assemble the cartridge.

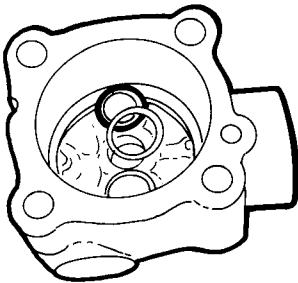
10
Grease a **new** shaft seal and install it in the housing.

11
Install a **new** bearing on the shaft and secure it with the small snap ring.

12
Install the shaft into the flange and secure it with the large snap ring.

13
Install **new** O-rings on the flange.

14

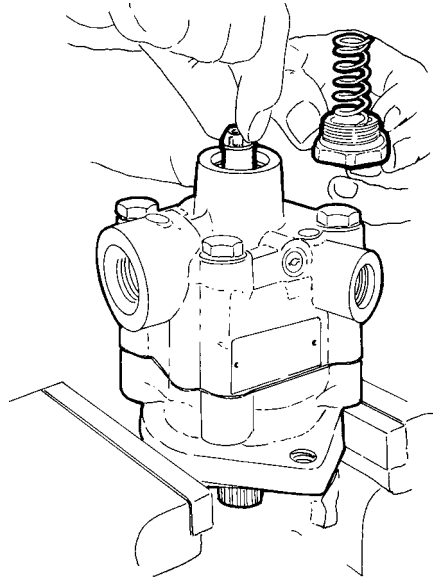


W6000793

Install new O-rings and back-up rings in the housing.

15
Fit the housing and flange together. Install and torque the bolts to 45 ± 5 Nm (33 ± 4 ft-lb).

16



W6000794

Install the control valve and its spring.

17
Install a **new** O-ring and install and tighten the plug.

Steering Gear Relief Valve, Adjustment

1
Perform adjustment of steering gear internal plungers (Sheppard), poppets (TRW), or steering lock limiter (ZF) in accordance with the appropriate vendor manual.

6421-03-02-01 Steering Gear, Replacement

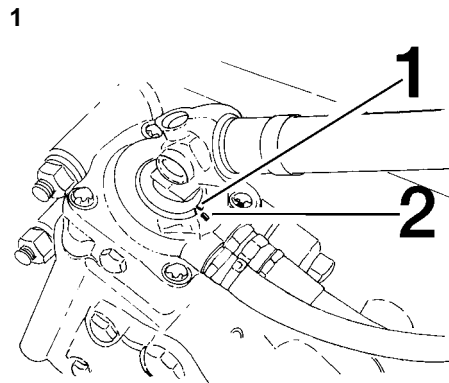
Removal

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

CAUTION

Component damage may occur if the cleanliness of the hydraulic system is not maintained. The area around any component to be disconnected should be cleaned prior to disconnecting. Used hydraulic fluid should never be put into the hydraulic system. Failure to follow these precautions could result in damage to the steering system hydraulic components.



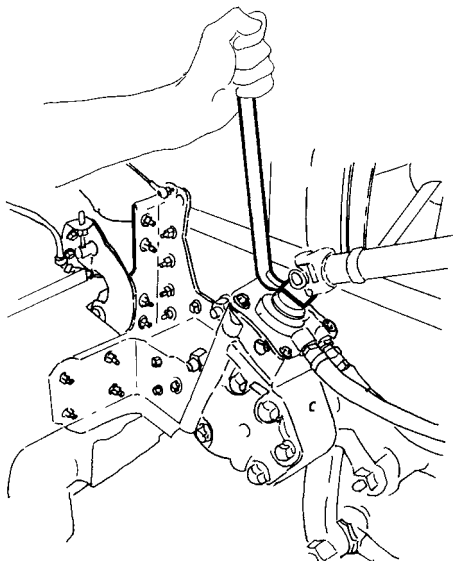
W6000630

Turn the steering wheel to align the timing mark on the input shaft or on the dirt and water seal (1) with the mark on the steering gear housing (2).

2
Disconnect the pressure and return hoses from the gear. Allow fluid to drain into a drip pan. Plug the ends of the hoses to avoid contamination.

Note: Dispose of used hydraulic fluid according to State and Local regulations.

3



W6000659

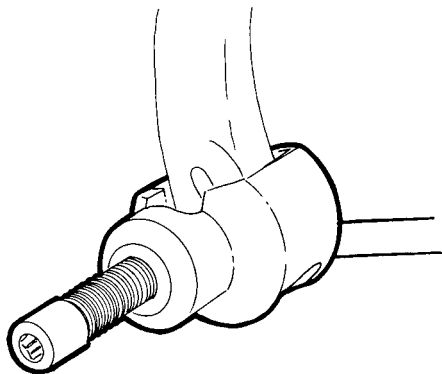
Using tool 9992337 remove the pinch bolt at lower end of steering shaft and pry the shaft from the steering gear. 9992337

Note: On TAS gears, take care not to damage the plastic alignment ring.

4

Remove the cotter pin and nut from the drag link. Discard the cotter pin.

5



W6000663

Using tool 9996201, press the ball socket from the pitman arm. 9996201

Note: On VHD Axle Forward vehicles, because the steering gear is located inside the frame rail, the cooling package is removed before removing the steering gear. For removal procedures for the Cooling Package, see service literature in Function Group 26.

6

Remove the steering gear mounting nuts. Lower the steering gear to the floor.

7

Place the gear in a vise or a holding fixture.

8

**CAUTION**

Potential equipment damage. Do not hammer on the pitman arm or apply any heat to aid in removal. Hammering on or applying heat to the pitman arm could cause damage to the pitman arm and sector shaft.

Note: Perform this step only for the Sheppard steering gear.

Remove the pitman arm in accordance with the Sheppard Power Steering Service Manual.

9

Note: Perform this step only for the TAS steering gear.

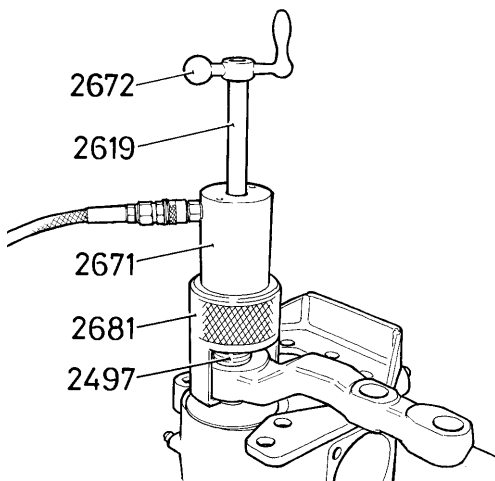
Loosen then remove the pitman arm pinch bolt. Spread the upper end of the pitman arm apart by driving a wedge into the slot in the end.

10

Note: Perform this step only for the ZF steering gear.

Loosen and remove the pitman arm nut.

11



Note: Perform this step only for the TAS or ZF steering gear. 9992497

Remove the pitman using puller 9992681, a hydraulic cylinder, and drift 9992497 or other suitable drift. 9992619
9992671
9992672
9992681

12

Remove the fluid hose fittings from the steering gear.

Installation

1

Install the fluid fittings using **new** sealant washers.

2

Set steering gear timing by turning input shaft to align timing marks on the sector shaft to timing mark on the steering gear housing.

3

Install pitman arm so that timing marks on pitman arm and sector shaft are aligned.

4

Note: Perform this step only for the Sheppard steering gear.

Install the pitman in accordance with the Sheppard Power Steering Service Manual.

5

Note: Perform this step only for the TAS steering gear. 400 ± 60 Nm (295 ± 45 ft-lb)

Torque the pitman arm pinch bolt to 400 ± 60 Nm (295 ± 45 ft-lb).

6

Note: Perform this step only for the ZF steering gear. 600 ± 50 Nm (445 ± 37 ft-lb)

Torque the pitman arm lock nut to 600 ± 50 Nm (445 ± 37 ft-lb). Stake the locking edge of the lock nut.

7

Install the gear on the vehicle using the spacers and mounting bolts. 540 ± 90 Nm (400 ± 67 ft-lb)
Torque mounting bolts to 540 ± 90 Nm (400 ± 67 ft-lb).

8

Install the drag link ball joint in the pitman arm. Torque the nut to 200 ± 30 Nm (150 ± 22 ft-lb). 200 ± 30 Nm (150 ± 22 ft-lb)

9

Tighten the nut until the slots in the castellated nut line up with the cotter pin hole. Do NOT loosen the nut to align. Install and bend a **new** cotter pin.

