

SECTION 11-02 Steering System, Power

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Quick Connect Power Steering Fitting, Atsugi	11-02-70	Tie Rod Ends, Bellows and Ball Joint Sockets	11-02-46
Rack Yoke Plug Clearance	11-02-68	Tie Rods, Bellows	11-02-44
CLEANING AND INSPECTION		OPERATION	
Steering Gear, Power	11-02-67	Rotary Valve	11-02-11
Steering Gear, Power—Flushing	11-02-67	Rotary Valve, VAPS	11-02-11
Steering Pump, Power	11-02-68	REMOVAL AND INSTALLATION	
Steering Pump, Power—Flushing	11-02-67	Cooler	11-02-37
DESCRIPTION		Cooler Lines	11-02-36
Atsugi Steering Pump	11-02-10	Cooler to Reservoir	11-02-36
Power Steering Hoses	11-02-10	Power Steering Pump	11-02-28
Steering Gear	11-02-1	Pressure and Return Line Fitting at Steering Gear and Power Steering Pump	11-02-39
Steering Pump, CII	11-02-7	Pressure and Return Lines	11-02-34
Variable Assist Power Steering (VAPS)	11-02-5	Pressure Line	11-02-36
DIAGNOSIS AND TESTING		Pressure Switch	11-02-40
Electrical Component Diagnosis	11-02-16	Pump Reservoir	11-02-41
External Leakage	11-02-14	Quick Connect Power Steering Fitting, CII	11-02-40
External Leakage	11-02-27	Remote Reservoir	11-02-28
Power Steering Diagnosis	11-02-12	Steering Gear	11-02-29
Pump Noise, Atsugi	11-02-15	Steering Gear Actuator	11-02-43
Pump Noise, CII	11-02-16	Steering Pump	11-02-41
Test Procedure	11-02-15	Steering Pump and Pulley Hub	11-02-41
Tie Rod Articulation Torque Check	11-02-26	Supply Line—Reservoir to Pump	11-02-35
DISASSEMBLY AND ASSEMBLY		Tie Rod End Replacement	11-02-28
Gear Housing, Rack Yoke Plug, Rack Assembly, Rack Bushing and Oil Seals	11-02-55	VAPS Module	11-02-43
Input Shaft and Valve Assembly	11-02-48	SPECIAL SERVICE TOOLS	
Pressure and Return Line Fitting	11-02-46	11-02-72	
Pressure and Return Line Fitting	11-02-60	SPECIFICATIONS	
Steering Gear	11-02-46	11-02-71	
Steering Pump	11-02-61	VEHICLE APPLICATION	
		11-02-1	

VEHICLE APPLICATION

Taurus/Sable.

DESCRIPTION

Steering Gear

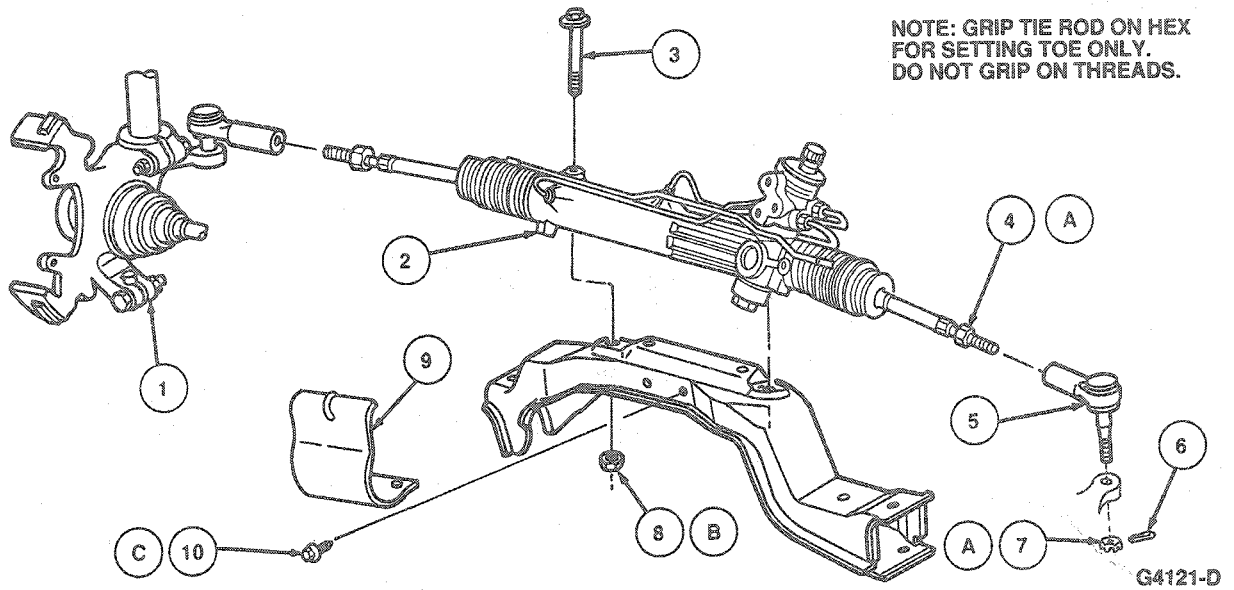
The power steering gear is a 16:1 constant ratio power rack-and-pinion design for all vehicles except Taurus LX and Sable.

The gear housing and valve housing are combined into a one-piece aluminum die casting. The gear design incorporates quick connect fittings for the pressure and return lines that allow the lines to swivel; this is normal and does not indicate loose fittings. If the fittings leak, check to ensure they are tightened to 14-20 N·m (10-15 lb-ft). Do not overtighten. If the leak is not corrected, replace the fitting seals.

The gear is a hydraulic-mechanical unit, which uses an integral piston and rack design to provide power-assisted vehicle steering control. Internal valving directs pump flow and controls pressure, as required, to reduce steering effort during operation. The unit contains a rotary hydraulic fluid control valve integrated to the input shaft and a boost cylinder integrated with the rack.

NOTE: The power steering gear used on the Taurus SHO utilizes travel restrictors mounted inboard of the ball joint housings. The restrictors limit wheel travel to prevent the tires from hitting the wheel housing.

DESCRIPTION (Continued)



NOTE: GRIP TIE ROD ON HEX FOR SETTING TOE ONLY. DO NOT GRIP ON THREADS.

G4121-D

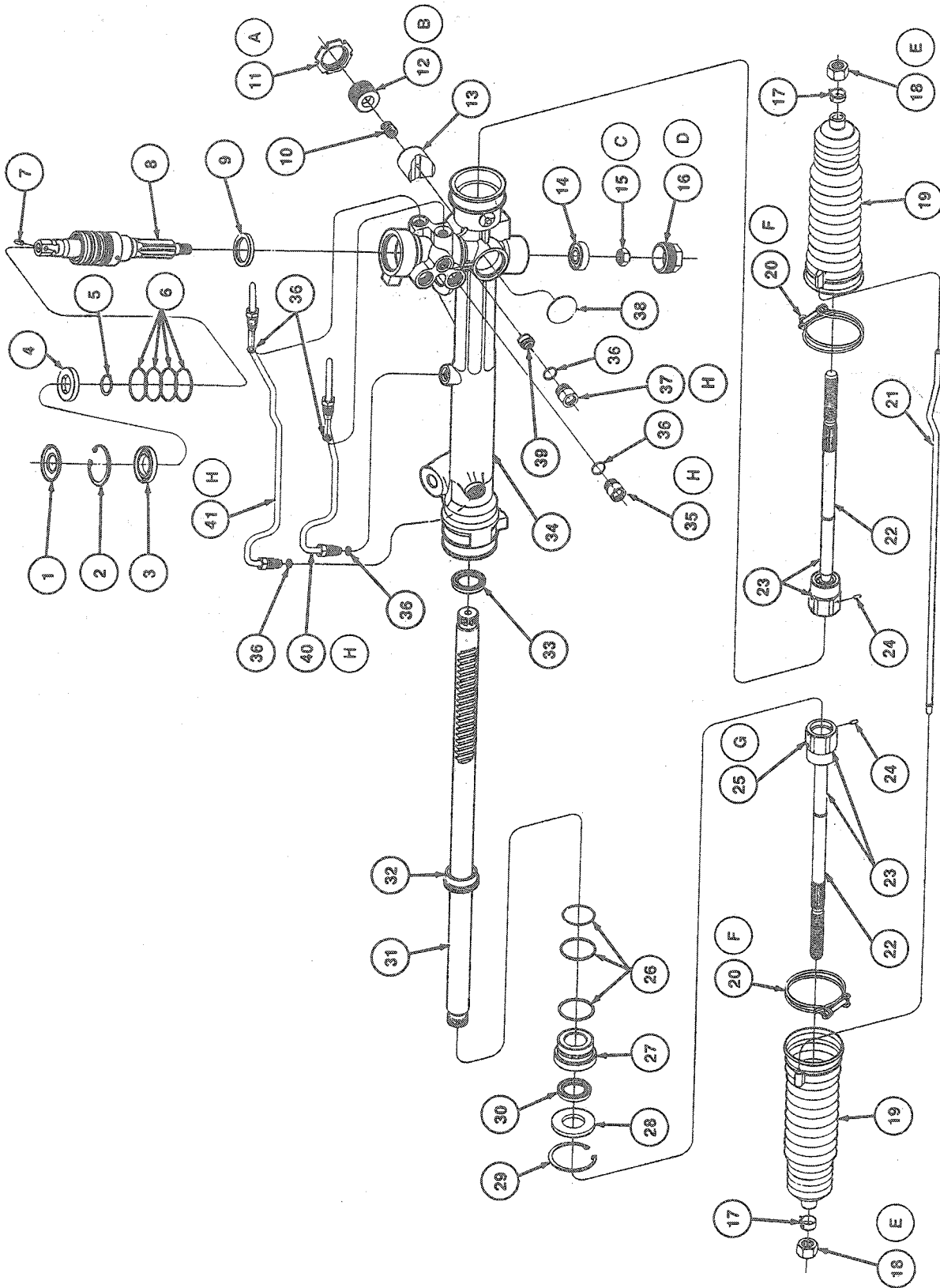
Item	Part Number	Description
1	3K1867	Spindle Assy
2	3504	Gear Assy
3	804246-S150	Bolt (2 Req'd)
4A	N803637-S36	Nut (2 Req'd)
5	3289	Tie Rod End Assy (2 Req'd)
6	—	Cotter Pin (2 Req'd)
7A	N803972-S150	Nut (2 Req'd)

(Continued)

Item	Part Number	Description
8B	N803956-S150	Nut (2 Req'd)
9	3F540	Shield
10C	N610957-S36	Bolt (2 Req'd)
A		Tighten to 47-68 N·m (35-50 Lb-Ft)
B		Tighten to 115-135 N·m (85-100 Lb-Ft)
C		Tighten to 5.5-8.0 N·m (49-71 Lb-In)

DESCRIPTION (Continued)

Taurus/Sable



G4120-E

DESCRIPTION (Continued)

Item	Part Number	Description
1	3D527	Power Steering Gear Input Shaft Dust Seal
2	6140	Snap Ring
3	3D526	Power Steering Gear Input Shaft Seal
4	3D525	Power Steering Gear Input Shaft Bearing
5	386387-S	Snap Ring
6	3D728	Seals
7	390920-S	Roll Pin
8	3D517	Power Steering Gear Input Shaft and Control Assy
9	3591	Seal
10	3F516	Spring
11A	3F606	Yoke Plug Locknut
12B	3580	Yoke Plug
13	3F515	Sector Shaft Support Yoke
14	3552	Steering Gear Worm Bearing
15C	34988-S100	Nut
16D	3568	Steering Gear Housing Cover
17	3C650	Clamp
18E	N803637-S	Nut
19	3332	Boot
20F	N803259-S	Clamp
21	3K762	Breathe Tube
22	—	Spindle Rod (Part of 3280)
23	3280	Tie Rod Assy
24	—	Roll Pin (Part of 3280)
25G	—	Ball Joint Housing (Part of 3280)

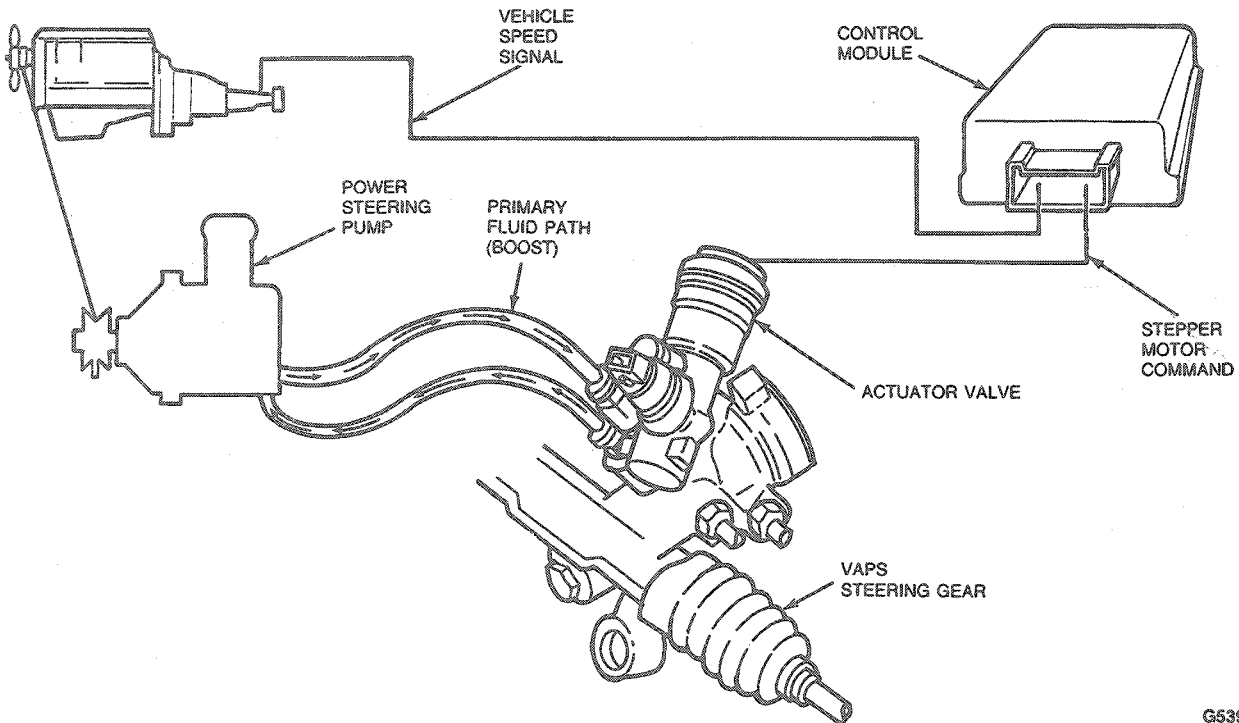
(Continued)

Item	Part Number	Description
26	N803637-S	Seal
27	3576	Bushing
28	3568	Plate
29	97630-S	Snap Ring
30	3F520	Seal
31	3575	Rack Assy
32	—	Piston (Part of 3575)
33	3F520	Rack Seal
34	3548	Steering Gear Housing Assy
35H	3R608	Transfer Tube Connector
36	388898-S	Seal
37H	3C751	Transfer Tube Connector
38	N804432-S	Plug
39	3N603	Check Valve
40H	3A714	Transfer Tube Assy
41H	3A717	Transfer Tube
A		Tighten to 60-89 N·m (44-66 Lb·Ft)
B		Tighten to 5-5.6 N·m (45-50 Lb·In)
C		Tighten to 41-54 N·m (31-39 Lb·Ft)
D		Tighten to 54-68 N·m (40-50 Lb·Ft)
E		Tighten to 47-68 N·m (35-50 Lb·Ft)
F		Tighten to 2.2-3.4 N·m (20-30 Lb·In)
G		Tighten to 75-88 N·m (55-65 Lb·Ft)
H		Tighten to 13-27 N·m (10-20 Lb·Ft)

DESCRIPTION (Continued)

Variable Assist Power Steering (VAPS)

The variable assist power steering (VAPS) system consists of a microprocessor-based module, a power rack-and-pinion steering gear, an actuator valve assembly, hose assemblies, and a high efficiency power steering pump for Taurus LX and Sable 3.0L and 3.8L.



