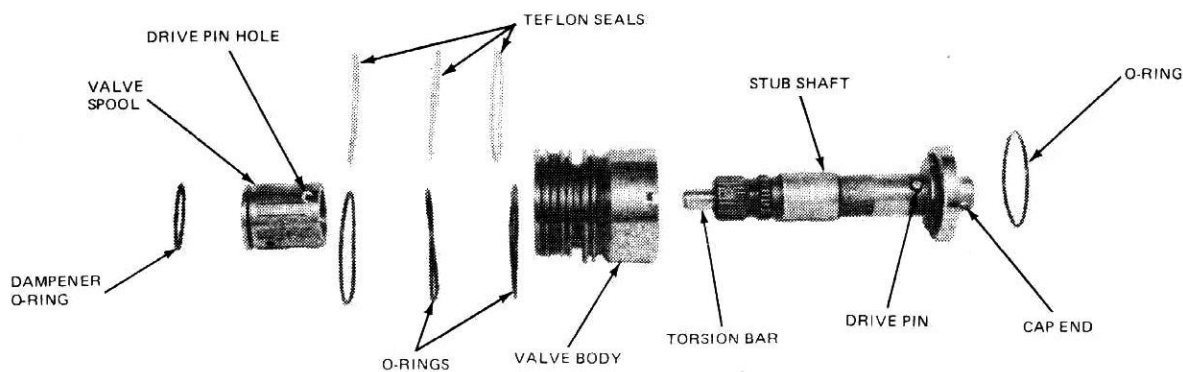
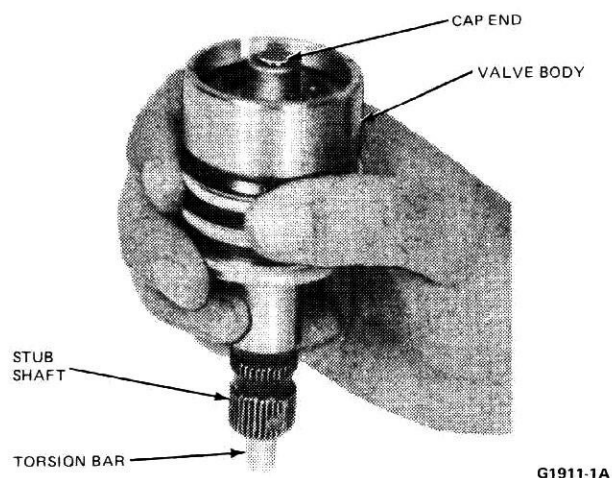




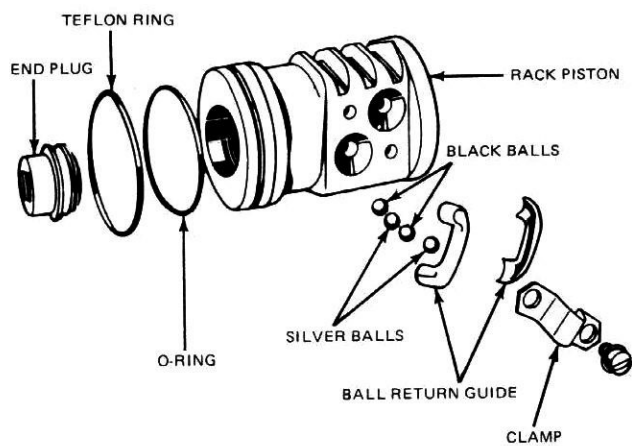
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FIG. 34 Rotary Valve Disassembled