10

Replace the lower steering shaft U-joint pinch bolt with a new original equipment bolt. 6782610
971086

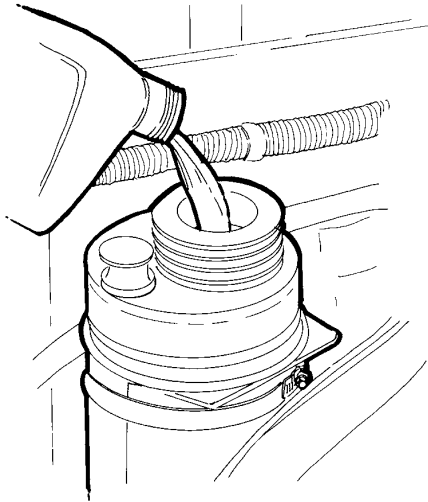
11

Ensure the timing marks on the steering gear are aligned, then install the steering shaft U-joint on the steering gear. Ensure the U-joint cup faces up. Tighten the pinch bolt to 60 ± 10 Nm (45 ± 7 ft-lb) 60 ± 10 Nm (45 ± 7 ft-lb)

12
Install high pressure hose and tighten the fitting.

13
Install the return hose using a **new** clamp. Crimp the clamp.

14



W6000669

Fill the reservoir with power steering fluid and bleed the system in accordance with the hydraulic system bleeding service procedure. Verify there is no leakage in the system.

15
Set the steering gear plungers/poppets using the appropriate vendor manual.

16
Perform road test of the vehicle steering system. Refill fluid reservoir if necessary.

Note: For instructions on performing the TRW Ball Socket Wear Inspection procedure refer to TRW Service Bulletin #LNK-105.

6456-03-03-02 Power Steering Fluid Filter, Replacement

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

CAUTION

Component damage may occur if the cleanliness of the hydraulic system is not maintained. The area around the reservoir cap should be cleaned prior to removal. Used hydraulic fluid should never be put into the hydraulic system. Failure to follow these precautions could result in damage to the steering system hydraulic components.

- 1**
Unscrew and remove the reservoir cover.
- 2**
Press down and turn the filter locking device to unlock it.
- 3**
Lift out the existing filter while placing a finger under the lower hole to prevent dirt from falling back into the reservoir.
- 4**
Transfer the locking device and spring to the new filter and place it in the reservoir.
- 5**
Secure the filter by pressing down the locking device and turning until the it snaps in place.
- 6**
Refill the reservoir if necessary. Install the reservoir cover.
- 7**
Dispose of filter properly.

1750-03-02-11 Power Steering Hydraulic Fluid, Changing

DANGER

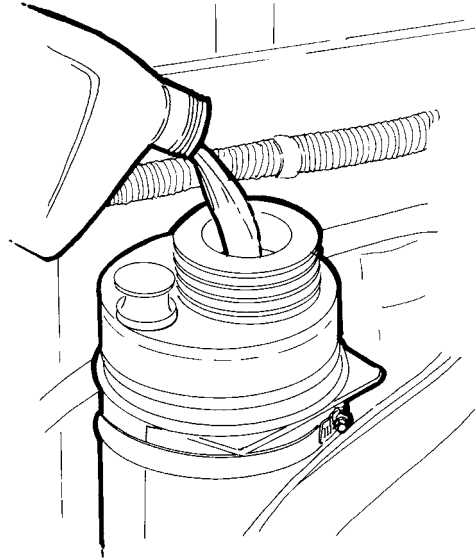
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

CAUTION

Component damage may occur if the cleanliness of the hydraulic system is not maintained. The area around any component to be disconnected should be cleaned prior to disconnecting. Used hydraulic fluid should never be put into the hydraulic system. Failure to follow these precautions could result in damage to the steering system hydraulic components.

- 1**
Jack up the front of the vehicle and place it on jack stands.
- 2**
Place a drain pan under the steering gear.
- 3**
Turn the steering wheel to the full left position. Remove the plug from the bottom of the steering gear.
- 4**
Start the engine and let it idle for a maximum of 10 seconds, then shut it off.
- 5**
Turn the steering wheel from full left to full right until all fluid has run out of the gear.
- 6**
Install the plug in the steering gear.

7



W6000669

Fill the reservoir with Dexron II® or Dexron III® fluid.

- 8**
Bleed the system in accordance with the appropriate service procedure. See "Power Steering Hydraulic System, Bleeding" page 59.

6459-05-03-02 Power Steering Hydraulic System, Bleeding

Note: Ensure steering gear poppets are set prior to performing this procedure.

1



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



DANGER

Exhaust gases contain carbon monoxide. When testing a vehicle with the engine running, conduct the test outdoors or use a properly vented exhaust hose. Prolonged or excessive exposure may cause serious illness or death.



CAUTION

Potential equipment damage. Do NOT turn the steering wheel until required by the procedure. Turning the steering wheel before the system has been sufficiently bled could result in damage to the steering gear.

Fill the fluid reservoir nearly full. Do NOT steer.

2

Start and run the engine for 10 seconds, then shut it off. Check the reservoir and refill if necessary. Repeat this step at least three times.

3



CAUTION

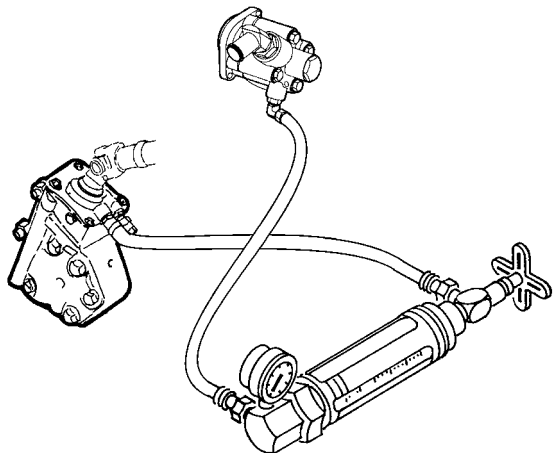
Equipment damage. Do NOT allow the fluid level to drop significantly or run out of the reservoir. This may introduce air into the system which could result in damage to the steering gear.

Start the engine and let it idle for two minutes, then shut it off. Check the reservoir and refill if necessary. Do NOT steer.

4

Start the engine. Steer the vehicle from full left to full right several times. Add fluid as necessary to maintain it at the full line on the dipstick.

6459-06-02-02 Power Steering System, Checking



W6000625

Preparation

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

WARNING

A faulty steering pump high pressure relief valve may not relieve pump pressure. Closing the high pressure shut off valve may cause severe pump damage or high pressure hoses to rupture. Watch the pressure closely when closing the shut off valve. If pressure rises rapidly or exceeds 17.2 MPa (2500 psi), immediately open the valve. Failure to follow these precautions could result in severe equipment damage or personal injury.

WARNING

Never check for leaks with your hands. Oil released under high pressure can penetrate the skin causing severe injury.

1
Install a steering system analyzer in the high pressure fluid line between the pump and the steering gear. The analyzer should include a pressure gauge, flow meter, and a shut off valve.

2
Place a thermometer in the fluid reservoir.

3
Start the engine and warm the hydraulic system by partially closing the shut off valve until the pressure gauge reads 6.9 MPa. When fluid temperature reaches 50 – 55°C (125 – 135°F) open the shut off valve.

Pump Pressure Test

1

CAUTION

Potential pump damage. Do NOT leave the shut off valve fully closed for more than 5 seconds. Leaving the shut off valve fully closed too long could result in excessive fluid temperatures and pump damage.

Close the shut off valve and read the pressure gauge. **Immediately open the shut off valve.**

2
If pump pressure was below the minimum value listed in the Specifications section, repair or replace the pump.

3
Allow the fluid to cool to 50 – 55°C (125 – 135°F) before performing other tests or shutting off the engine.

Pump Flow Test

1

CAUTION

Potential steering gear damage. The maximum flow rate for the TAS series steering gear is 27 L/min (7 gpm). Excessive flow can cause damage to the steering gear.

Ensure the engine is idling and fluid temperature is between 50 – 55°C (125 – 135°F).

2
Note the fluid flow rate.

3

**CAUTION**

Possible equipment damage. The substeps within this step must be performed in rapid succession. Leaving the shut off valve closed for too long could result in excessive fluid temperatures and pump damage.