G6395-A

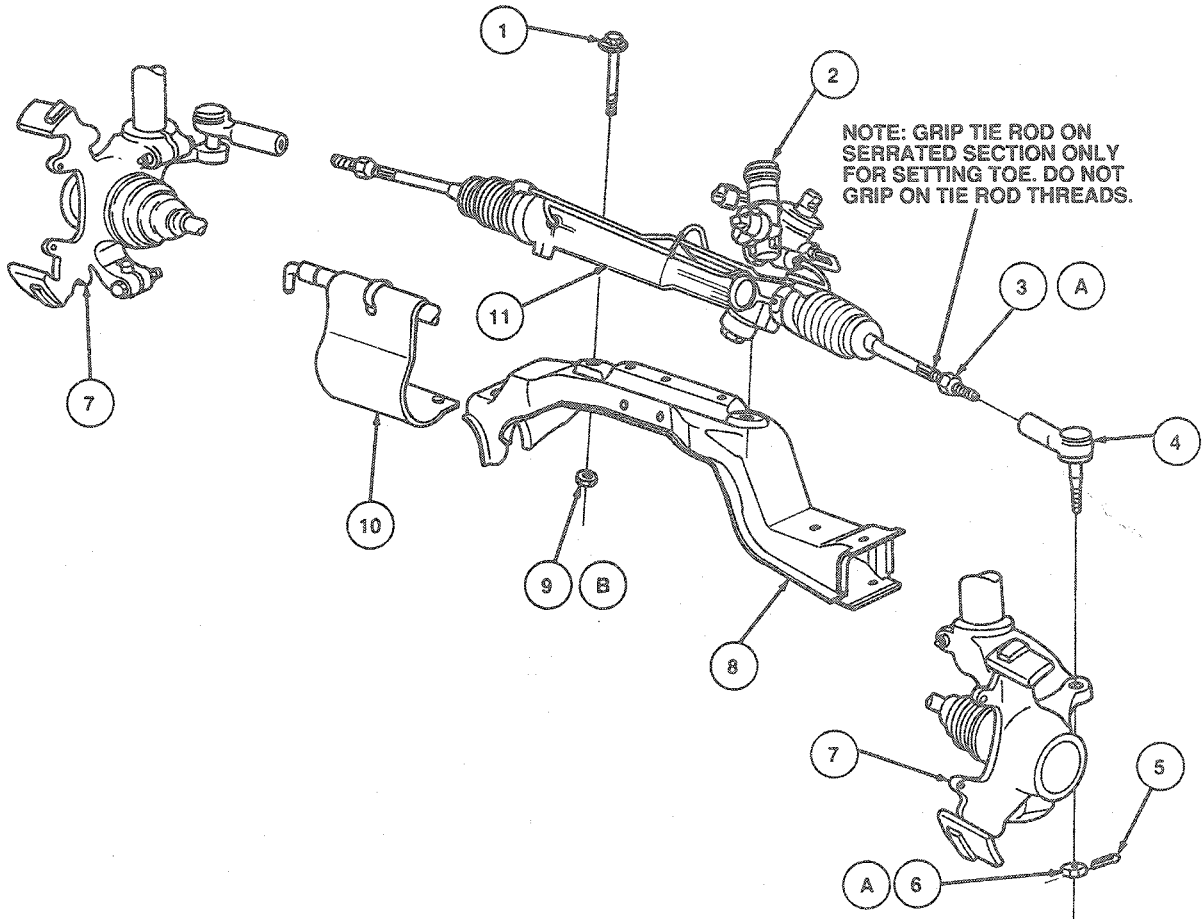
The system uses a modified rotary valve in the gear with two independent hydraulic circuits called the primary and secondary circuits. During parking and low speed operation, the flow from the pump is routed to the primary circuit by an electrically controlled actuator valve assembly. As vehicle speed increases, the actuator valve gradually opens, diverting an increasing amount of fluid to the secondary circuit.

The actuator valve is a pressure-balanced variable orifice valve, controlled by a stepper motor-driven linear spool. The VAPS module receives inputs from a vehicle speed sensor, and signals the stepper motor-driven spool to adjust the opening of the actuator valve.

The VAPS module is programmed to perform a self-diagnostic check every 16 milliseconds. If a concern is detected, the module microprocessor deactivates its outputs.

The VAPS module is programmed to perform a service diagnostic procedure when activated by the service technician.

DESCRIPTION (Continued)



G4920-B

Item	Part Number	Description
1	N804433-S150	Bolt (2 Req'd)
2	3N803	Actuator Assy
3A	N803637-S36	Nut (2 Req'd)
4	3289	Tie Rod End Assy (2 Req'd)
5	72044-S100	Cotter Pin (2 Req'd)
6A	N803972-S150	Nut (2 Req'd)
7	3K185 (LH) 3K186 (RH)	Spindle Assy

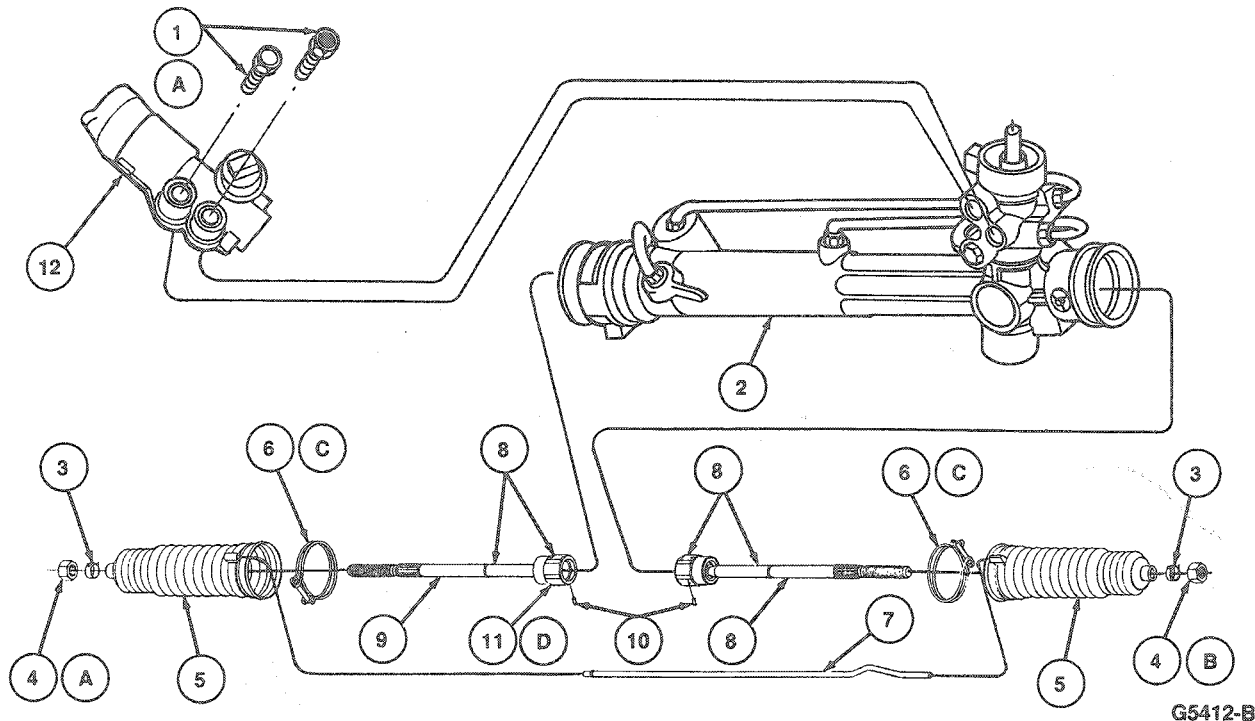
Item	Part Number	Description
8	—	Crossmember
9B	N803956-S150	Nut (2 Req'd)
10	3F570	Shield
11	3504	Gear Assy
A		Tighten to 47-68 N·m (35-50 Lb·Ft)
B		Tighten to 115-135 N·m (85-100 Lb·Ft)

(Continued)

TG4920C

DESCRIPTION (Continued)

VAPS Exploded View



G5412-B

Item	Part Number	Description
1A	3R659	Bolt
2	3548	Steering Gear Housing Assy
3	3C650	Clamp
4B	N803637-S	Nut
5	3332	Boot
6C	N803259-S	Clamp
7	3K762	Breather Tube
8	3280	Tie Rod Assy
9	—	Spindle Rod (Part of 3280)
10	—	Roll Pin (Part of 3280)

Item	Part Number	Description
11D	—	Ball Joint Housing (Part of 3280)
12	3N803	Actuator Assy
A		Tighten to 27-34 N-m (20-25 Lb-Ft)
B		Tighten to 47-68 N-m (35-50 Lb-Ft)
C		Tighten to 2.2-3.4 N-m (20-30 Lb-In)
D		Tighten to 75-88 N-m (55-65 Lb-Ft)

(Continued)

TG5412B

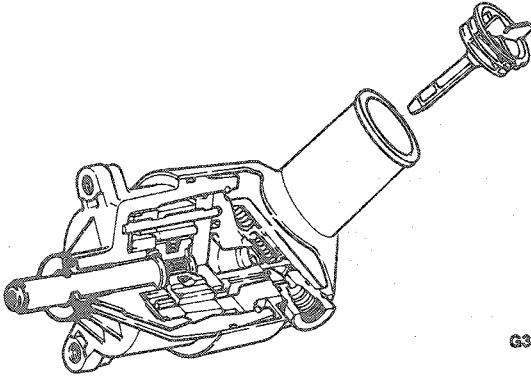
Steering Pump, CII

The Ford Model CII power steering pump is a belt-driven, 10-slipper type pump with a fiberglass-filled nylon reservoir. The reservoir is attached to the rear side of the aluminum pump housing, and the pump body is encased within the housing and reservoir. The pump design incorporates a pump pressure fitting which allows the pump pressure line to swivel. This is normal and does not indicate a loose fitting.

DESCRIPTION (Continued)

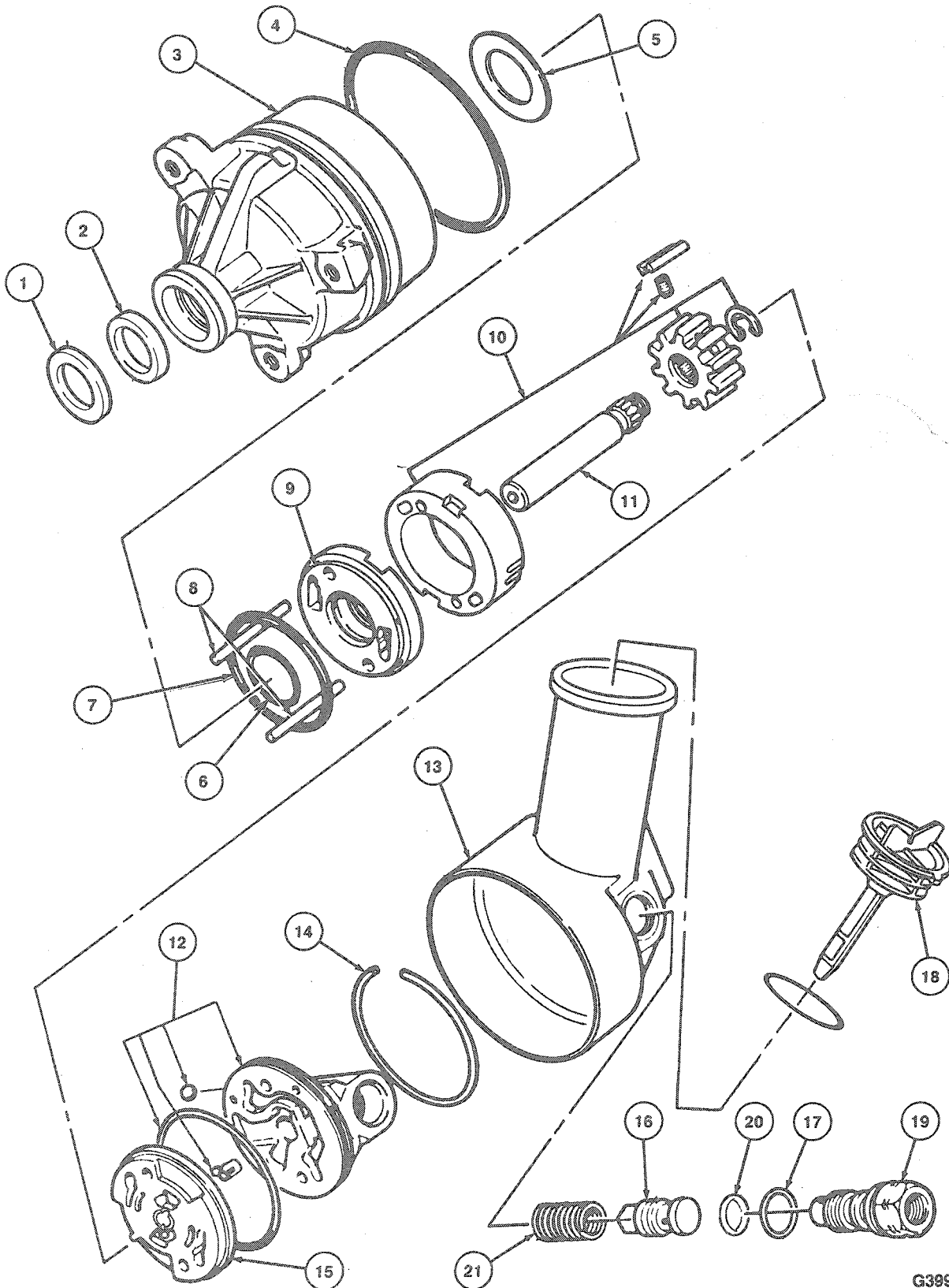
A pressure-sensitive identification tag is attached to the reservoir body. This tag indicates the basic model number and the suffix.