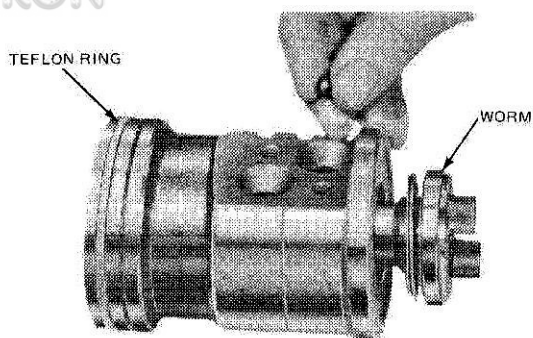
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FIG. 35 Removing Spool from Rotary Valve

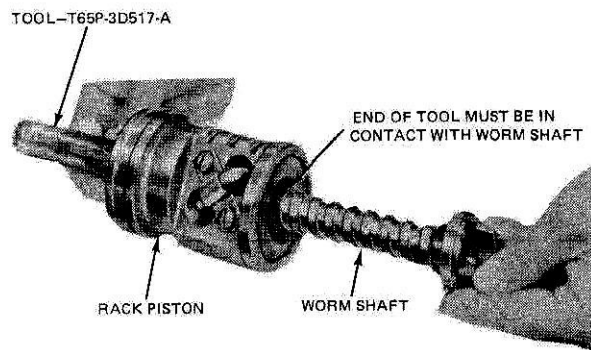


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FIG. 36 Rack Piston Disassembled



G1632-1A



G1631-1A

FIG. 37 Assembling Rack Piston

FIG. 38 Installing Tool in Rack Piston

**SAGINAW INTEGRAL POWER
STEERING GEAR TORQUE LIMITS (FT-LB)**

Description	Torque Limit	Description	Torque Limit
Sector Shaft Cover Bolts	30-45	Piston End Cap	50-100
Mesh Load Adjusting Screw Lock Nut	27-37	Pressure and Return Hoses to Gear	25-34
Ball Return Guide Clamp Screw	3-6	Hose Clamps	1-2
Preload Adjusting Lock Nut	50-110		

**SAGINAW INTEGRAL POWER
STEERING GEAR SPECIFICATIONS**

Description	Constant Ratio
Type	Recirculating Ball Torsion Bar
Ratio	17.5:1
Turns of Steering Wheel (Lock to Lock-Linkage Disconnected)	4
Fluid Specification	C1AZ-19582-A, -C or -D
Fluid Capacity (Included in Reservoir Fill)	1.6 Pt. (Approx.)
Total Meshload Over Worm Bearing Preload	4-8 In-Lb
Total Meshload Over Mechanical Center	18 In-Lb (Max)
Worm Bearing Preload	9 In-Lb (Max)
Worm to Piston Preload	0.5-4.5 In-Lb

**SAGINAW INTEGRAL POWER STEERING
GEAR SPECIAL SERVICE TOOLS**

Tool No.	Description	Tool No.	Description
T59L-100-B	Impact Slide Hammer	T65P-3D525-A	Adjuster Plug Bearing Remover and Installer
T58L-101-A	Puller Attachment	T65P-3D526-A	Adjuster Plug Seal Installer
T65P-3548-A	Oil Line Connector Seat Installer	T65P-3A537-A	Bearing Preload Spanner Wrench
T65P-3576-C	Sector Needle Bearing Remover and Installer Adapter	T65P-3A537-B	Adjuster Plug Seal Protector
T65P-3805-A	Piston Rack Ring Compressor	T65P-3D642-A	Sector Shaft Seal Installer
T65P-3D516-A	Rack Piston Arbor		

Integral Power Rack and Pinion Steering Gear - Ford

PART
13-46

Applies To Fairmont/Zephyr

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENT		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Rack Yoke Bearing Preload	46-12	Steering Gear	46-14
DESCRIPTION		Tie Rod Ends, Bellows and Tie Rod	46-14
Steering Gear	46-1	Ball Joint Sockets	46-14
DIAGNOSIS	46-6	OPERATION	
DISASSEMBLY AND ASSEMBLY		Rotary Valve	46-4
Gear Housing, Rack Yoke Bearing, Rack Assembly, Rack Bushing and Oil Seals	46-23	REMOVAL AND INSTALLATION	
Input Shaft and Valve	46-15	Steering Gear	46-14
		SPECIFICATIONS AND SPECIAL TOOLS	46-29