Fully close the shut off valve. When pump relief pressure is reached, verify the flow rate is zero. Immediately open the shut off valve. Verify the flow rate rapidly returns to the value noted in above.

4

Allow the fluid to return to 50 – 55°C (125 – 135°F).

5

Set engine speed at governed rpm, then note the fluid flow rate.

6

**CAUTION**

Possible equipment damage. The substeps within this step must be performed in rapid succession. Leaving the shut off valve closed for too long could result in excessive fluid temperatures and pump damage.

Fully close the shut off valve. When pump relief pressure is reached, verify the flow rate is zero. Immediately open the shut off valve. Verify the flow rate rapidly returns to the value noted in above.

7

Allow the fluid to return to 50° to 55°C (125° to 135°F).

8

Repeat steps 6 and 7 two additional times.

9

If flow rate did not immediately return to the noted flow rate, the pump is malfunctioning and should be repaired or replaced.

Steering Gear Internal Leakage Test

**DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

1

Place a socket over the left wheel stop bolt.

2

Ensure fluid temperature is between 50 – 55°C (125 – 135°F).

3

**CAUTION**

Potential pump damage. Do not hold the steering wheel at full lock longer than 10 seconds. Pump damage could result.

Turn the steering wheel to the right until the left spindle contacts the socket on the left stop bolt. Verify the pump pressure equals the relief pressure value from the pump pressure test. . Read the steering gear leakage flow on the flow meter.

4

Return the wheel to neutral.

5

Move the socket to the right wheel stop bolt.

6

Ensure fluid temperature is between 50 – 55°C (125 – 135°F).

7

CAUTION

Potential pump damage. Do not hold the steering wheel at full lock longer than 10 seconds. Pump damage could result.

Turn the steering wheel to the left until the right spindle contacts the socket on the right stop bolt. Verify the pump pressure equals the relief pressure value from the pump pressure test. Read the steering gear leakage flow on the flow meter.

8

Return the wheel to neutral.

9

If internal leakage is greater than 1.0 gpm (3.8 L/min), overhaul or replace the steering gear.

10

Following repair or replacement of steering gear, repeat the leakage test.

6412-05-02-01 Tilt Steering Column Cable, Adjustment

DANGER

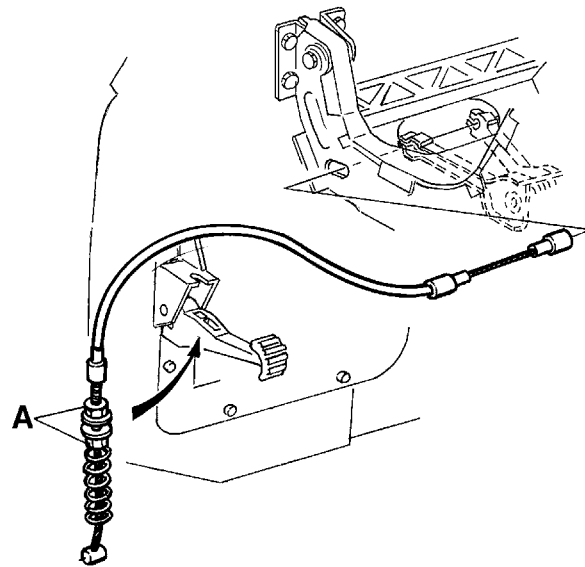
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

It is important that any adjustments to the tilt steering column be made only on the cable at the foot pedal.

DANGER

DO NOT attempt to adjust the tilt steering column by tightening or loosening the screw joint. Adjustments must be made ONLY from the cable at the foot pedal. Adjustments attempted at any other location may affect the safety features of the steering column, resulting in an accident and/or personal injury or death.

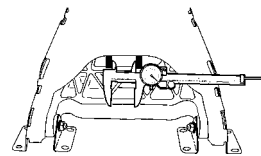
1



T6006169

Adjust the tilt steering column ONLY by increasing or decreasing the tension on the cable. This is done by adjusting the position of the fasteners (A) that connect the cable to the foot pedal.

2



W6001307

Using a caliper, verify the distance between the adjustment forks. The adjustment forks should be preset at the factory to a distance (inside measurement) of 38 ± 1 mm (1.5 ± 0.04 in)

Note: Do not attempt to modify this measurement by adjusting the screw joint.

6429-03-04-02 Input Shaft Seal, Replacement (Steering Gear Removed)

DANGER

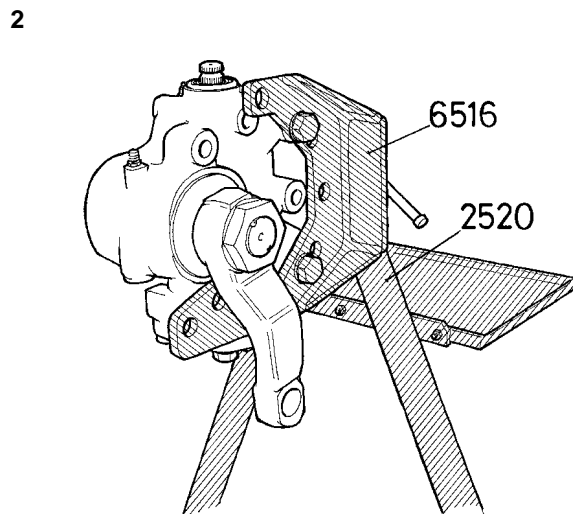
Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

This repair information covers the ZF Steering gear.

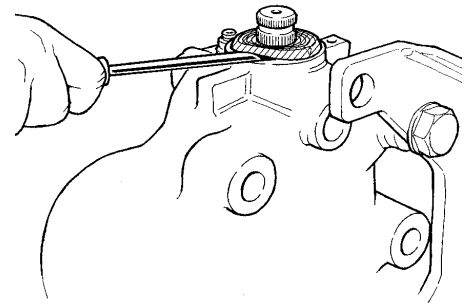
1
Clean the steering gear.



Attach fixture 9996516 to overhaul stand 9992520.
Secure the steering gear to the fixture.

T6006308
9992520
9996516

3

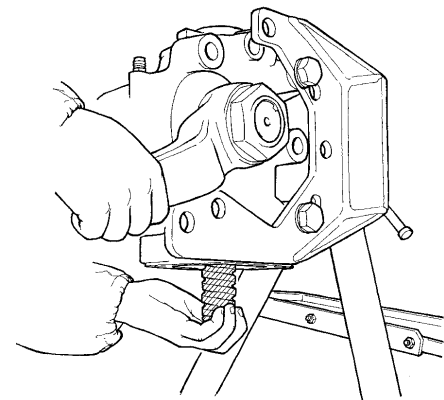


T6006277

Remove the input shaft dust cover and rubber seal.

4
Remove the cover on the steering gear housing.

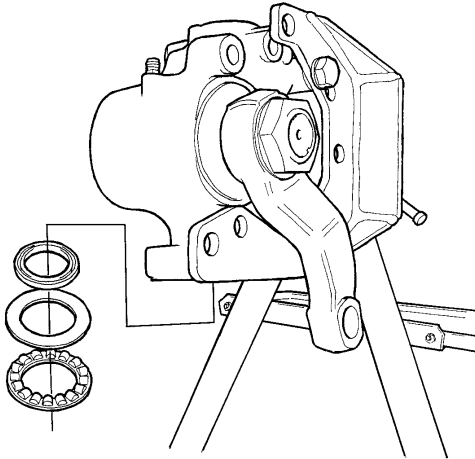
5



T6006312

Move the pitman arm rearward while removing the piston at the same time.

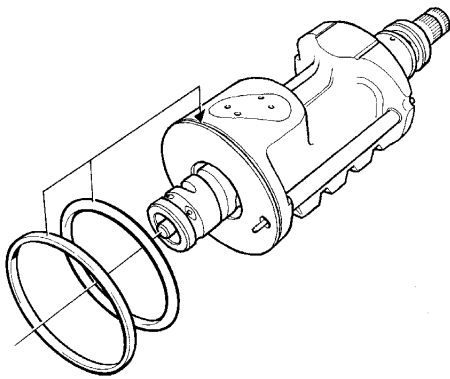
6



T6006315

Remove the input shaft roller bearing, washer and sealing ring from the housing.