CAUTION: Always use the model codes on the tag when requesting service parts in case of differences in internal components. Refer to Section 11-00 for an example of this tag.



G3618-B

DESCRIPTION (Continued)



G3996-D

DESCRIPTION (Continued)

Item	Part Number	Description
1	3F655	Retainer Assy
2	3B592	Shaft Seal
3	3A643	Pump Housing Plate
4	387572-S100	Seal
5	3D596	Belleville Spring
6	387569-S100	Seal
7	3875700-S100	Seal
8	387579-S	Dowel Pin (2 Req'd)
9	3D590	Lower Plate
10	3D607	Cam and Rotor Assy
11	3B599	Shaft

(Continued)

Item	Part Number	Description
12	3C544	Valve Cover Assy
13	3A578	Reservoir
14	387573-S	Retaining Ring
15	3A645	Upper Plate
16	3B604	Valve Body
17	389349-S	Seal
18	3A006	Dipstick
19	3D653	Outlet Fitting
20	384975-S94	Seal
21	3D586	Spring

TG3996D

Power Steering Hoses

The power steering hoses use O-ring seals at the quick connect fittings. Note that there are two possible leak points.

Power Steering Pump and Gear Connection

NOTE:
IF LEAK OCCURS
HERE, REPLACE
HOSE ASSY

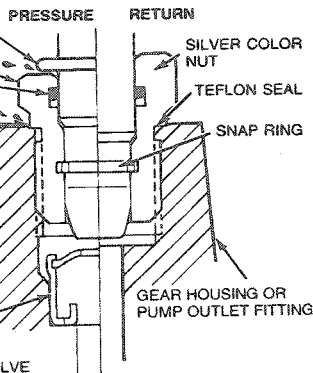
GOLD COLOR
NUT

O-RING

NOTE: IF LEAK OCCURS
HERE, TIGHTEN NUT TO
SPECIFICATION. REPLACE
TEFLON SEAL IF
NECESSARY.

NOTE: ALWAYS REPLACE
THIS SEAL WHEN A
LINE IS REMOVED

CHECK VALVE
NOTE: MAKE SURE CHECK VALVE
IS IN PRESSURE PORT ONLY,
PROPERLY ORIENTED AS SHOWN.



G5370-B

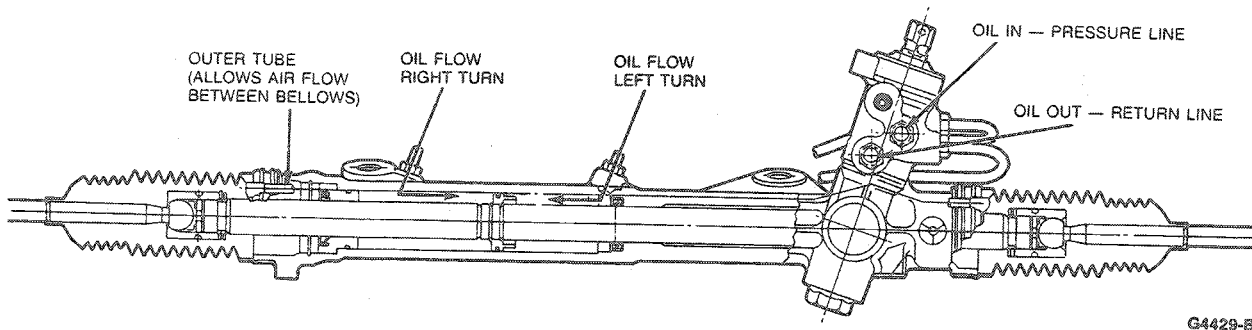
Atsugi Steering Pump

The Atsugi power steering pump is a belt driven, vane-type power steering pump. The pump uses a remote reservoir mounted on the RH fender apron, an oil cooler and a special quick connect fitting at the pump outlet.

OPERATION

Rotary Valve

The rotary design control valve uses relative rotational motion of the input shaft and valve sleeve to direct fluid flow.



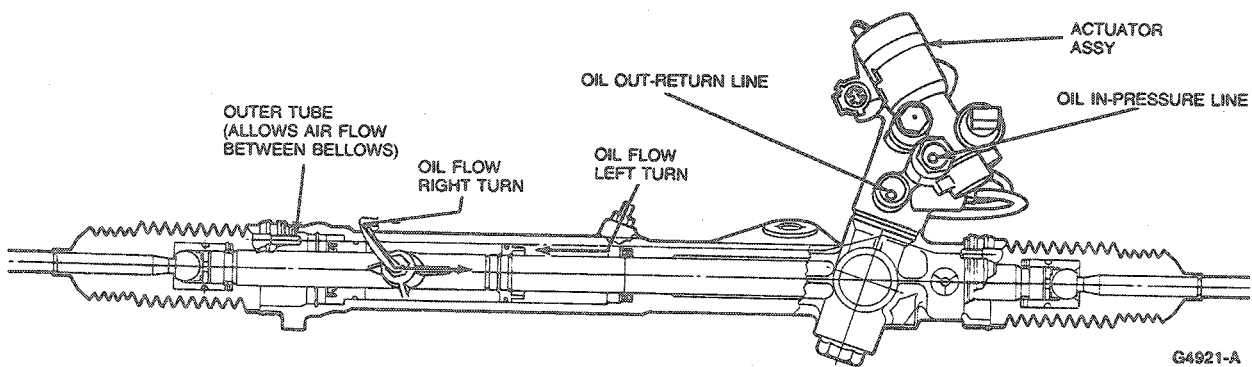
G4429-B

When the steering wheel is turned, resistance of the wheels and the weight of the vehicle cause a torsion bar to deflect. This deflection changes the position of the valve spool and sleeve ports, directing fluid under pressure to the appropriate end of the power cylinder. The difference in pressure forces on the piston helps move the rack to assist turning effort. The piston is attached directly to the rack, and the housing functions as the power cylinder. The oil in the opposite end of the power cylinder is forced to the control valve and back to the pump reservoir.

When the driver stops applying steering effort, the valve is forced back to a centered position by the torsion bar. When this occurs, pressure is equalized on both sides of the piston, and the front wheels tend to return to a straight-ahead position.

Rotary Valve, VAPS

The rotary design control valve directs fluid flow using relative rotational motion of the input shaft and valve sleeve.



G4921-A

OPERATION (Continued)

When the steering wheel is turned, resistance of the wheels and the weight of the vehicle cause a torsion bar to deflect. This deflection changes the position of the valve spool and sleeve ports, directing pressurized fluid to the appropriate end of the power cylinder. The difference in pressure forces on the piston helps move the rack to assist turning effort. The piston is attached directly to the rack, and the housing functions as the power cylinder. The oil in the opposite end of the power cylinder is forced to the control valve and back to the pump reservoir.

When the driver stops applying steering effort, the valve is forced back to a centered position by the torsion bar. When this occurs, pressure is equalized on both sides of the piston, and the front wheels tend to return to a straight-ahead position.

DIAGNOSIS AND TESTING

The diagnosis charts provide procedures to resolve typical customer concerns encountered with the power steering system.

Follow the sequence indicated to save time during condition identification and corrective action.

Power Steering Diagnosis

Before any internal service is performed on the rack and pinion power steering, diagnosis of the condition must be performed. Ensure that the tire size is correct, with matched tires (front and rear), all inflated to specifications. The following conditions, possible sources and corrective action will assist in performing the proper service.

POWER STEERING DIAGNOSIS

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> Wander: Condition Where Vehicle Wanders Side-To-Side On The Roadway When Being Driven Straight Ahead While The Steering Wheel Is Held In A Firm Position. Evaluation Should Be Conducted On A Level Road (Little Road Crown). 	<ul style="list-style-type: none"> Loose tie rod ends. Inner ball housing loose or worn . Gear assembly mounting loose. Loose suspension struts or ball joints. Column intermediate shaft connecting bolts loose. Column intermediate shaft joints loose or worn. Improper wheel alignment. 	<ul style="list-style-type: none"> Replace tie rod end assemblies. Replace tie rod assemblies. Tighten mounting bolt to specification. Adjust or replace as required. Tighten bolts to specification. Replace intermediate shaft. Set alignment to specification.
<ul style="list-style-type: none"> Feedback—Rattle, Chuckle, Knocking Noises In the Steering Gear. Condition Where Roughness Is Felt In The Steering Wheel By The Driver When The Vehicle Is Driven Over Rough Pavement. 	<ul style="list-style-type: none"> Column U-joints loose. Loose tie rod ends. Loose / worn tie rod ball. Gear assembly mounting loose. Piston disengaged or loose on rack. Column intermediate shaft connecting bolts loose. Loose suspension struts or ball joints. 	<ul style="list-style-type: none"> Replace if damaged or worn. Replace tie rod end assemblies. Replace tie rod assemblies. Tighten mounting bolts to specification. Replace rack assembly. Tighten bolts to specification. Adjust or replace as necessary.

DIAGNOSIS AND TESTING (Continued)

POWER STEERING DIAGNOSIS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> Poor Returnability— Sticky Feel: Condition Where The Steering Fails To Return To Center Following A Turn Without Manual Effort From The Driver. In Addition, When The Driver Returns The Steering To Center, It May Have A Sticky Or Catchy Feel. 	<ul style="list-style-type: none"> Misaligned steering column or column flange rubbing steering wheel and /or flange. Check rotational torque of intermediate shaft joints. Tight inner tie rod ball joints. Tight inner tie rod end ball studs. Binding in valve assembly. Bent or damaged rack. Bent or damaged subframe. Column bearing binding. Tight suspension struts or lower control arm ball joints. Improper wheel alignment. Contamination in system. Improper yoke clearance (tight). 	<ul style="list-style-type: none"> Align column. If binding, replace intermediate shaft. Replace tie rod as required. Replace tie rod end assemblies. Replace input shaft valve assembly. Replace rack assembly. Replace as necessary. Replace bearing. Adjust or replace as required. Set to specification. Flush power steering system. Set to specification.
<ul style="list-style-type: none"> Heavy Steering Efforts — Poor or Loss of Assist: Condition Where A Heavy Effort And Poor Assist Condition Is Recognized By The Driver While Turning Corners And Especially While Parking. A Road Test Will Verify This Condition. 	<ul style="list-style-type: none"> Leakage / loss of fluid. Low pump fluid. Valve seal cut or twisted. Damaged / worn Teflon® piston seal. Loose / missing rubber backup piston O-ring. Loose rack piston. Gear assembly oil passages restricted. Bent / damaged rack assembly. Pump external leakage. Improper drive belt tension. Hose or cooler external leakage. Improper engine idle speed. Pulley loose or warped. Pump / flow pressure not to specification. Hose cooler line restrictions. 	<ul style="list-style-type: none"> Refer to external leakage diagnosis for service. Fill as necessary. Replace seal. Replace seal. Replace / install O-ring. Replace rack assembly. Clear / service as required. Replace rack assembly. Service per Pump Diagnosis. Readjust belt tension. Replace as necessary. Readjust idle. Replace pulley. Refer to Pump Service Diagnosis. Clear or replace as required.

TG3117F

FORD INTEGRAL POWER RACK-AND-PINION STEERING GEAR

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> Hissing Sound <p>NOTE: There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and the performance of the steering gear.</p> <p>CAUTION: Do not hold steering wheel at full lock more than five seconds, as damage to power steering pump may result.</p>	<ul style="list-style-type: none"> Hiss may be expected when the steering wheel is at the end of travel or when turning at standstill. 	<ul style="list-style-type: none"> Hiss is a normal characteristic of rotary steering gears and in no way affects steering. Do not replace the rack assembly unless the hiss is extremely objectionable. A replacement rack will also exhibit a slight noise and is not always a cure for the condition. Investigate for a grounded column or a loose boot at the dash panel. Any metal-to-metal contact will transmit valve hiss into the passenger compartment through the steering column. Verify clearance between flexible coupling components. Ensure steering column shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates.

TG3022G

DIAGNOSIS AND TESTING (Continued)

External Leakage

When looking for leaks, use this procedure to pinpoint the exact cause and location to avoid mis-diagnosis:

1. Check for overfilled power steering pump reservoir.
2. Wipe suspected area dry.
3. Check for power steering pump overflow and aeration.

4. Check for exact source of oil. Example: Oil may be running down from another area (engine, etc.) and drip may not be leak point.

CAUTION: Do not hold the steering wheel against a stop for more than three to five seconds at a time, as damage to power steering pump may result. Cycle the steering wheel from stop to stop 10 times and check for leaks. The bellows may have to be moved back from the housing to see the leak.

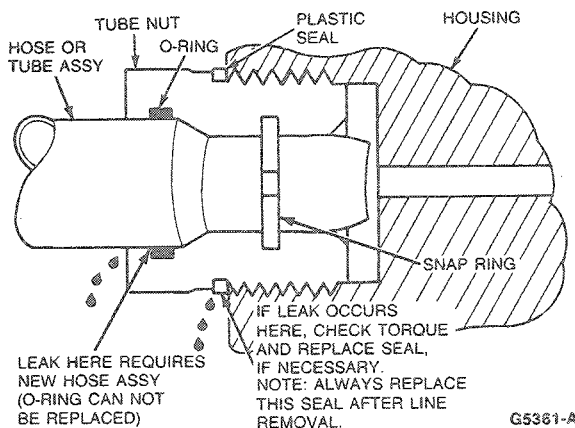
5. Some leaks are high pressure leaks and may require holding steering wheel against stops to seep out.
6. Power steering gear assembly leaks fall into several categories as listed in the Leakage Diagnosis chart. The category determines which seals or parts to replace. Refer to the corresponding illustrations for the leak category.

LEAKAGE DIAGNOSIS

Leak Category	Part Required to Service
1. Hose fittings.	<ul style="list-style-type: none"> ● Loose—Tighten to specification—Do not over-tighten. ● Plastic seals at tube nut—Plastic seals should be replaced each time hose is disconnected. ● O-ring leaks—Replace hose.
2. Leak at (right or left) transfer line.	<ul style="list-style-type: none"> ● Loose—Tighten to specification—Do not over-tighten. ● Replace plastic seals. ● Replace line assembly as required.
3. Leak at input shaft seal.	<ul style="list-style-type: none"> ● Replace input shaft seal kit. Rack and tie rod assembly removal is not required.
4. Leak at either or both bellows.	<ul style="list-style-type: none"> ● Replace all gear housing and rack bushing seals. Do not disturb transfer lines.
5. Leak at end of input shaft.	<ul style="list-style-type: none"> ● Replace input shaft valve assembly along with input shaft seal kit. Rack and tie rod assembly removal is not required.
6. Housing—porosity, cracked or stripped threads.	<ul style="list-style-type: none"> ● Replace the housing assembly.