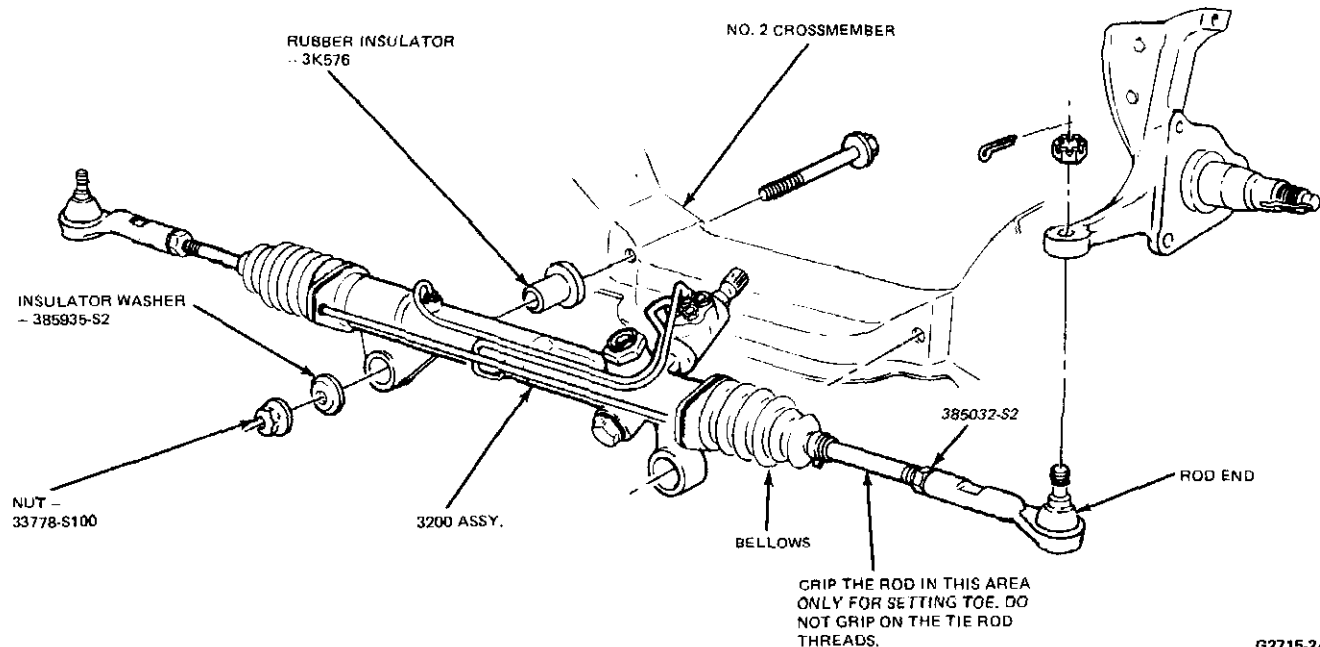
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DESCRIPTION STEERING GEAR

The 1978 Ford integral power rack and pinion gear features variable ratio steering. The gear housing and valve housing are combined into a one-piece aluminum die casting, where previously, the valve housing was bolted on. The new gear design incorporates quick connect fittings for the pressure and return lines which allow the lines to swivel. This is normal and does not indicate undertorqued fittings. If the fittings leak, do not torque the nut, but remove the fittings and replace the

O-rings. Upon reassembly, be careful not to overtorque the fittings. The torque specification is 10-15 ft-lb.

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 (see Figs. 1 and 2).