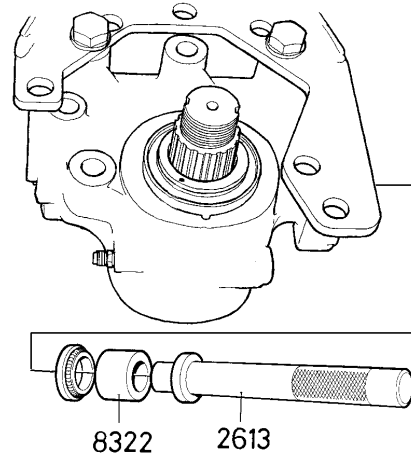
7



T6006294

Install a new O-ring and teflon ring on the piston.

8



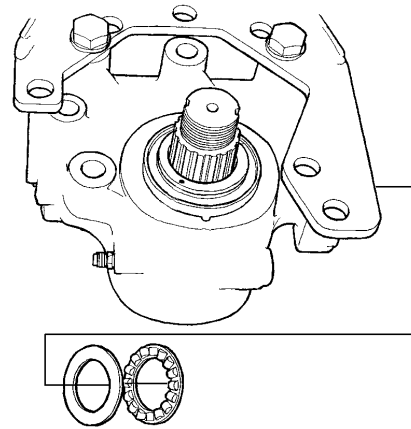
T6006313

Install the input shaft sealing ring on drift 9998322.

9992613
9998322

The sealing lip on the sealing ring should face away from the drift. Install the sealing ring in the housing.

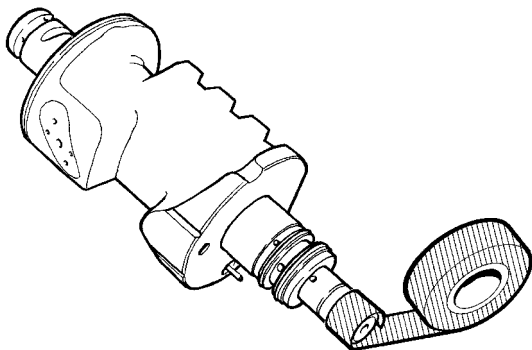
9



T6006314

Lubricate the input shaft washer and bearing with ATF and install them in the housing.

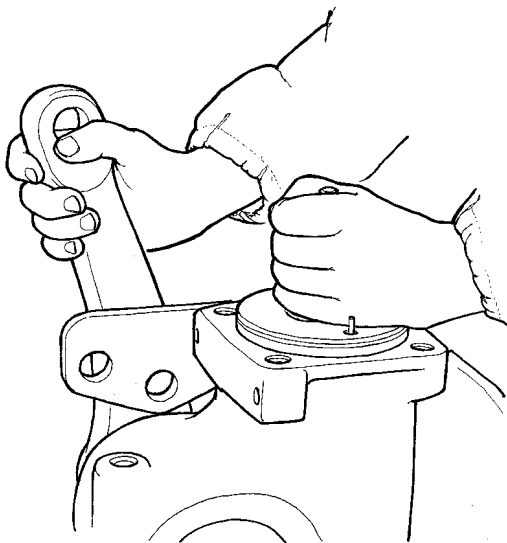
10



T6006299

Wrap thin tape around the input shaft splines so as not to damage the seal when installing the piston in the housing.

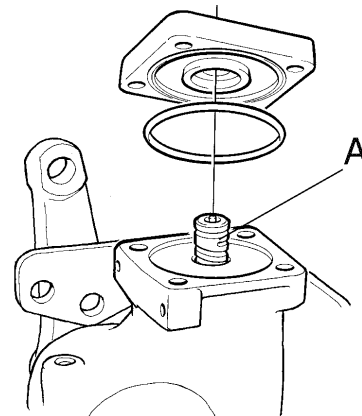
11



T6006310

Insert the piston in the housing. Move the pitman arm forward when the first tooth on the piston is engaged with the first tooth on the sector shaft.

12



T6006309

Screw down the input shaft (A). Install the cover using a new O-ring. The adjusting screw for the off-loading valve in the cover should be aligned with the valve on the piston.

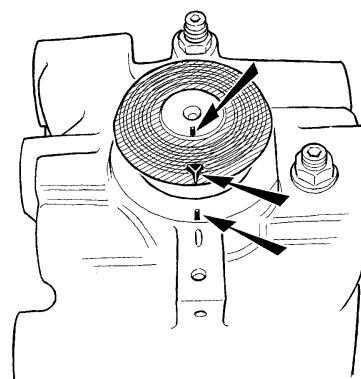
If the cover does not lay flat against the housing, the piston may not be sufficiently far down in the housing due to the teeth on the sector shaft and piston not being correctly synchronized.

13

Tighten the cover bolts to 190 Nm (140 ft-lb).

190 Nm (140 ft-lb)

14



T6006291

Remove the tape from the input shaft and install the rubber seal and dust cover on the input shaft.

Note: When installing the dust cover, the arrow on the cover should be in line with the marks on the pin and housing.

15

Remove the steering gear from the fixture.

6425-03-04-01 Sector Shaft Seal, Replacement (Steering Gear Removed)



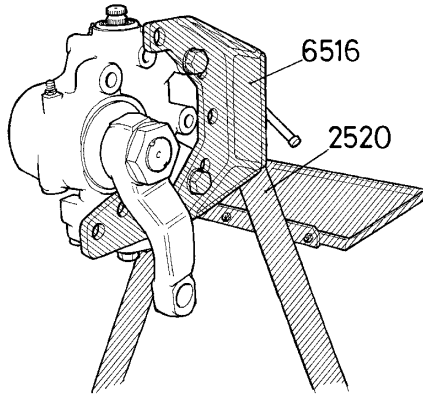
WARNING

Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

This repair information covers the ZF Steering gear.

1
Clean the steering gear.

2

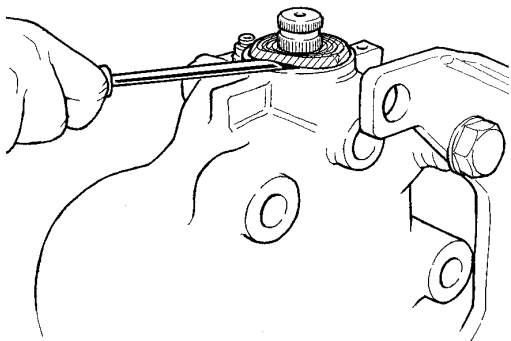


T6006308

Attach fixture 9996516 to overhaul stand 9992520.
Secure the steering gear to the fixture.

9992520
9996516

3



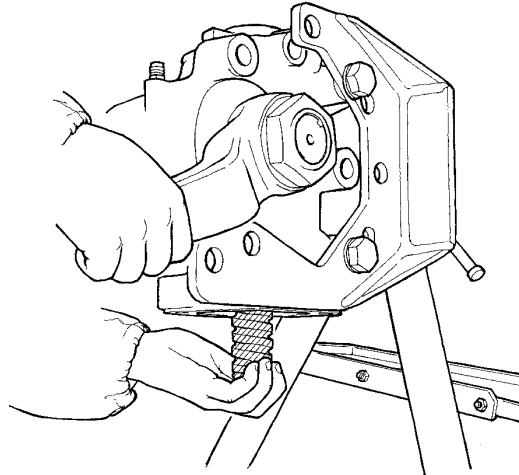
T6006277

Remove the input shaft dust cover and rubber seal.

4

Remove the cover on the steering gear housing.

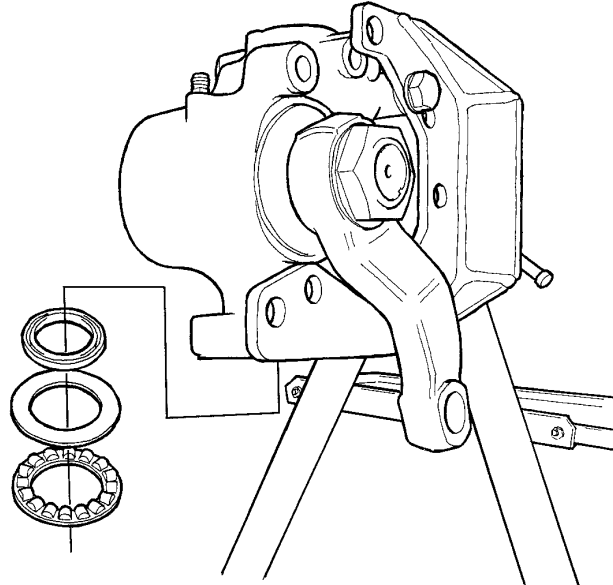
5



T6006312

Move the pitman arm rearward while removing the piston.