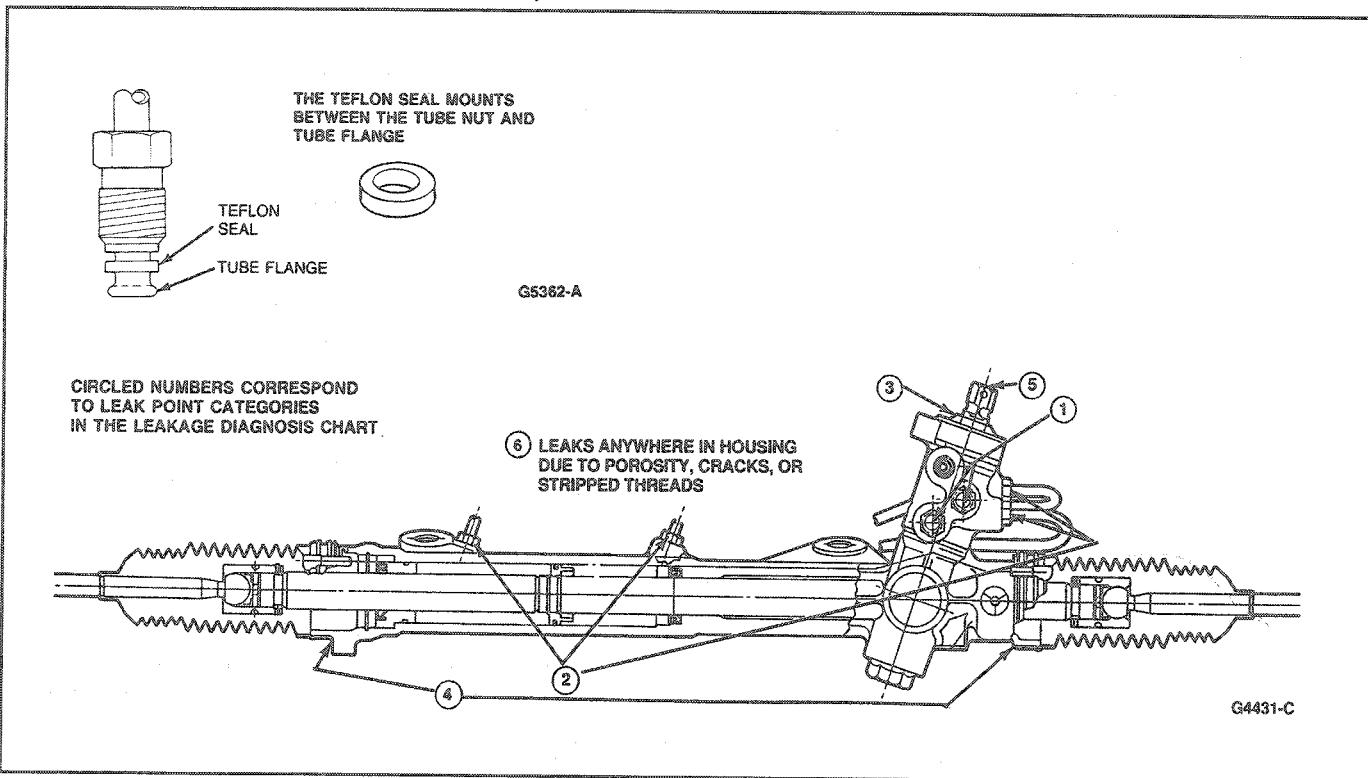
TG3118F

NOTE: Whenever a gear assembly is disassembled for seal replacement, the gear seal contact surfaces should be checked for roughness and cleaned. Replace components such as input shaft / valve assembly or rack assembly only if the sealing surfaces cannot be cleaned satisfactorily with crocus cloth.



G5361-A

DIAGNOSIS AND TESTING (Continued)

**Pump Noise, Atsugi**

NOTE: The power steering pump is serviced as an assembly. If any service is required, the entire pump assembly must be replaced.

Refer to pump noise diagnosis chart.

Test Procedure

For test procedure refer to Section 11-00.

DIAGNOSIS AND TESTING (Continued)

Pump Noise, CII

Refer to the pump noise diagnosis chart.

PUMP NOISE DIAGNOSIS

CONDITION	POSSIBLE SOURCE	ACTION
● Power Steering	● Check belt for proper tension or glazing.	● Tighten or replace belt as required.
● Pump Noisy	● Low fluid level and possible leakage.	● Refill to specified level. Purge air from system. Check for leaks. Service as required.
● Swish-Type Noise	● Fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54°C (130°F).	● Normal noise.
● Whine-Type Noise	● Aerated fluid, or cam contour damaged.	● Purge system of air. If condition is not resolved, replace rotor assembly.
● Clicking Mechanical-Type Noise	● Pump slippers too long, excessive wear of pumping elements. Excessive slipper to slot clearance, or out of square slipper springs.	● Replace rotor assembly.
● Chatter-Type Noise	● Chipped corners on rotor outside diameter or distorted slipper spring.	● Replace rotor assembly.
● Other Cause of Noise	<ul style="list-style-type: none"> ● Improper assembly of components such as slippers. ● Imperfections on rotor outside diameter or rotor end surface. ● Damaged rotor splines. ● Hairline crack on cam inner surface. ● Interference between rotor and cam. ● Excessively worn or scored pumping elements and pressure plates. 	<ul style="list-style-type: none"> ● Rebuild pump and replace components as required. ● Replace rotor assembly. ● Replace rotor assembly. ● Replace rotor assembly. ● Replace rotor assembly. ● Replace rotor assembly and pressure plates.

CG4058-C

The diagnosis charts provide procedures to resolve typical concerns encountered with the power steering system.

Follow the sequence indicated to save time during condition identification and corrective action.

Electrical Component Diagnosis

Tools Required:

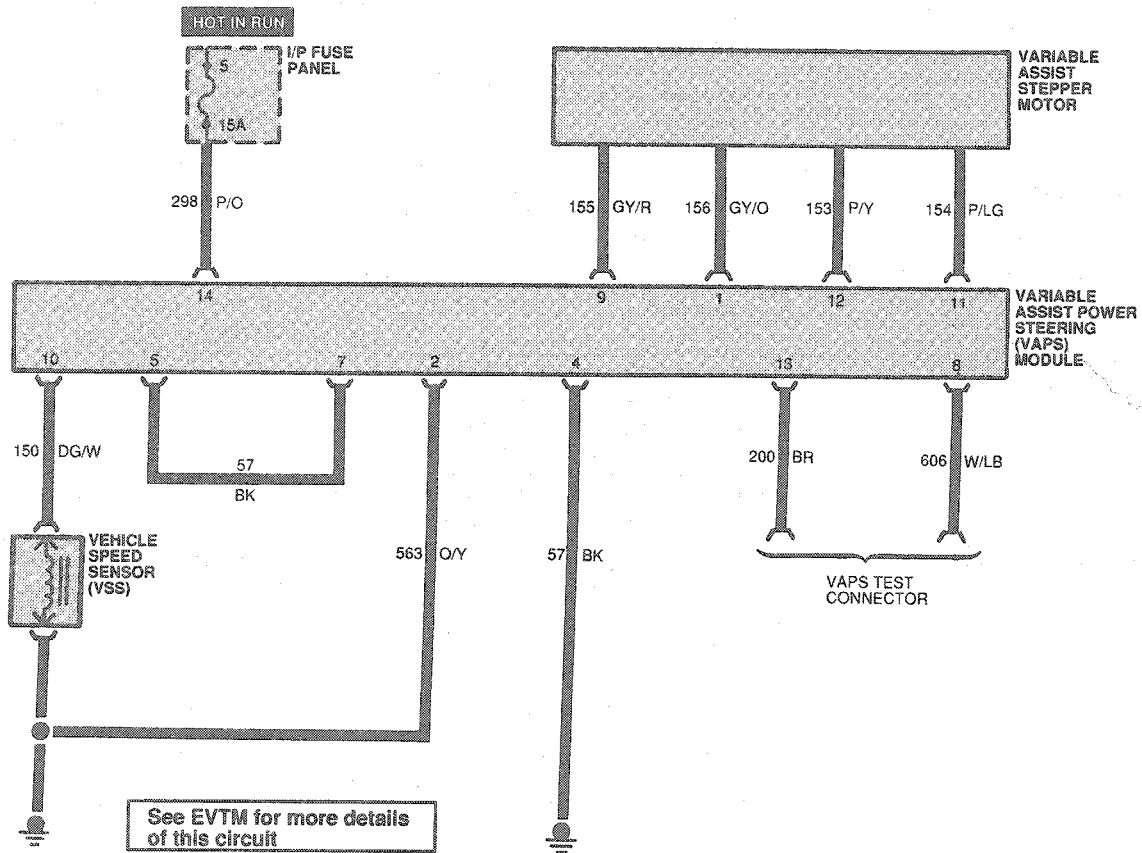
- Rotunda Digital Volt Ohmmeter 007-00001
- Rotunda Inductive Dwell-Tach-Volt-Ohm Tester 059-00010

This portion of the power steering diagnosis refers only to the electrical components of the VAPS system:

- VAPS Control Module
- Speed Sensor
- Actuator Valve
- Wiring Harness and Connectors

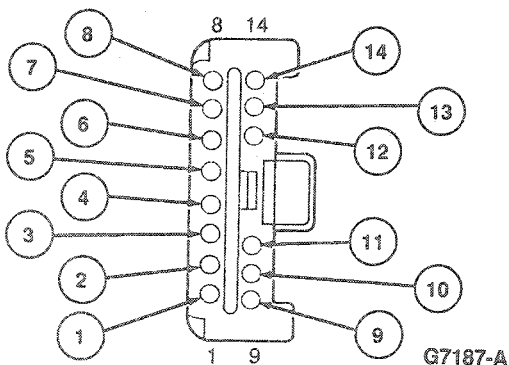
DIAGNOSIS AND TESTING (Continued)

The procedure is a systematic method of determining which of the above components, if any, require servicing. Testing can be done using Rotunda Digital Volt Ohmmeter 007-00001, Rotunda Inductive Dwell-Tach-Volt-Ohm Tester 059-00010 or equivalent.



G7176-A

VAPS Connector End View

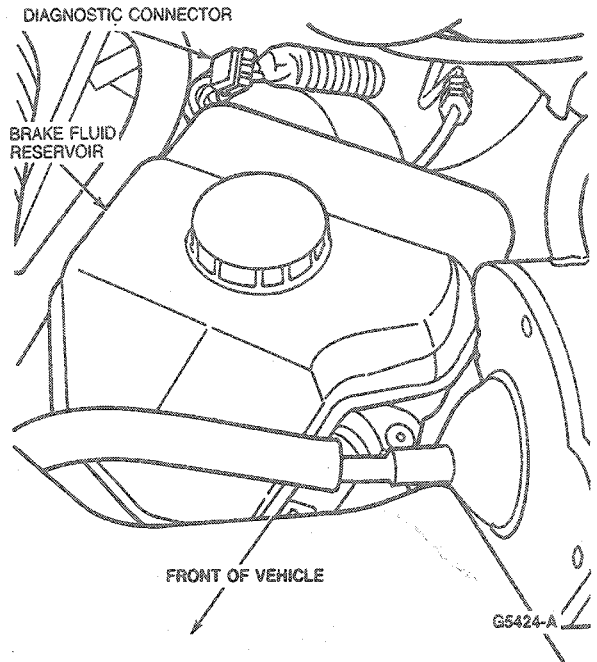


G7187-A

Item	Part Number	Description
1	156 (GY / O)	Stepper Motor
2	563 (O / Y)	Ground
3	—	Not Used
4	57 (BK)	Ground
5	57 (BK)	Ground
6	—	Not Used
7	57 (BK)	Ground
8	606 (W / LB)	VAPS Test Connector
9	155 (GY / R)	Stepper Motor
10	150 (DG / W)	Vehicle Speed Sensor (VSS) 9E731
11	154 (P / LG)	Stepper Motor
12	153 (P / Y)	Stepper Motor
13	200 (BR)	VAPS Test Connector
14	298 (P / O)	Hot in RUN

DIAGNOSIS AND TESTING (Continued)

A diagnostic connector is located in the engine compartment near the brake fluid reservoir and brake booster.

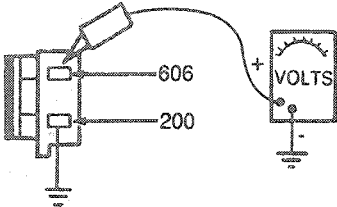


**PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS**

TEST STEP		RESULT	ACTION TO TAKE
A1	<p>MODULE CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Locate test connector 14489 in engine compartment near brake booster. ● Connect DVOM positive lead (R) to Circuit 606 and negative lead (BK) to vehicle ground. <p>The diagram shows a DVOM (Digital Volt-Ohm Meter) with its positive lead (R) connected to terminal 606 and its negative lead (BK) connected to terminal 200. The meter is labeled 'G5315-A'.</p> <ul style="list-style-type: none"> ● Position DVOM where it can be observed. ● Start engine. ● Observe voltage reading on DVOM. 	<p>Voltage reads 11-14 volts</p> <p>Voltage reads zero</p> <p>Voltage reads above 14 volts</p>	<p>▶ GO to A2.</p> <p>▶ GO to A3.</p> <p>▶ CORRECT over-voltage condition then GO to A2.</p>

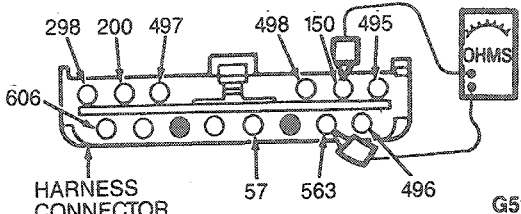
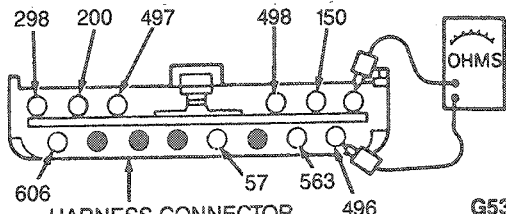
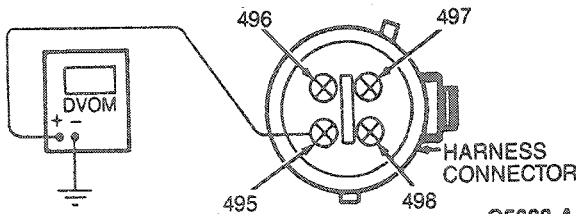
DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A2	MODULE CHECK		
	<ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Connect an analog voltmeter as in Step A1. ● Use jumper wire and ground Circuit 200.  <p style="text-align: center;">G5320-A</p> <ul style="list-style-type: none"> ● Start engine. ● Rotate steering wheel for approximately 90 seconds noting any changes in steering effort. The effort required to turn the steering wheel should vary between light and heavy in both directions. ● After approximately 90 seconds, voltmeter will show a sweep pattern four times between battery voltage and zero if module proveout is OK. Six or zero sweeps if a system component is malfunctioning. After a five second pause, the sweep pattern will be repeated. ● Remove Circuit 200 ground before proceeding to next test. 	<ul style="list-style-type: none"> ▶ Effort changes with 2 sweeps ▶ No effort change with 2 sweeps ▶ Effort change with 4 sweeps ▶ No effort change with 4 sweeps ▶ Effort change with 6 sweeps ▶ No effort change with 6 sweeps ▶ Effort change with 0 sweeps ▶ No effort change with 0 sweeps 	<ul style="list-style-type: none"> ▶ GO to A4. ▶ GO to A7. ▶ GO to A19. ▶ GO to A19. ▶ GO to A20. ▶ GO to A12. ▶ GO to A20. ▶ GO to A12.
A3	FUSE CHECK		
	<ul style="list-style-type: none"> ● Inspect fuse located in fuse panel on LH side below instrument panel. ● Is fuse OK? 	<ul style="list-style-type: none"> ▶ Yes ▶ No 	<ul style="list-style-type: none"> ▶ GO to A16. ▶ REPLACE fuse. GO to A1.
A4	TEST DRIVE VEHICLE		
	<ul style="list-style-type: none"> ● Ensure VAPS system is connected. ● Drive vehicle up to 55 mph and set speed control. ● Do steering efforts change and is effort balanced (left vs. right turn direction)? ● While driving vehicle, note operation of speedometer. 	<ul style="list-style-type: none"> ▶ Change in steering effort ▶ Assist only at high speed ▶ No change in steering effort ▶ Efforts unbalanced left to right 	<ul style="list-style-type: none"> ▶ Diagnostics complete. System is OK. ▶ GO to A11. ▶ GO to A5. ▶ REPLACE steering gear assembly. REPEAT A4.
A5	SPEEDOMETER CHECK		
	<ul style="list-style-type: none"> ● Note operation of speedometer and speed control (from Step A4). ● Are speedometer and speed control operating properly? ● The VAPS system requires a speed signal from the vehicle speed sensor. If the speedometer or speed control does not work, these systems should be serviced using the appropriate diagnostic and service procedures. 	<ul style="list-style-type: none"> ▶ Yes ▶ No 	<ul style="list-style-type: none"> ▶ GO to A6. ▶ SERVICE as required. GO to A4.