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FIG. 1 Power Steering Gear Installation—Ford Rack and Pinion

OPERATION

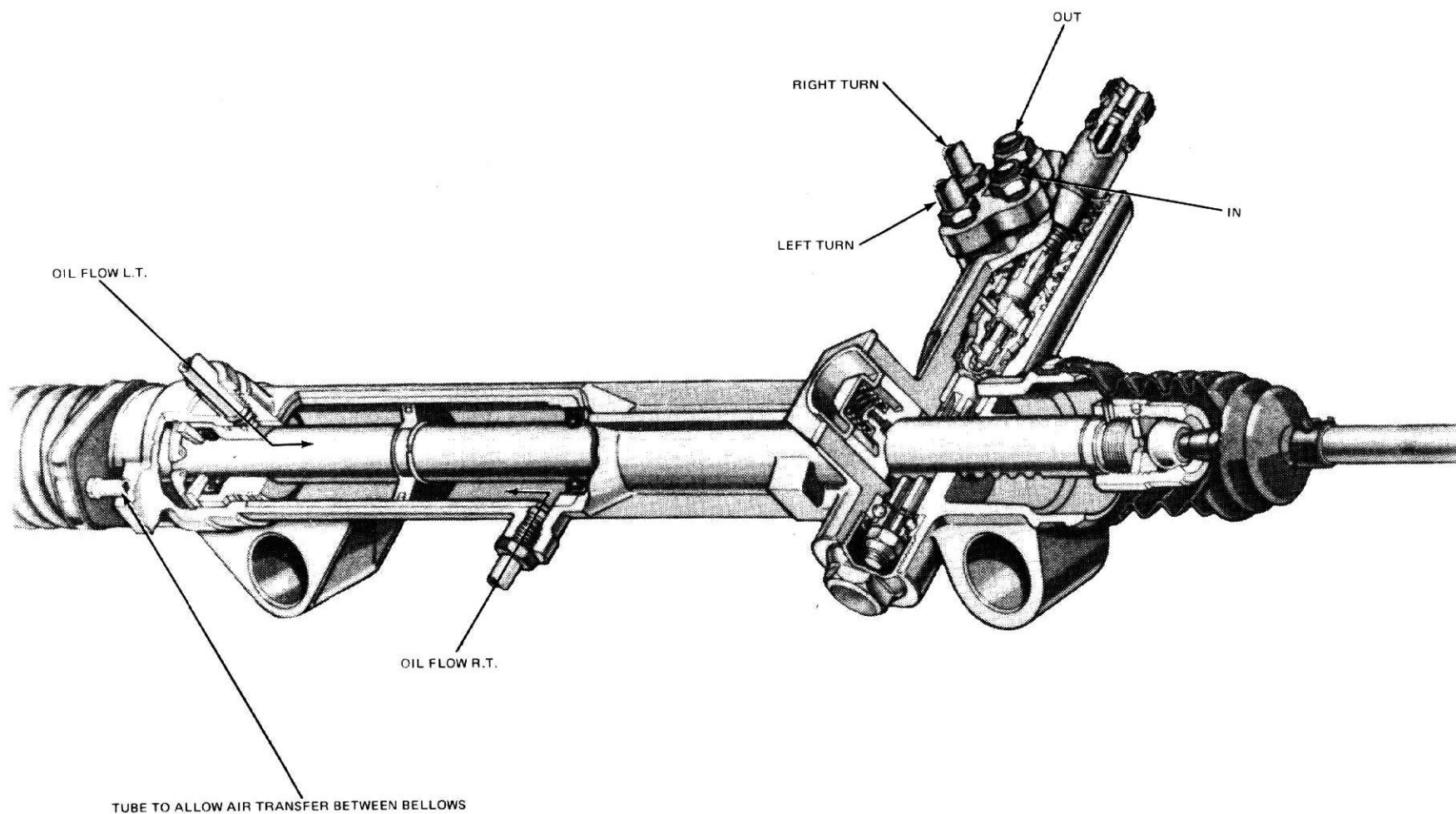
ROTARY VALVE

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

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. Fig. 3 illustrates the hydraulic fluid flow assisting rack movement.