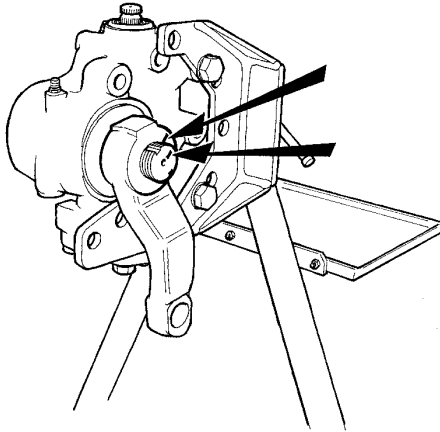
6



T6006315

Remove the input shaft roller bearing, washer and sealing ring from the housing.

7

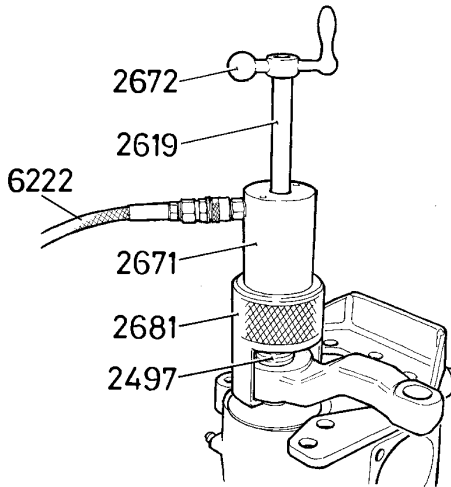


T6006307

Tap loose the nut locking arrangement on the pitman arm. Remove the nut.

Note: Check that the position of the pitman arm on the sector shaft is marked. If not, mark the position.

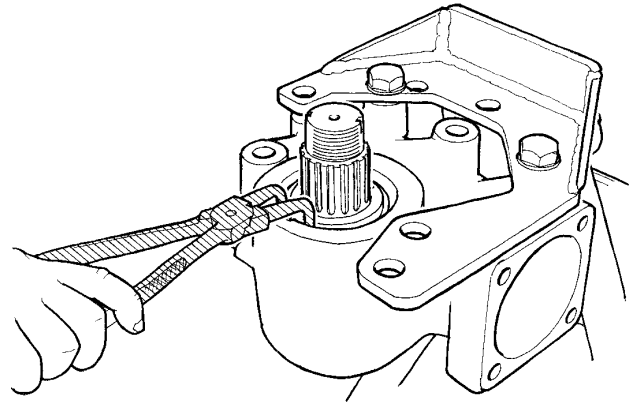
8



T6006311

Remove the pitman arm with puller 9992497 9992619 9992671 9992672 9992681 9996222

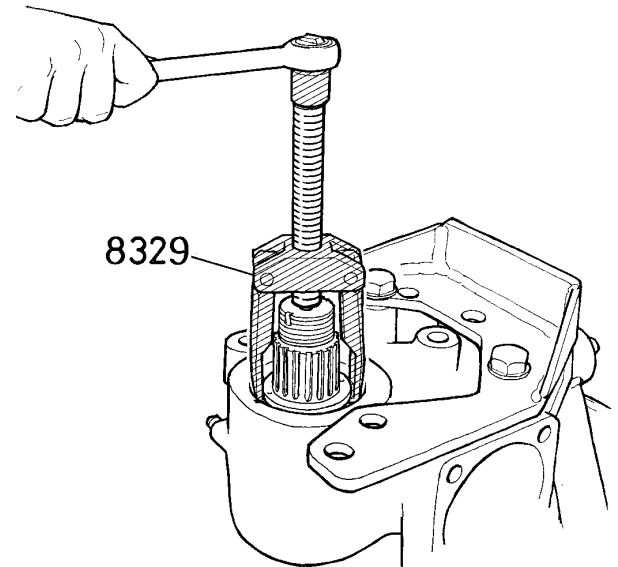
9



T6006281

Remove the sector shaft dust cover. Remove the bearing snap ring.

10



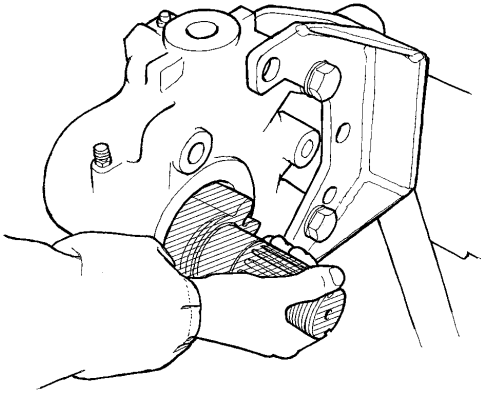
T6006282

Pull out the bearing using puller 9998329. Remove the plastic washer on the sector shaft.

11

Turn the steering gear around and remove the dust cover on the other side of the sector shaft. Remove the snap ring, pull out the bearing and remove the plastic washer.

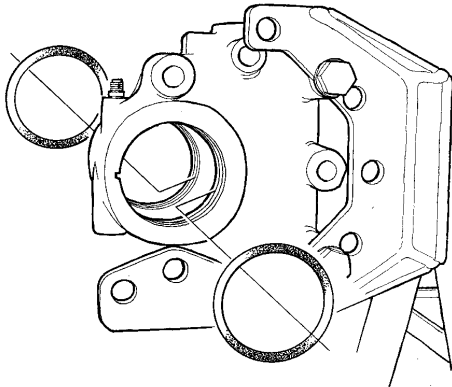
12



T6006283

Remove the sector shaft.

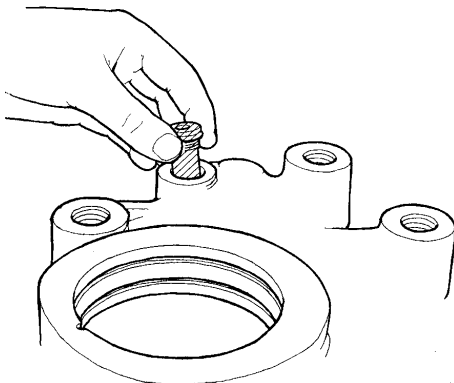
13



T6006306

Remove the O-rings for the sector shaft bearings from the housing.

14



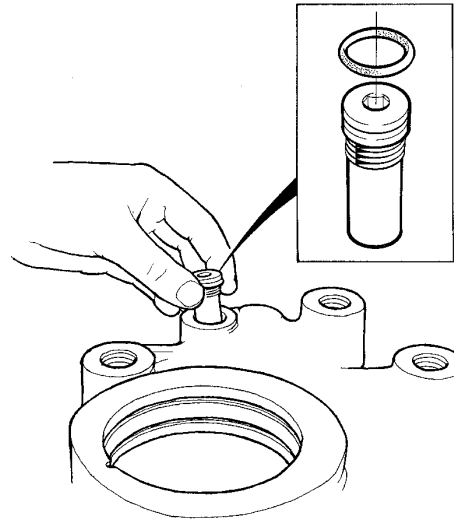
T6006284

Remove the steering gear from the fixture and remove the pressure limiting valve.

15

Clean all components. Remove the sealing ring and plastic washer in the sector shaft bearings and clean the bearings.

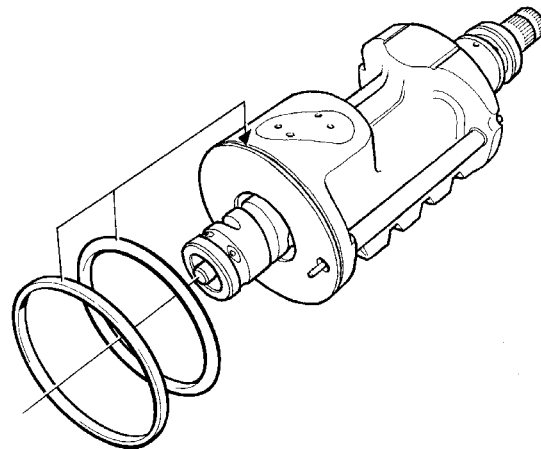
16



T6006305

Install a new O-ring on the pressure limiting valve. Install the valve in the housing.