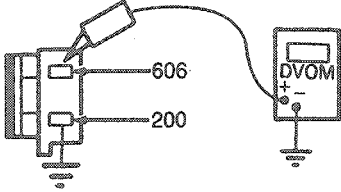
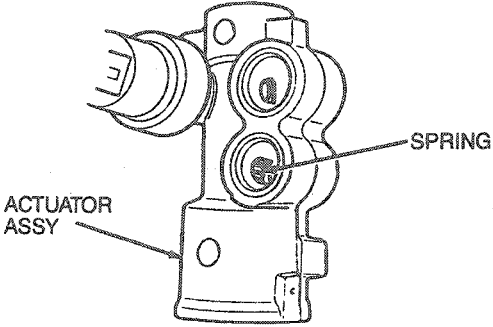
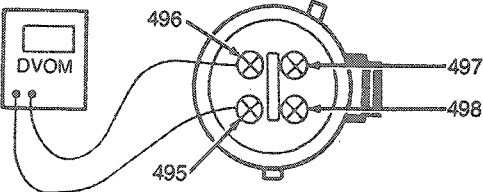
DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)

TEST STEP	RESULT	ACTION TO TAKE
<p>A6 SPEED SENSOR CIRCUIT CHECK</p> <ul style="list-style-type: none"> ● Disconnect VAPS connector from module. ● Connect DVOM across Circuits 150 and 563. ● Measure resistance.  <p style="text-align: right;">G5321-A</p>	<p>Resistance is between 150-225 ohms</p> <p>Resistance is less than 150 or greater than 225 ohms</p>	<p>▶ REPLACE VAPS module. GO to A4.</p> <p>▶ SERVICE harness. GO to A4.</p>
<p>A7 ACTUATOR (ELECTRICAL) CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Disconnect VAPS harness connector from module. ● Connect DVOM to Circuits 495 and 496. ● Measure resistance.  <p style="text-align: right;">G5322-A</p> <ul style="list-style-type: none"> ● Connect DVOM to Circuits 497 and 498. ● Measure resistance. 	<p>Resistance between 43 and 70 ohms</p> <p>Resistance less than 43 or greater than 70 ohms</p>	<p>▶ GO to A8.</p> <p>▶ GO to A10.</p>
<p>A8 HARNESS VOLTAGE AT ACTUATOR CONNECTOR</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Verify that VAPS connector is connected to VAPS module. ● Disconnect actuator connector from VAPS harness connector. ● Turn ignition switch to RUN. ● Wait five seconds. ● Measure DC voltage between Circuit 495 and ground. Then measure voltage between Circuit 496 and ground. ● One of these two circuits should be greater than 10 volts and the other less than 2 volts. ● Repeat the two steps above for Circuit 497 and 498. ● Do voltage readings check OK?  <p style="text-align: right;">G5323-A</p>	<p>Yes</p> <p>No</p>	<p>▶ GO to A9.</p> <p>▶ REPLACE VAPS module. GO to A2.</p>

DIAGNOSIS AND TESTING (Continued)

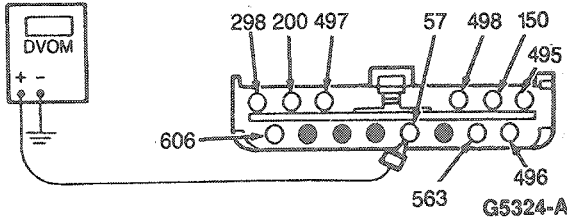
**PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)**

TEST STEP	RESULT	ACTION TO TAKE
<p>A9 ACTUATOR (MECHANICAL) CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Remove actuator as outlined. ● Reconnect actuator connector to VAPS harness connector. ● Attach DVOM to diagnostic connector (near brake booster) as shown.  <p align="center">G5315-A</p> <ul style="list-style-type: none"> ● Turn ignition switch to ON. ● The module will go through a diagnostic check, consisting initially of the 90 second efforts change sequence. ● If the actuator is mechanically operable, the actuator valve will move between its two limits of travel. This movement can be detected by watching the valve spring expand and relax between the travel limits. ● Does spring move?  <p align="center">G5316-A</p>	<p>Yes</p> <p>No</p>	<p>▶ REPLACE steering gear assembly. GO to A2.</p> <p>▶ REPLACE actuator. GO to A2.</p>
<p>A10 ACTUATOR (ELECTRICAL) CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Disconnect actuator connector from harness connector. ● Connect DVOM to Circuits 495 and 496. ● Measure resistance.  <p align="center">G5317-A</p> <ul style="list-style-type: none"> ● Connect DVOM to Circuit 497 and 498. ● Measure resistance. 	<p>Resistance between 43 and 70 ohms</p> <p>Resistance less than 43 or greater than 70 ohms</p>	<p>▶ GO to A11.</p> <p>▶ REPLACE actuator. GO to A2.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A
 VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)

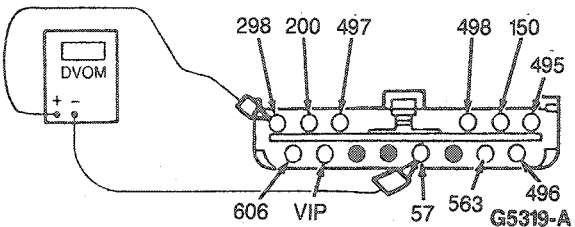
TEST STEP		RESULT	ACTION TO TAKE
A11	<p>CONTINUITY CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Disconnect module connector from module. ● Disconnect actuator connector from actuator. ● Check continuity of Circuit 495 from module connector to actuator connector. ● Repeat for Circuits 296, 497 and 498. ● Do all circuits check OK? 	<p>Yes</p> <p>No</p>	<p>▶ GO to A9.</p> <p>▶ SERVICE harness. GO to A2.</p>
A12	<p>VAPS HARNESS AND CONNECTORS CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Disconnect VAPS connector from module. ● Connect positive lead of DVOM to Circuit 57 and negative lead to ground. ● Measure resistance. ● Is resistance greater than 15 ohms? 	<p>No</p> <p>Yes</p>	<p>▶ GO to A13.</p> <p>▶ SERVICE harness. REPEAT A12.</p>



NOTE: All doors and hood must be closed for proper resistance readings.

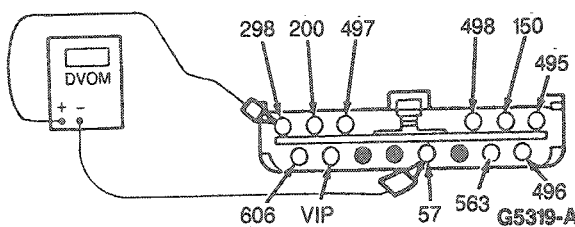
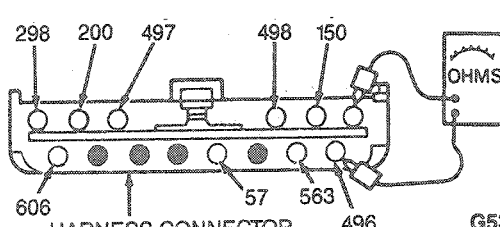
DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)**

TEST STEP		RESULT	ACTION TO TAKE																																																
A13	VAPS HARNESS AND CONNECTORS CHECK																																																		
<ul style="list-style-type: none"> ● Disconnect VAPS connector from module. ● Connect DVOM as shown.  <ul style="list-style-type: none"> ● Turn ignition switch to ON. ● Measure voltage at each circuit (Circuit 57 to ground). ● Are voltage readings near given values? <table border="1" data-bbox="68 786 748 1236"> <thead> <tr> <th>Row</th> <th>Circuit</th> <th>Function</th> <th>Volts (DC)</th> </tr> </thead> <tbody> <tr> <td>Top</td> <td>298</td> <td>Power</td> <td>Battery</td> </tr> <tr> <td>Top</td> <td>200</td> <td>Diagnostic</td> <td><.1</td> </tr> <tr> <td>Top</td> <td>497</td> <td>Actuator</td> <td><.1</td> </tr> <tr> <td>Top</td> <td>498</td> <td>Actuator</td> <td><.1</td> </tr> <tr> <td>Top</td> <td>150</td> <td>Speed Sensor</td> <td>—</td> </tr> <tr> <td>Top</td> <td>495</td> <td>Actuator</td> <td><.1</td> </tr> <tr> <td>Bottom</td> <td>606</td> <td>Diagnostic</td> <td><.1</td> </tr> <tr> <td>Bottom</td> <td>57</td> <td>Ground</td> <td><.1</td> </tr> <tr> <td>Bottom</td> <td>563</td> <td>Speed Sensor</td> <td>—</td> </tr> <tr> <td>Bottom</td> <td>496</td> <td>Actuator</td> <td><.1</td> </tr> <tr> <td>Bottom</td> <td>—</td> <td>VIP</td> <td><.1</td> </tr> </tbody> </table>		Row	Circuit	Function	Volts (DC)	Top	298	Power	Battery	Top	200	Diagnostic	<.1	Top	497	Actuator	<.1	Top	498	Actuator	<.1	Top	150	Speed Sensor	—	Top	495	Actuator	<.1	Bottom	606	Diagnostic	<.1	Bottom	57	Ground	<.1	Bottom	563	Speed Sensor	—	Bottom	496	Actuator	<.1	Bottom	—	VIP	<.1	Yes No	GO to A14. SERVICE harness. REPEAT A13.
Row	Circuit	Function	Volts (DC)																																																
Top	298	Power	Battery																																																
Top	200	Diagnostic	<.1																																																
Top	497	Actuator	<.1																																																
Top	498	Actuator	<.1																																																
Top	150	Speed Sensor	—																																																
Top	495	Actuator	<.1																																																
Bottom	606	Diagnostic	<.1																																																
Bottom	57	Ground	<.1																																																
Bottom	563	Speed Sensor	—																																																
Bottom	496	Actuator	<.1																																																
Bottom	—	VIP	<.1																																																

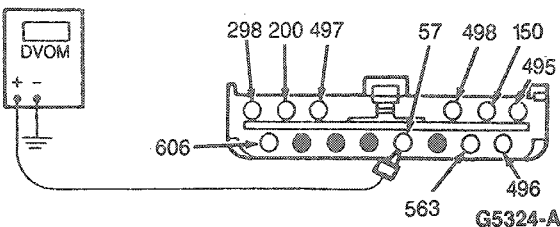
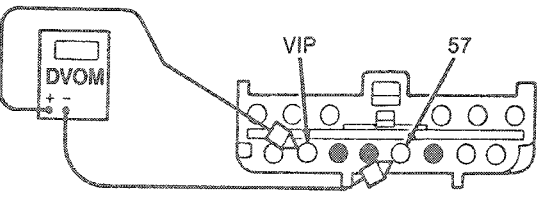
DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)**

TEST STEP	RESULT	ACTION TO TAKE																																												
<p>A14 VAPS HARNESS AND CONNECTORS CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Measure resistance between Circuit 57 ground and all other indicated circuits. ● Connect DVOM as shown.  <ul style="list-style-type: none"> ● Measure resistance of each circuit, by moving positive lead. ● Is resistance near given values? <table border="1" data-bbox="133 817 808 1226"> <thead> <tr> <th>Row</th> <th>Circuit</th> <th>Function</th> <th>Typical Value (ohm)</th> </tr> </thead> <tbody> <tr><td>Top</td><td>298</td><td>Power</td><td>3.6</td></tr> <tr><td>Top</td><td>200</td><td>Diagnostic</td><td>Open</td></tr> <tr><td>Top</td><td>497</td><td>Actuator</td><td>Open</td></tr> <tr><td>Top</td><td>498</td><td>Actuator</td><td>Open</td></tr> <tr><td>Top</td><td>150</td><td>Speed Sensor</td><td>195</td></tr> <tr><td>Top</td><td>495</td><td>Actuator</td><td>Open</td></tr> <tr><td>Bottom</td><td>606</td><td>Diagnostic</td><td>Open</td></tr> <tr><td>Bottom</td><td>563</td><td>Speed Sensor</td><td>0.6</td></tr> <tr><td>Bottom</td><td>496</td><td>Actuator</td><td>Open</td></tr> <tr><td>Bottom</td><td>—</td><td>VIP</td><td>Open</td></tr> </tbody> </table>	Row	Circuit	Function	Typical Value (ohm)	Top	298	Power	3.6	Top	200	Diagnostic	Open	Top	497	Actuator	Open	Top	498	Actuator	Open	Top	150	Speed Sensor	195	Top	495	Actuator	Open	Bottom	606	Diagnostic	Open	Bottom	563	Speed Sensor	0.6	Bottom	496	Actuator	Open	Bottom	—	VIP	Open	<p>Yes</p> <p>No</p>	<p>▶ GO to A15.</p> <p>▶ SERVICE harness. GO to A2.</p>
Row	Circuit	Function	Typical Value (ohm)																																											
Top	298	Power	3.6																																											
Top	200	Diagnostic	Open																																											
Top	497	Actuator	Open																																											
Top	498	Actuator	Open																																											
Top	150	Speed Sensor	195																																											
Top	495	Actuator	Open																																											
Bottom	606	Diagnostic	Open																																											
Bottom	563	Speed Sensor	0.6																																											
Bottom	496	Actuator	Open																																											
Bottom	—	VIP	Open																																											
<p>A15 ACTUATOR (ELECTRICAL) CHECK</p> <ul style="list-style-type: none"> ● Connect VOM to Circuit 495 and 496. ● Measure resistance.  <ul style="list-style-type: none"> ● Connect VOM to Circuit 497 and 498. ● Measure resistance. 	<p>Resistance between 43 and 70 ohms</p> <p>Resistance less than 43 or greater than 70 ohms</p>	<p>▶ REPLACE VAPS module. GO to A2.</p> <p>▶ SERVICE harness or connectors. GO to A2.</p>																																												

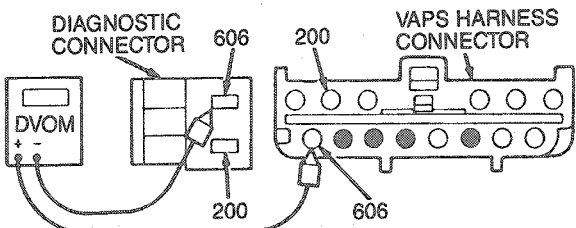
DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)

TEST STEP	RESULT	ACTION TO TAKE
<p>A16 VAPS HARNESS AND CONNECTORS CHECK</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Disconnect VAPS connector from module. ● Connect positive lead of DVOM to Circuit 57 and negative lead to ground. ● Measure resistance. ● Is resistance greater than 15 ohms?  <p>NOTE: All doors and hood must be closed for proper resistance readings.</p>	<p>No</p> <p>Yes</p>	<p>▶ GO to A17.</p> <p>▶ SERVICE harness. GO to A1.</p>
<p>A17 VAPS HARNESS AND CONNECTORS CHECK</p> <ul style="list-style-type: none"> ● Connect positive lead of DVOM to Circuit 298 and negative lead to Circuit 57. ● Turn ignition switch to ON. ● Measure voltage. ● Turn ignition switch to OFF. ● Does DVOM read 12 volts? 	<p>Yes</p> <p>No</p>	<p>▶ GO to A18.</p> <p>▶ SERVICE harness. GO to A1.</p>
<p>A18 CONTINUITY CHECK</p> <ul style="list-style-type: none"> ● Check continuity of Circuit 606 from diagnostic connector to module connector. ● Is Circuit 606 OK? 	<p>Yes</p> <p>No</p>	<p>▶ REPLACE module. GO to A1.</p> <p>▶ SERVICE Circuit 606. GO to A1.</p>
<p>A19 VAPS HARNESS AND CONNECTORS CHECK (VIP PIN)</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Doors and hood must be closed for proper reading. ● Connect DVOM as shown. ● Measure resistance between Circuit 57 (ground) and VIP Pin 7. Typical resistance is infinite. ● Measure voltage between Circuit 57 (ground) and VIP Pin 7. Typical voltage is less than 0.1 volt. ● Is resistance and voltage near given values? 	<p>Yes</p> <p>No</p>	<p>▶ GO to A4.</p> <p>▶ SERVICE harness. GO to A2.</p>

DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST A
VARIABLE ASSIST POWER STEERING ELECTRICAL COMPONENT DIAGNOSIS (Continued)**

	TEST STEP	RESULT	ACTION TO TAKE
A20	<p>VAPS HARNESS AND CONNECTOR CHECK (DIAGNOSTIC CONNECTOR)</p> <ul style="list-style-type: none"> ● Turn ignition switch to OFF. ● Doors and hood must be closed for proper readings. ● Disconnect VAPS harness connector from module. ● Connect DVOM as shown. ● Measure resistance between Circuit 606 of VAPS harness connector and Circuit 606 of diagnostic connector. Typical resistance is 2.0 ohms or less. ● Measure voltage between Circuit 606 of VAPS harness connector and Circuit 606 of diagnostic connector. Typical voltage is less than 0.1. ● Move leads to Circuit 200. Measure resistance between Circuit 200 of VAPS harness connector and Circuit 200 of diagnostic connectors. Typical resistance is 2.0 ohms or less. ● Measure voltage between Circuit 200 of VAPS harness connector and Circuit 200 of diagnostic connector. Typical voltage is less than 0.1 volt. ● Is resistance and voltage near given values?  <p align="right">G6251-A</p>	<p>Yes</p> <p>No</p>	<p>▶ Go to A2.</p> <p>▶ SERVICE harness. GO to A2.</p>

TG5305D

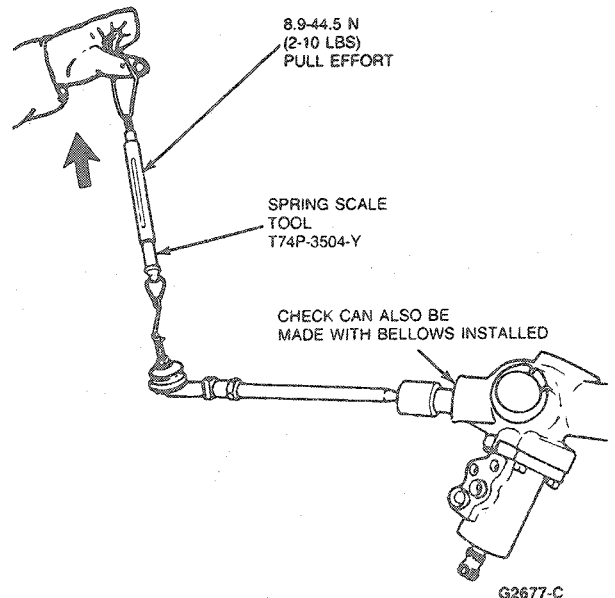
Tie Rod Articulation Torque Check

Tools Required:

- Hook Spring Scale T74P-3504-Y
- Tie Rod End Remover TOOL-3290-D

This check may be done with the gear on or off the vehicle.

1. Disconnect tie rod end from spindle using Tie Rod End Remover TOOL-3290-D or equivalent.
2. Hook Spring Scale T74P-3504-Y over tie rod end and measure force required to move tie rod.
3. If force required to move tie rods is not between 8.9N and 45N (2 lb and 10 lb), replace tie rod.



DIAGNOSIS AND TESTING (Continued)

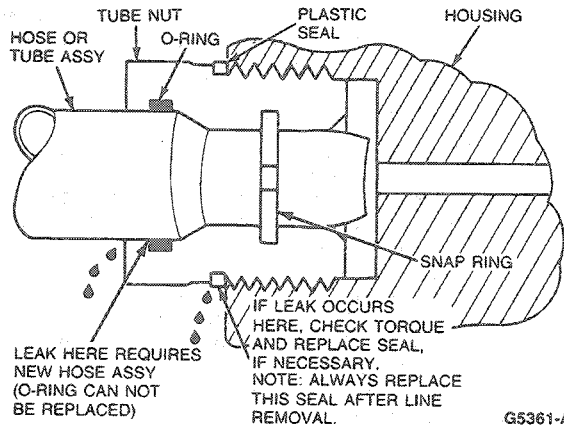
External Leakage

When looking for leaks, use this procedure to pinpoint the exact cause and location to avoid misdiagnosis:

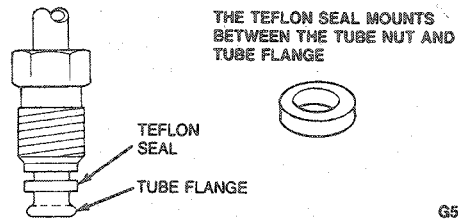
1. Check for overfilled power steering pump reservoir.
2. Wipe suspected area dry.
3. Check for power steering pump overflow and aeration.
4. Check for exact source of oil. Example: Oil may be running down from another area (engine, etc.) and drip may not be leak point.

CAUTION: Do not hold the steering wheel against a stop for more than three to five seconds at a time, as damage to power steering pump may result. Cycle the steering wheel from stop-to-stop 10 times and check for leaks. The bellows may have to be moved back from the housing to see the leak.

5. Some leaks are high-pressure leaks and may require holding steering wheel against stops to seep out.
6. Power steering gear assembly leaks fall into several categories as listed in the Leakage Diagnosis chart. If the leak cannot be serviced by tightening a fitting to the specified torque, replace the gear.



G5361-A



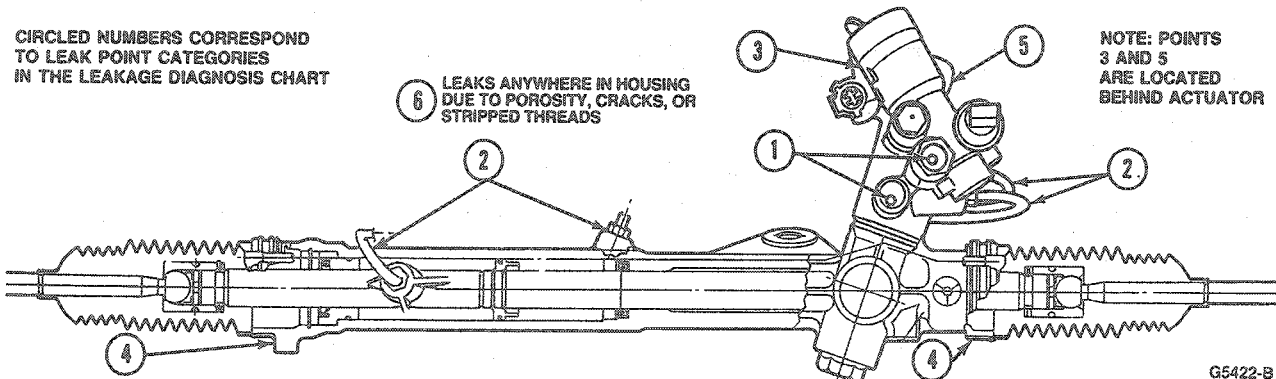
G5362-A

LEAKAGE DIAGNOSIS

Leak Category	Part Required to Service
1. Hose fittings.	a. Loose—Tighten to specification—Do not over-tighten. b. Plastic seals at tube nut—Plastic seals should be replaced each time hose is disconnected.
2. Leak at (right or left) transfer line.	a. Loose—Tighten to specification—Do not over-tighten.
3. Leak at input shaft seal.	a. Replace gear assembly.
4. Leak at either or both bellows.	a. Replace gear assembly
5. Leak at end of input shaft.	a. Replace gear assembly.
6. Housing—porosity, cracked or stripped threads.	a. Replace gear assembly.

TG5423A

CIRCLED NUMBERS CORRESPOND TO LEAK POINT CATEGORIES IN THE LEAKAGE DIAGNOSIS CHART



G5422-B

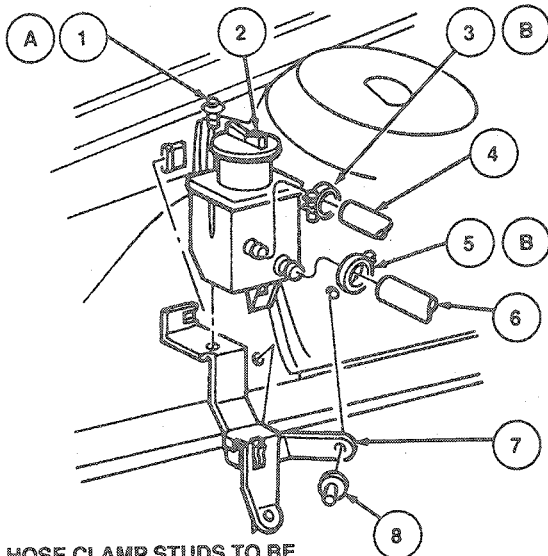
REMOVAL AND INSTALLATION

Remote Reservoir**Removal**

1. Loosen inlet and outlet hose clamps.
2. Remove hoses and allow fluid to drain into a container.
3. Remove retaining screw and reservoir from attachments.

Installation

1. Position reservoir to attachments. Tighten retaining screw to 6-8 N·m (54-70 lb-in).
2. Install hoses. Tighten clamps to 1.4-2 N·m (13-17 lb-in).
3. Fill reservoir to proper level. Refer to Section 11-00.



HOSE CLAMP STUDS TO BE POSITIONED AS SHOWN

G5211-C

Item	Part Number	Description
1A	W611101-S2	Screw
2	3R700	Power Steering Reservoir Assy
3B	390462-S100	Clamp (3 Req'd)
4	3493	Hose
5B	97242-S100	Clamp (2 Req'd)
6	3691	Hose
7	3490	Bracket Assy
8	N803710-S	Rivet (2 Req'd)
A		Tighten to 6-8 N·m (54-70 Lb-In)
B		Tighten to 1.4-2 N·m (13-17 Lb-In)

Power Steering Pump**Removal**

1. Disconnect negative battery cable.

2. Remove engine damper strut. Refer to Section 03-01B.
3. Remove power steering belt.
4. Raise vehicle on hoist. Refer to Section 00-02.
5. Remove right front wheel and tire assembly.
6. Position jack under engine. Remove right rear engine mount. Refer to Section 03-01B.
7. Remove power steering pump pulley.
8. Position drain pan. Remove pressure and return lines from pump.
9. Remove four pump retaining bolts (three in front, one in rear) and remove pump.

Installation

1. Position pump and install retaining bolts. Tighten retaining bolts to 20-32.5 N·m (15-24 lb-ft).
2. Install pressure and return lines to pump. Remove drain pan.
3. Install power steering pump pulley.
4. Install right rear engine mount and remove jack. Refer to Section 03-01B.
5. Install right front wheel and tire assembly. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
6. Lower vehicle.
7. Install belt to pump pulley.
8. Install engine damper strut.
9. Connect negative battery cable.
10. Fill power steering fluid to proper level. Refer to Section 11-00.

Tie Rod End Replacement**Tools Required:**

- Tie Rod End Remover TOOL-3290-D

Steering Gear Installed**Removal**

1. Remove and discard cotter pin and nut from worn tie rod end ball stud.
2. Disconnect tie rod end from steering spindle, using Tie Rod End Remover TOOL-3290-D or equivalent.
3. Hold tie rod end with a wrench and loosen tie rod jam nut.
4. Note depth to which tie rod was located by using the jam nut as a marker. Grip tie rod with a pair of suitable pliers, and remove rod end assembly from tie rod.

Installation

1. Clean tie rod threads.
2. Thread new tie rod end into tie rod to same depth as removed tie rod end.

REMOVAL AND INSTALLATION (Continued)

3. Place tie rod end stud into steering spindle. Ensure front wheels are pointed straight ahead before connecting stud to spindle.
4. Install a new nut on tie rod end stud. Tighten nut to 48 N·m (35 lb-ft), and continue tightening nut to align next castellation of nut with cotter pin hole in stud. Install a new cotter pin.
5. Set toe to specification. Refer to Section 04-00. Tighten jam nut to 47-68 N·m (35-50 lb-ft).