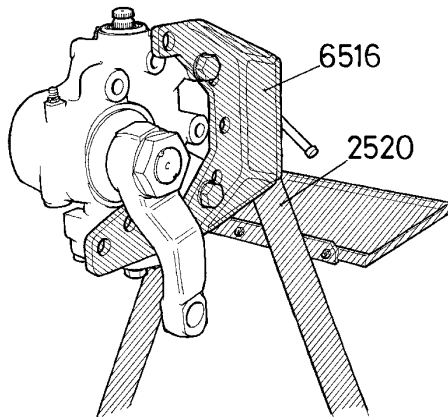
17



T6006294

Install a new O-ring and teflon ring on the piston.

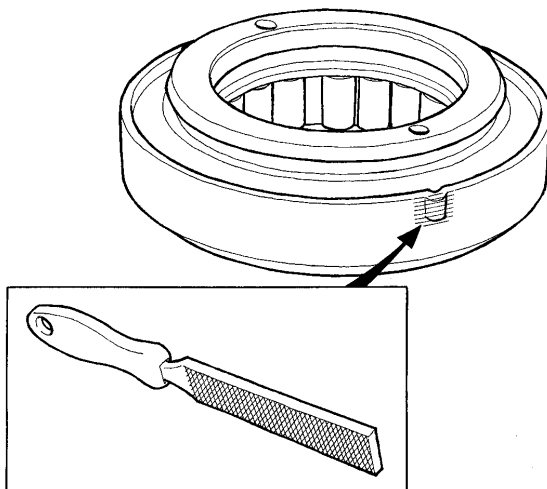
18



T6006308

Install new O-rings for the sector shaft bearings in the housing.
Lubricate the O-rings with ATF to make it easier to press in the bearings.

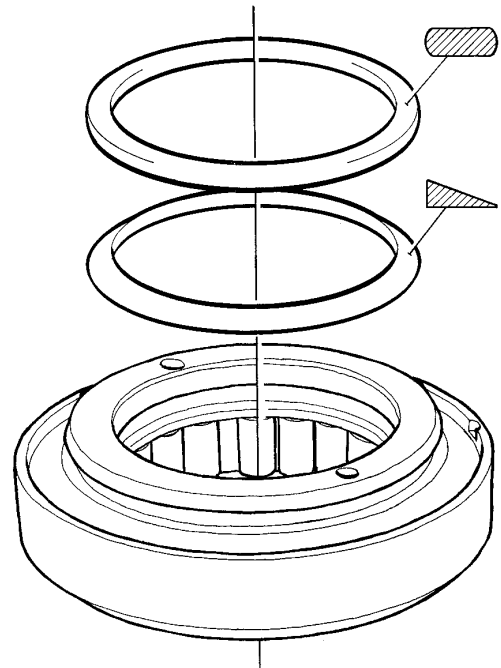
19



T6006295

Carefully tap in the locking tab on the bearings.
Grind/file the outside of the bearings at the tab to round-off the surface.
Clean the bearings.

20

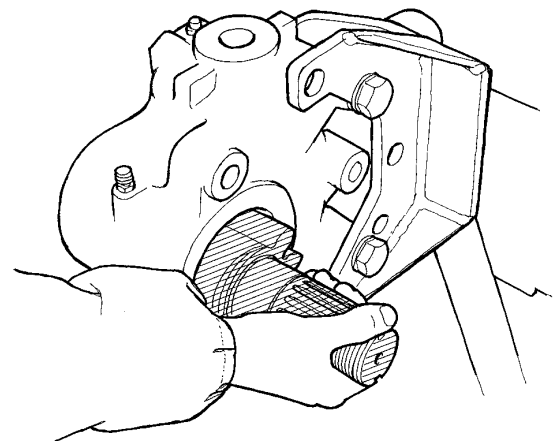


T6006285

Install the plastic washer and sealing ring in the bearings.

Note: The flat side of the plastic washer should face the bearing rollers.

21

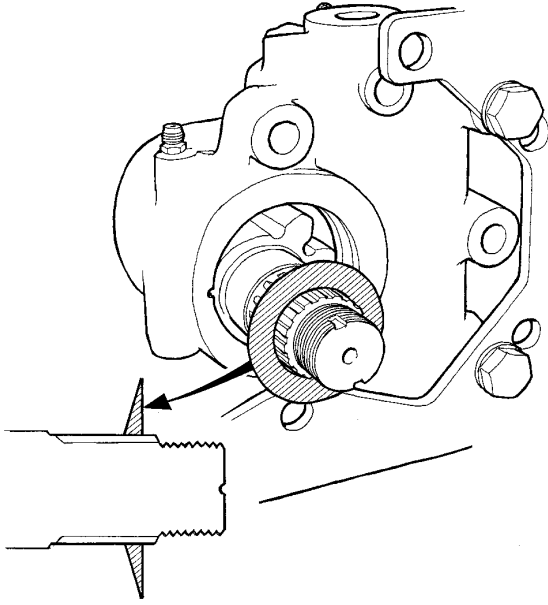


T6006283

Install the sector shaft in the housing.

Note: Make sure the sector shaft is turned the correct way.

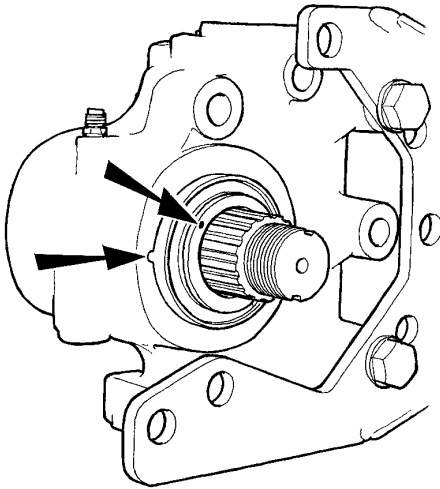
22



T6006303

Install the plastic washers on the sector shaft with the flat side facing outward.

23



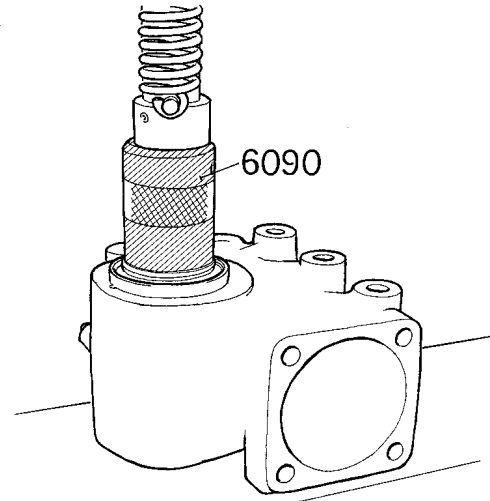
T6006286

Set the sector shaft bearings in position. When installing the bearings, make sure that the locking tabs are not positioned in the same place in the housing as previously. Place the bearings so that the small holes in the bearing inner races come opposite each other and as near the recess in the housing as possible. Tap in the bearings until they enter the housing.

24

Place the steering gear in a press with the splined end of the sector shaft facing upward.

25

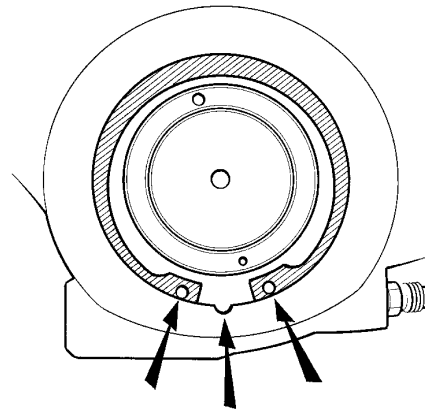


T6006296

9996090

Using drift 9996090, press down the bearing far enough to be able to install the snap ring.

26



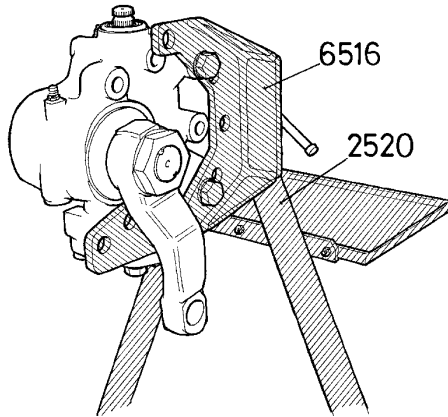
T6006297

Install the snap ring. The ends of the snap ring should be positioned as near the recess in the housing as possible.

27

Press in the other bearing in the same manner and install the snap ring.