Steering Gear**Except Taurus LX****Removal**

1. From inside vehicle, remove nuts retaining steering shaft weather boot to dash panel.
2. Remove two bolts retaining intermediate shaft to steering column shaft.
3. Set weather boot aside. Remove pinch bolt at steering gear input shaft and remove intermediate shaft.
4. Raise vehicle on a hoist. Refer to Section 00-02.
5. Remove LH front wheel.
6. Remove heat shield.
7. Cut bundling strap retaining hydraulic pressure and return lines to gear.
8. Remove tie rod ends from spindles.

NOTE: The pressure and return lines are on the front of the valve housing. Do not mix them with the transfer lines on the side of the valve.

9. Place a drain pan under vehicle and remove hydraulic pressure and return lines from steering gear.

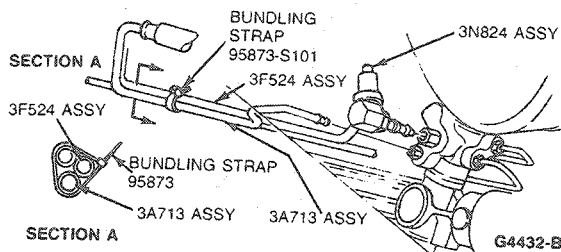
NOTE: The bolts are pressed into the gear housing and should not be removed during gear removal.

10. Remove gear retaining nuts.
11. Push weather boot end into vehicle and lift gear out of mounting holes. Rotate gear so input shaft will pass between brake booster and floorpan. Carefully start working steering gear out through LH fender apron opening.
- NOTE: If steering gear seems to be stuck, check RH rod to ensure stud is not caught on any obstacle.
12. Rotate input shaft so that it clears LH fender apron opening and complete removal of steering gear.

Installation

1. Install new plastic seals on hydraulic line fittings as outlined.

2. Insert steering gear through LH fender apron. Rotate input shaft forward to completely clear fender apron opening. To allow gear to pass between brake booster and floorpan, rotate input shaft rearward.
3. Align steering gear bolts to bolt holes and install retaining nuts. Tighten to 115-135 N·m (85-100 lb-ft).
4. Lower vehicle.
- NOTE: Swivel movement of lines is normal when fittings are properly tightened.
5. From engine compartment, install hydraulic pressure and return lines. Tighten pressure line to 20-35 N·m (15-25 lb-ft), and return line to 20-35 N·m (15-25 lb-ft).
6. Raise vehicle.
7. Secure pressure and return lines to transfer tube with bundling strap as shown.



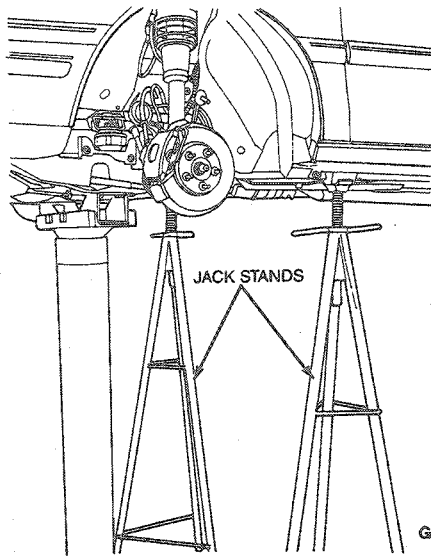
8. Install heat shield.
9. Install tie rod ends to spindles. Tighten castellated nuts to minimum of 48 N·m (35 lb-ft). If necessary, tighten slightly more to align slot in nut for the cotter pin.
10. Install a new cotter pin.
11. Install LH front wheel and lower vehicle.
12. From inside vehicle, pull weather boot end out of vehicle and install over valve housing.
13. From inside vehicle, install intermediate shaft to steering gear input shaft.
14. Install inner weather boot to floorpan.
15. Install intermediate shaft to steering column shaft.
16. Fill power steering system with premium power steering fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent.
17. Check system for leaks and proper operation.
18. Adjust toe setting. Refer to Section 04-00.

Taurus LX and Sable**Removal**

1. From inside vehicle, remove nuts retaining steering shaft weather boot to dash panel.
2. Remove two bolts retaining intermediate shaft to steering column shaft.
3. Set weather boot aside. Remove pinch bolt at steering gear input shaft and remove intermediate shaft.

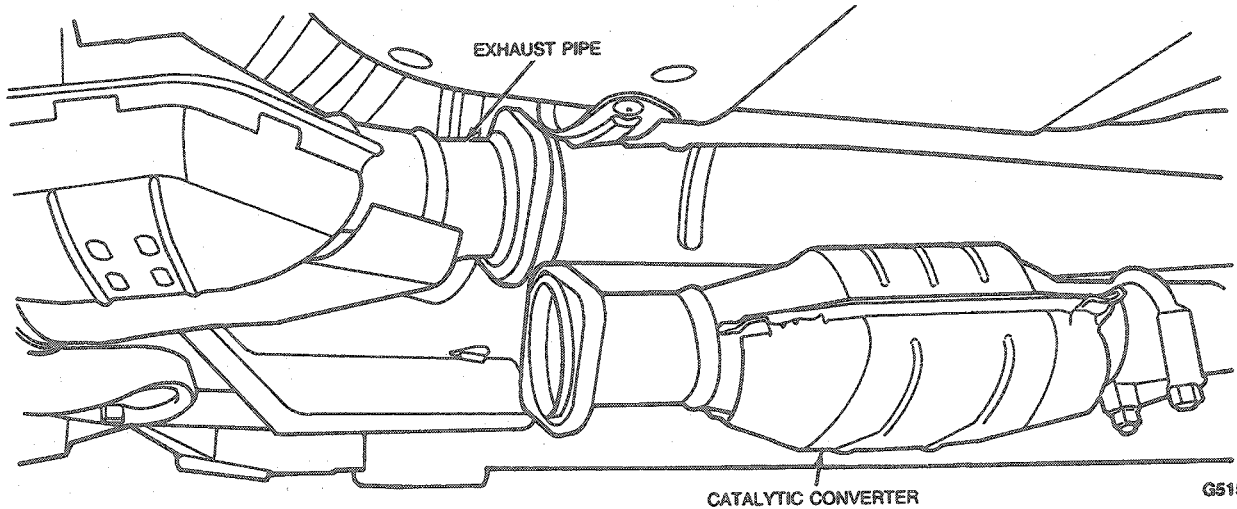
REMOVAL AND INSTALLATION (Continued)

4. Raise vehicle on a twin post hoist and remove front wheel and tire assemblies. Refer to Section 00-02.



G5792-A

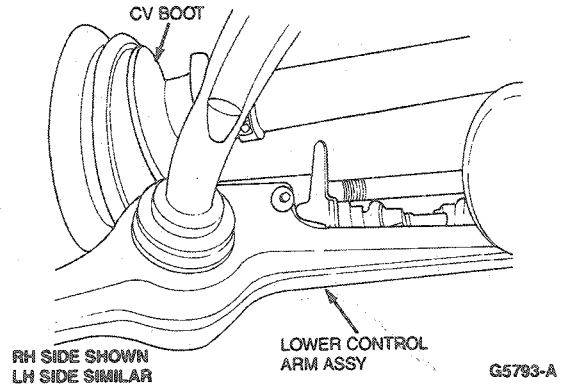
5. Support vehicle with jackstands under rear edge of subframe.



CATALYTIC CONVERTER

G5158-A

6. Remove tie rod cotter pins and nuts, and remove tie rod ends from spindle.
7. Remove tie rod ends from shaft. Mark position of jam nut to maintain alignment.
8. Remove nuts from gear-to-subframe retaining bolts.

RH SIDE SHOWN
LH SIDE SIMILARLOWER CONTROL
ARM ASSY

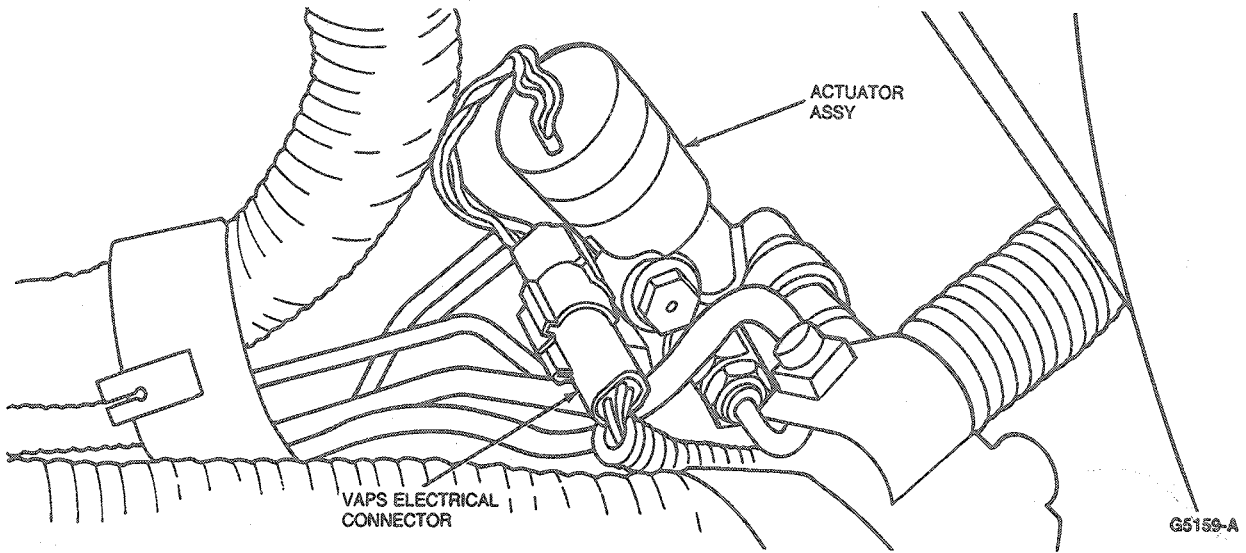
G5793-A

9. Remove rear subframe-to-body retaining bolts.
10. Remove exhaust pipe-to-catalytic converter attachment.

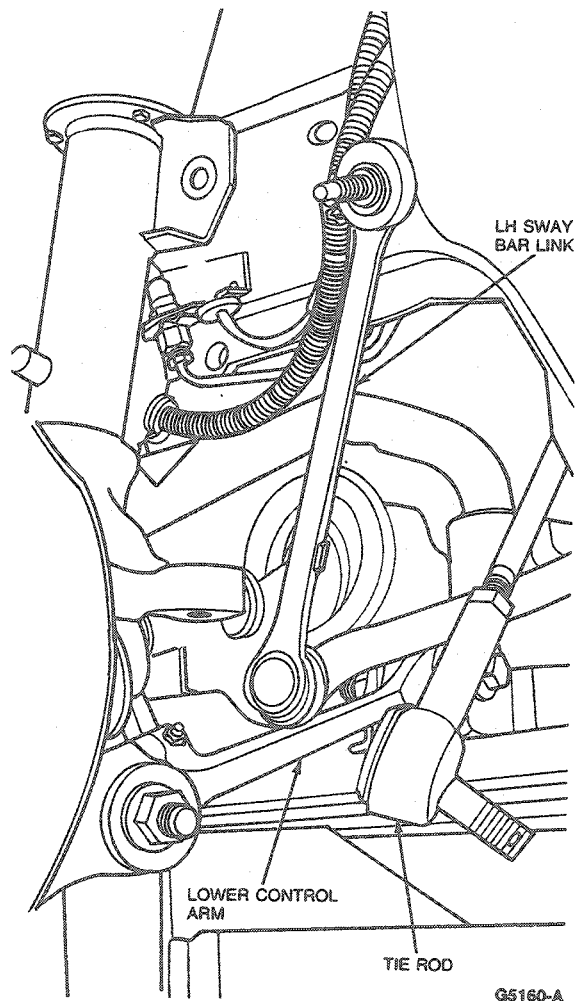
11. Lower twin post hoist carefully until subframe separates from body; approximately four inches.
12. Remove heat shield band and fold shield down.

REMOVAL AND INSTALLATION (Continued)

13. Disconnect VAPS electrical connectors.

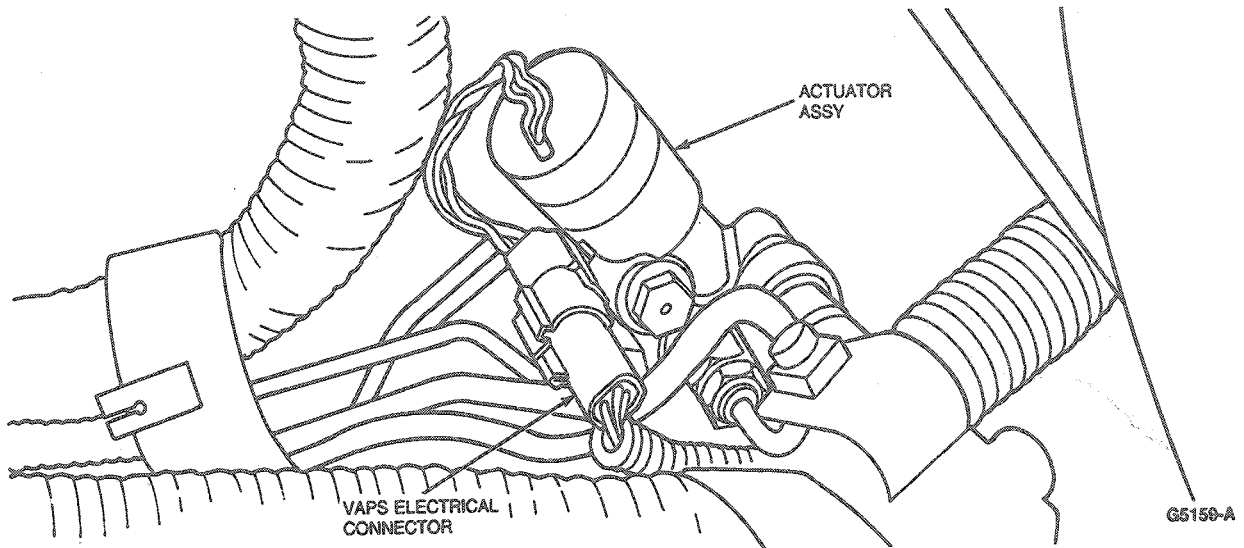


14. Rotate gear to clear bolts from subframe and pull left to facilitate line fitting removal.
15. Place a drain pan under vehicle and remove line fittings.
16. Remove LH sway bar link.
17. Remove gear assembly through LH wheel well.



REMOVAL AND INSTALLATION (Continued)**Installation**

1. Install new TFE O-rings on line fittings as outlined in Pressure and Return Line Seal Replacement.
2. Place gear retaining bolts in gear housing.
3. Install gear through LH wheel well.
4. Install power steering line fittings to gear assembly.
5. Install VAPS electrical connectors.