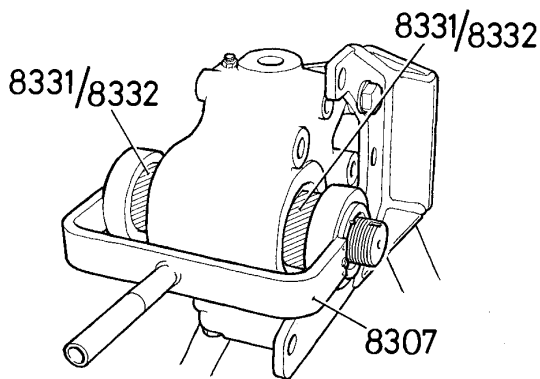
28



T6006308

Secure the steering gear to fixture 9996516.

29



T6006298

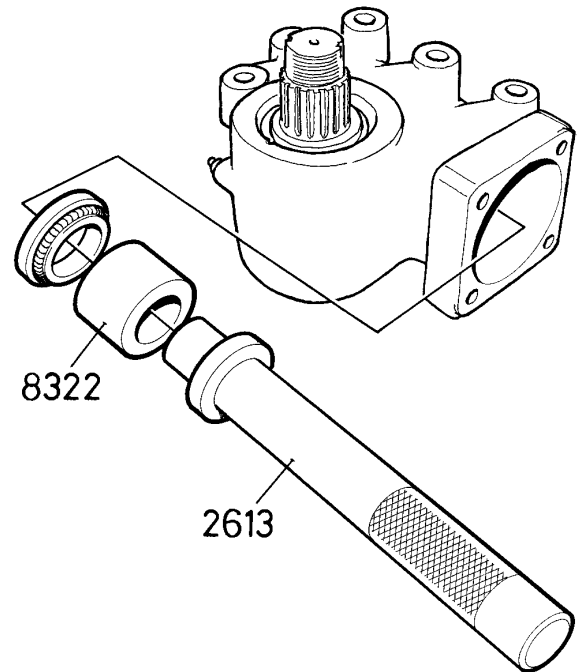
Install setting tool 8307 with sleeves 9998307 and 9998331 on the sector shaft.

The pins in the sleeves should fit into the holes in the bearings. Lock the sleeves to the tool with the locking screws.

30

The bearings for the shaft are eccentric. Adjust the sector shaft outward, i.e. from the piston center position in the steering gear housing by altering the position of the bearings in the housing. Remove the tool.

31



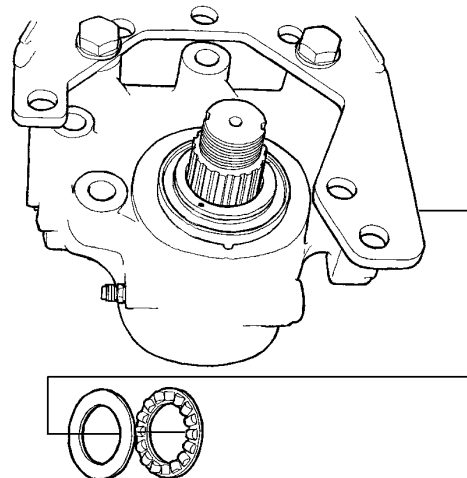
T6006287

Install the input shaft sealing ring on drift 8322.

9992613
9998322

The sealing ring should be positioned with the sealing lip facing away from the drift. Install the sealing ring in the housing.

32

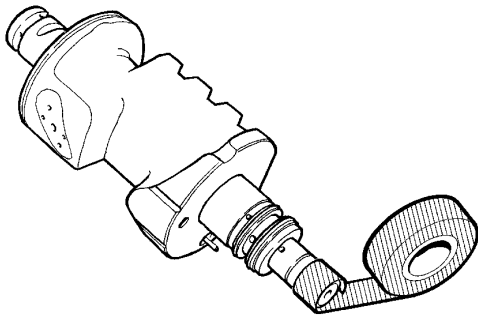


T6006314

Lubricate the input shaft washer and bearing with ATF and install them in the housing.

33
Install the pitman arm on the sector shaft according to the marking.

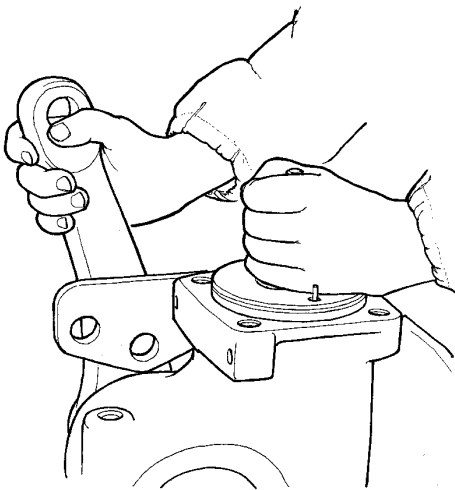
34



T6006299

Wrap thin tape around the input shaft splines so as not to damage the seal when installing the piston in the housing.

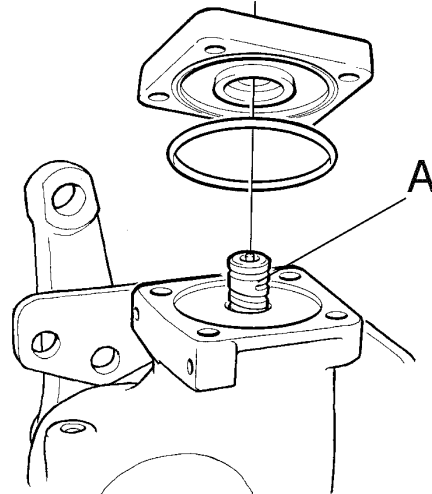
35



T6006310

Insert the piston in the housing. Move the pitman arm forward when the first tooth on the piston is engaged with the first tooth on the sector shaft.

36



T6006309

Screw down the input shaft A. Install the cover using a new O-ring. The adjusting screw for the off-loading valve in the cover should be aligned with the valve on the piston. If the cover does not lay flat against the housing, the piston may not be sufficiently far down in the housing due to the teeth on the sector shaft and piston not being correctly synchronized.

37

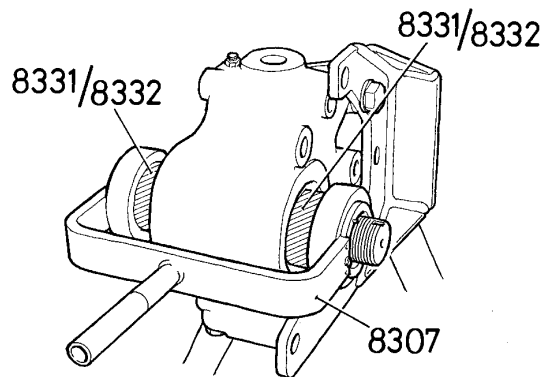
Tighten the cover bolts to 190 Nm (140 ft-lb).

190 Nm (140 ft-lb)

38

Remove the pitman arm.

39

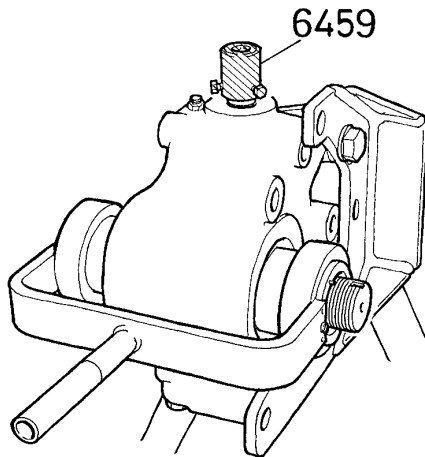


T6006298

Position the setting tool.

9998307
9998331
9998332

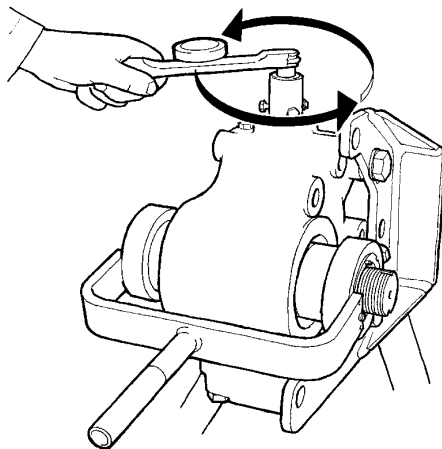
40



Remove the tape from the input shaft and install sleeve 9996459.

T6006289
9996459

41



Set torque-wrench 8081 on the sleeve. Set the torque wrench pointer to zero. Turn the input shaft from end to end position and count the number of turns. Turn back half of the number of those turns, in other words, to the center position.

T6006300
9998081

42

Turn the input shaft one turn to the left and then back again. Read off the increase in torque when the screw passes the center position (pressure point). Torque increase should be approx. 0.4 - 0.8 Nm (3.6 - 7.2 in-lb).

0.4 - 0.8 Nm
(3.6 - 7.2 in-lb).

43

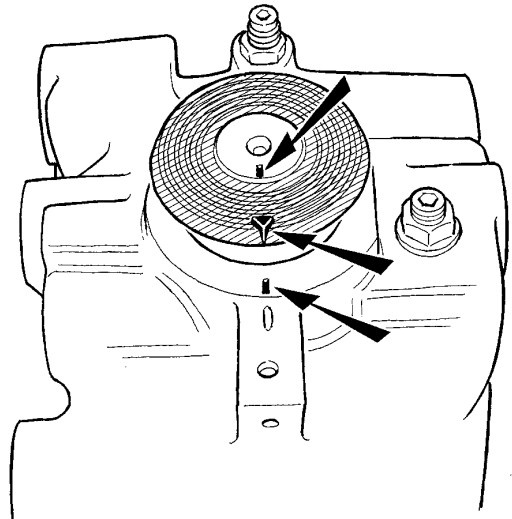
Turn the input shaft one turn to the right and then back again. Repeat the measuring procedure.

44

Both measurements should give a torque increase in the center position of approx. 0.4 - 0.8 Nm (3.6 - 7.2 in-lb). If the torque deviates from the above, the position of the sector shaft must be readjusted with the setting tool.

0.4 - 0.8 Nm
(3.6 - 7.2 in-lb).

45

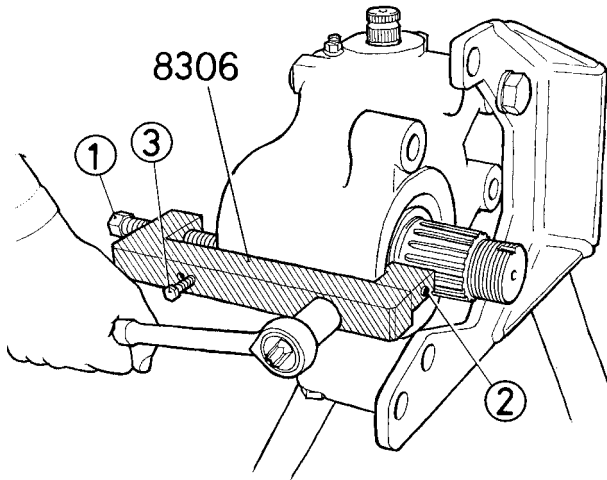


Remove the setting tool and sleeve from the input shaft. Install the rubber seal and dust cover on the input shaft.

T6006291

Note: When installing the dust cover, the arrow on the cover should be in line with the marks on the pin and housing.

46

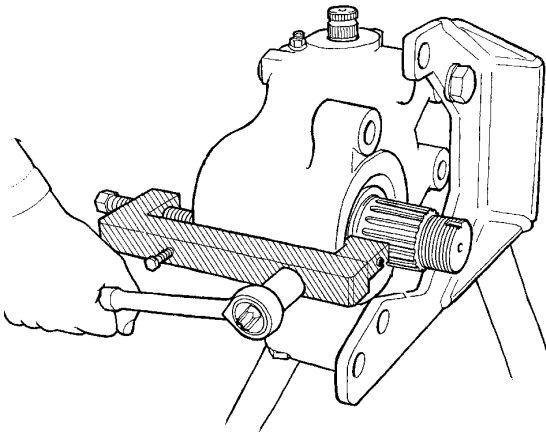


T6006301

Install pressing tool 8306 in position. Position the tool with the rubber pin (2) opposite the recess in the housing. Screw in the screw (1) and check that the position of the rubber pin (2) is not altered. Screw in the stop screw (3) to fix the tool in position.

9998306

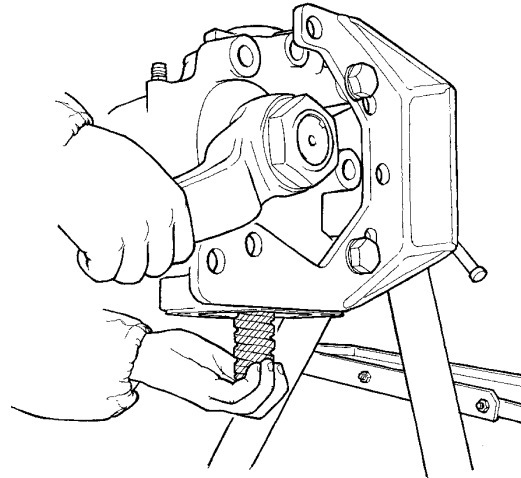
47



T6006316

Lock the bearing by screwing in the screw on the tool until the bearing outer ring is deformed.

48



T6006312

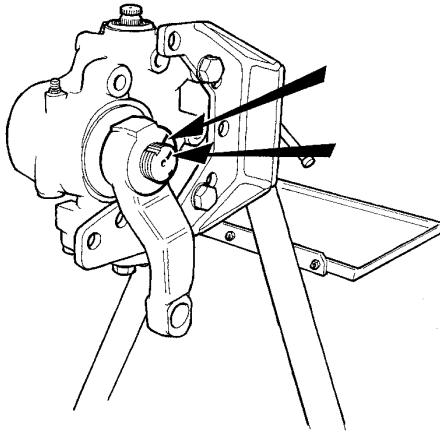
Remove the tool and check that the bearing race is locked in the groove, see illustration.

49

Install the tool and repeat the locking procedure on the other bearing outer ring.

50

Install the bearing dust covers.

51

Install the pitman arm as per the timing marks.

Torque tighten the nut and lock it by staking the locking edge of the nut.

T6006307

550 ± 50 Nm
(405 ± 35 ft-lb)

52

Remove the steering gear from the fixture.

Feedback

One of our objectives is that workshop personnel should have access to correct and appropriate service manuals where it concerns fault tracing, repairs and maintenance of Volvo trucks.
In order to maintain the high standards of our literature, your opinions and experience when using this manual would be greatly appreciated.
If you have any comments or suggestions, make a copy of this page, write down your comments and send them to us, either via telefax or mailing directly to the address listed below.

To

Volvo Trucks North America, Inc.

Dept. 516 Service Publications

7825 National Service Road

P.O. Box 26115

Greensboro, NC 27402-6115

USA

Fax (336) 393-3170

From

.....
.....
.....
.....
.....
.....

Comments/proposals

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Concerns Service Manual:

Operation Numbers

1750-03-02-11	Power Steering Hydraulic Fluid, Changing	58
6411-03-02-01	Steering Wheel, Replacement	31, 32
6412-03-02-02	Steering Shaft, Replacement	44
6412-03-02-03	Steering Column Adjustment Cable, Replacement	41
6412-03-02-04	Steering Column, Replacement	36
6412-03-02-08	Upper Steering Shaft, Replacement	47
6412-03-02-09	Lower Steering Shaft, Replacement	47
6412-03-02-10	Intermediate Steering Shaft, Replacement	49
6412-04-04-01	Steering Column, Overhaul	39
6412-05-02-01	Tilt Steering Column Cable, Adjustment	62
6419-03-02-06	Steering Shaft Carrier Bearing Bracket, Replacement	50
6419-03-02-07	Steering Shaft Boot, Replacement	49
6419-03-02-08	Steering Shaft Carrier Bearing, Replacement	48
6421-03-02-01	Steering Gear, Replacement	54
6425-03-04-01	Sector Shaft Seal, Replacement	66
6429-03-04-02	Input Shaft Seal, Replacement	63
6453-03-02-01	Power Steering Pump, Replacement	50
6453-04-04-01	Power Steering Pump, Overhaul	52
6456-03-03-02	Power Steering Fluid Filter, Replacement	57
6459-05-03-02	Power Steering Hydraulic System, Bleeding	59
6459-06-02-02	Power Steering System, Checking	60

VOLVO

Volvo Trucks North America, Inc.

P.O. Box 26115, Greensboro, NC 27402-6115

Volvo Trucks Canada, Ltd.

6490 Vipond Drive, Mississauga, Ontario L5T 1W8

<http://www.volvotrucks.volvo.com>