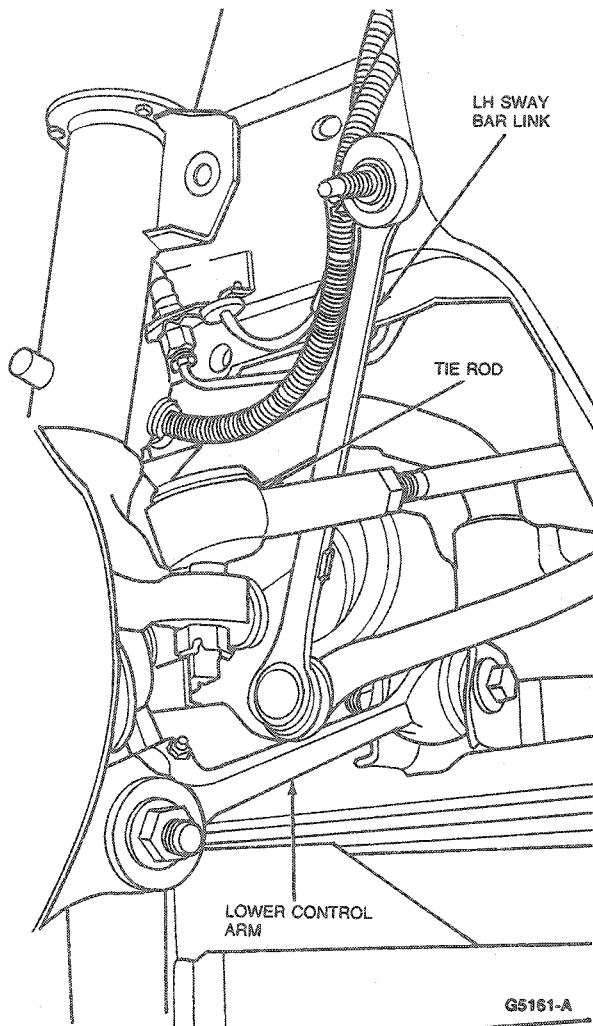


6. Position gear into subframe.
7. Install tie rod ends onto shaft.
8. Install band on heat shield.

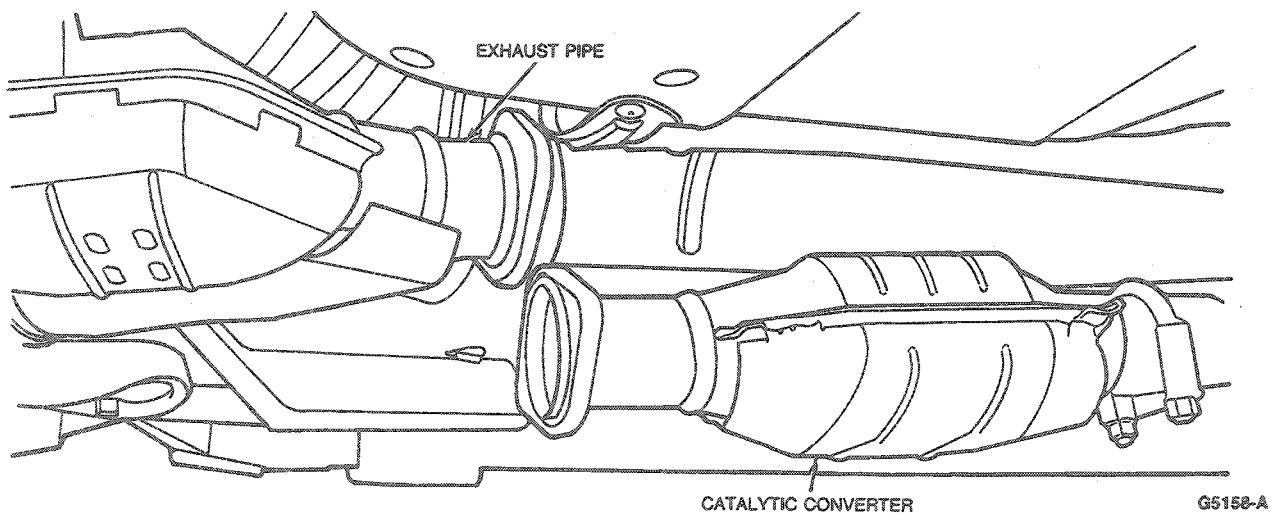
9. Attach tie rod ends to spindle. Install nuts and new cotter pins.

REMOVAL AND INSTALLATION (Continued)

10. Attach sway bar links.



11. Raise hoist until subframe contacts body.
12. Install subframe retaining bolts.
13. Install gear-to-subframe nuts and tighten to 115-135 N·m (85-100 lb-ft).
14. Attach exhaust pipe to catalytic converter.



REMOVAL AND INSTALLATION (Continued)

15. Install tire and wheel assemblies. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
16. Remove jackstands and lower vehicle.
17. From inside vehicle, push weather boot end out of vehicle and install over valve housing.
18. Install intermediate shaft to steering gear input shaft. Tighten bolt to 41-51 N·m (30-38 lb-ft).
19. Install inner weather boot to floorpan.
20. Install intermediate shaft to steering column shaft. Refer to Section 11-04.
21. Fill with premium power steering fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent.
22. Bleed power steering system. Refer to Section 11-00.
23. Check system for leaks and proper operation.
24. Adjust toe setting. Refer to Section 04-00.

Pressure and Return Lines**Taurus/Sable****Removal**

1. Disconnect battery ground cable.
2. Remove remote air cleaner.
3. Disconnect electrical connector in back of radiator fan motor.
4. Disconnect electrical connector from purge valve.
5. Remove radiator fan shroud.
6. Disconnect integrated module harness from headlamp harness and place module on top of engine to provide accessibility to power steering lines.
7. Remove wiring harness guide retaining screws and position guide aside.
8. Remove screw at pressure and return line bracket.
9. Remove anti-rattle clip.

NOTE: Removal of pressure switch may allow for additional tool clearance.

10. Disconnect electrical connector on power steering pressure switch at steering gear.
11. Remove plastic strap attaching tubes to steering gear.
12. Remove pressure line fitting at power steering pump using a 5/8-inch open-end wrench.
13. Loosen clamp and remove return line at pump.
14. Remove return line fitting at steering gear using an 18mm open-end wrench.
15. Remove pressure line fitting at steering gear, using an 11/16-inch open-end wrench.

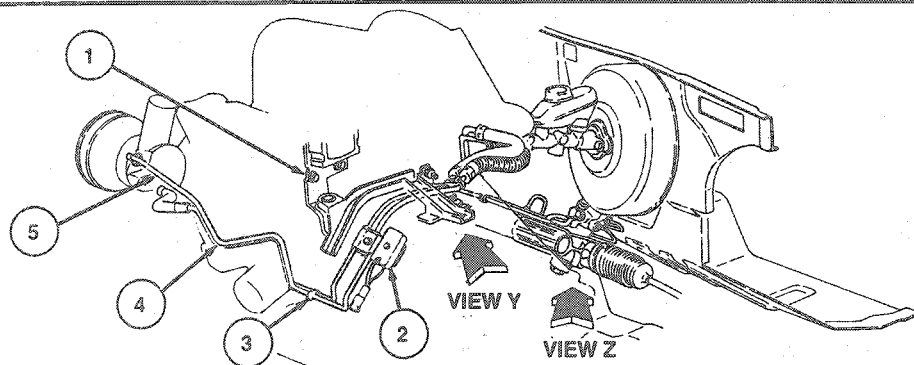
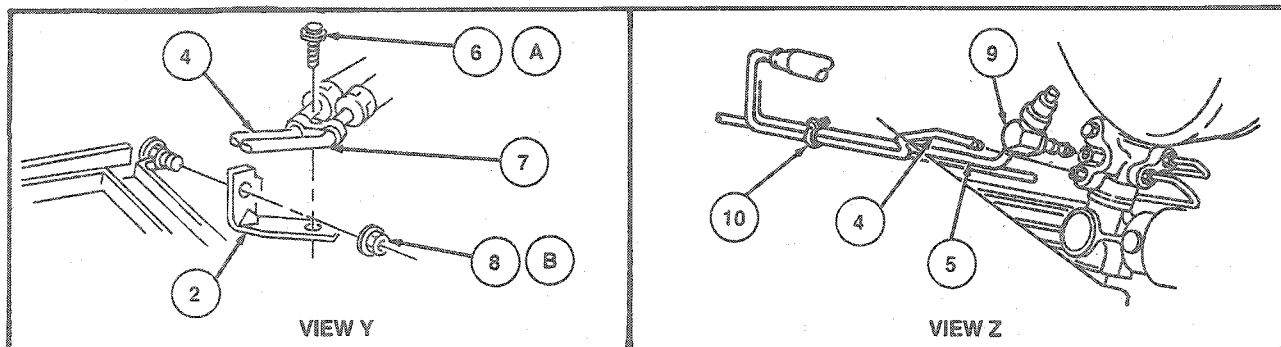
Installation

NOTE: Pressure and return fittings have the same thread size. Ensure the pressure nut (gold color) on line is installed in the pressure port, and that the check valve is properly oriented. The return fitting is silver colored and longer than the pressure line fitting.

1. Position power steering lines in vehicle and connect lines at power steering pump and steering gear. Tighten fitting(s) to 34-46 N·m (26-33 lb-ft). Tighten hose clamps to 1.4-2 N·m (13-17 lb-in).
2. Install screw at pressure and return line bracket.
3. Install anti-rattle clip.
4. Install plastic strap attaching lines to transfer tube on steering gear.
5. Connect power steering pressure electrical connector to switch.
6. Install wiring harness guide.
7. Position integrated module to top of fan shroud and connect module harness to headlamp harness.
8. Install fan shroud.
9. Connect electrical connector to purge valve.
10. Connect electrical connector to radiator fan motor.
11. Install remote air cleaner.
12. Connect battery ground cable.
13. Fill system. Refer to Section 11-00.

REMOVAL AND INSTALLATION (Continued)

3.0L Engine



G4158-E

Item	Part Number	Description
1	12257	Engine Coil Bracket
2	3C510	Bracket Assy
3	38511-S2	Clip
4	3A713	Power Steering Line Assy
5	3F524	Power Steering Line Assy
6A	N610959-S2	Bolt

(Continued)

Item	Part Number	Description
7	3A719	Pressure Hose Assy
8B	N621939-S2	Nut
9	3N824	T-Fitting Assy
10	95873-S101	Retainer
A		Tighten to 4.5-5.7 N·m (40-50 Lb-in)
B		Tighten to 8.1-13 N·m (6-9 Lb-Ft)

Supply Line—Reservoir to Pump

Taurus SHO

Removal

1. Disconnect battery ground cable.
2. Remove engine damper shock. Refer to Section 03-01B.
3. Remove power steering belt.
4. Loosen supply line hose clamp at reservoir and remove hose.
5. Drain fluid into a suitable container.
6. Remove strap retaining supply line to return line.
7. Raise vehicle on hoist. Refer to Section 00-02.
8. Remove RH front wheel and tire.
9. Position adjustable jack under engine.
10. Remove RH rear engine mount. Refer to Section 03-01C.

11. Remove power steering pump pulley.
12. Position drain pan under pump.
13. Disconnect supply line at pump.
14. Remove supply line from vehicle.

Installation

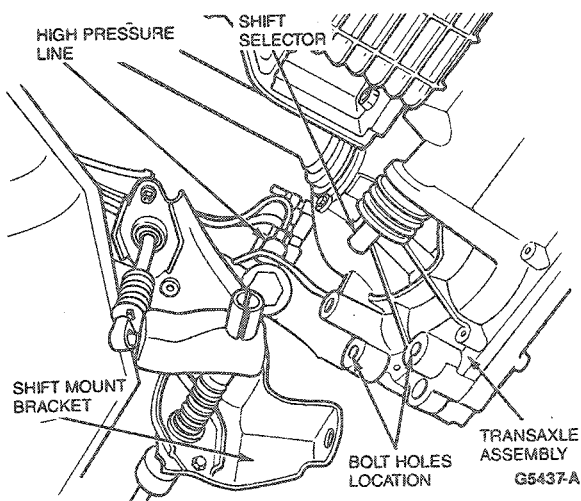
1. Position supply line in vehicle.
2. Connect supply line hose to pump. Tighten hose clamp to 1.4-2 N·m (13-17 lb-in).
3. Install power steering pump pulley.
4. Install RH rear engine mount.
5. Remove jack.
6. Install wheel and tire. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
7. Remove drain pan.
8. Lower vehicle.
9. Install engine damper shock.

REMOVAL AND INSTALLATION (Continued)

10. Install strap to secure supply line to return line.
11. Connect battery ground cable.
12. Fill system. Refer to Section 11-00.

Pressure Line**Taurus SHO****Removal**

1. Disconnect battery ground cable.
2. Remove engine damper shock. Refer to Section 03-01B.
3. Remove power steering belt.
4. Raise vehicle. Refer to Section 00-02.
5. Remove RH front wheel and tire.
6. Position jack under engine.
7. Remove RH rear engine mount. Refer to Section 03-01B.
8. Remove power steering pump pulley.
9. Position drain pan under pump.
10. Remove pressure line fitting at power steering pump.
11. Cut tie straps and remove heat shield around steering gear assembly.
12. Remove shift linkage mount bracket from transaxle to gain access to high pressure line at gear housing.



13. Disconnect electrical connector on power steering pressure switch at steering gear.
14. Remove pressure line fitting at steering gear.
15. Remove high pressure line from vehicle.

Installation

1. Position high pressure line in vehicle and connect line at power steering pump and steering gear.
2. Connect electrical harness to power steering pressure switch.

3. Install shift linkage mount bracket to transaxle.
4. Position heat shield around steering gear assembly and install tie straps.
5. Remove drain pan.
6. Install power steering pump pulley.
7. Install RH rear engine mount.
8. Remove jack.
9. Install wheel and tire. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
10. Lower vehicle.
11. Install power steering belt.
12. Install engine damper shock.
13. Connect battery ground cable.
14. Fill system. Refer to Section 11-00.

Cooler Lines**Steering Gear to Cooler****Taurus SHO****Removal**

1. Disconnect battery ground cable.
2. Raise vehicle. Refer to Section 00-02.
3. Loosen hose clamp at cooler. Disconnect line and drain fluid into a suitable container.
4. Remove shift mount bracket.
5. Cut tie straps and remove heat shield from steering gear.
6. Disconnect hose at steering gear.
7. Lower vehicle.
8. Remove hose from vehicle.

Installation

1. Position hose in vehicle.
2. Raise vehicle.
3. Connect hose at steering gear.
4. Position heat shield and install tie straps.
5. Install shift mount bracket.
6. Connect line to cooler and tighten clamp to 1.4-2 N·m (13-17 lb-in).
7. Lower vehicle.
8. Connect battery ground cable.
9. Fill system. Refer to Section 11-00.

Cooler to Reservoir**Taurus SHO****Removal**

1. Disconnect battery ground cable.
2. Raise vehicle. Refer to Section 00-02.