**FIG. 3 Rack Movement**

G2718-2A

DIAGNOSIS

Before any internal service is performed to the rack and pinion power steering, diagnosis must be performed. Make sure that tire size is correct with matched tires (front and rear) inflated to specifica-

tions. The following conditions, possible causes and resolutions will assist in performing the proper repairs:

DIAGNOSIS GUIDE — FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
● Front End Wander Front end wander is a condition that is noticed when the car is driven in a straight ahead position with the wheel held in a firm position, but the car wanders to either the right or left side. Front end alignment should be checked before any gear service is made.	● Tie rod ball socket loose/worn. ● Gear housing loose on No. 2 crossmember. ● Worn pinion bushing in gear housing. ● Loose pinion ball bearing. ● Worn right hand aluminum rack bushing. ● Loose outer ball joints.	● Replace the tie rod/ball socket assembly. ● Tighten mounting bolt nuts (2) to specifications. ● Replace gear housing. ● Replace pinion ball bearing. ● Replace aluminum rack bushing. ● Replace tie rod end assembly.

DIAGNOSIS GUIDE -- FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
● Feedback (Rattle, Chuckle, Knocking Noises in Steering Gear) Feedback is a condition that is noticed when a car is driven over rough pavement and this roughness is felt in the steering wheel by the driver. In addition, if the gear is not adjusted properly, excessive rattle, knocking and/or chuckle noises can be heard inside the car.	● Loose/worn tie rod ball socket. ● Tie rod thrust bearing broken or worn. ● Oversize pinion shaft bushing in the gear housing. ● Gear housing loose on No. 2 crossmember. ● Worn rack bushing. ● Loose pinion bearing locknut. ● Loose pinion bearing cap. ● Loose yoke bearing. ● Broken yoke bearing spring. ● Loose yoke bearing plug. ● Deteriorated shock absorbers.	● Replace tie rod/ball socket assembly. ● Replace tie rod/ball socket assembly. ● Replace gear housing. ● Tighten mounting bolt nuts (2) to specifications. ● Replace rack bushing. ● Tighten pinion bearing locknut to specification. ● Tighten pinion bearing cap to specifications. ● Adjust yoke bearing preload to specifications. ● Replace yoke bearing spring. ● Adjust yoke bearing preload to specification. ● Replace shock absorbers.

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DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
Heavy Steering Efforts, Poor Assist A heavy effort and poor assist condition is recognized by the driver while turning corners and especially while parking. A road test can verify the condition.	- Leakage/loss of fluid due to leaking rack, pinion and/or input shaft seals. - Low steering system fluid level. - Damaged/worn plastic piston O-ring. - Bent rack assembly. - Loose rack piston. - Loose/missing rubber backup piston O-ring. - Undersize pinion shaft bushing in the gear housing. - Rack bushing O-ring and/or rack seal leak. - Valve assembly internal leakage. - Valve plastic O-rings cut or twisted. - Rack bushing snap ring broken or backed out.	- Replace rack seals, pinion seals, and/or input shaft seals. - Add steering fluid to proper level. - Replace plastic piston O-ring. - Replace rack and piston assembly. - Replace rack and piston assembly. - Replace/install rubber backup piston O-ring. - Replace gear housing. - Replace O-ring and rack seal. - Replace input shaft and valve assembly. - Replace plastic O-rings. - Replace rack bushing snap ring.

DIAGNOSIS GUIDE — FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
● Poor Returnability—Sticky Feeling Poor returnability is a condition that is noticed when the vehicle is in a turn and returns to center with effort from the driver. In addition, when the driver returns the steering wheel to center, it may have a sticky or catchy feel.	● Yoke bearing plug too tight. ● Binding in valve assembly. ● Undersize pinion shaft bushing in the gear housing. ● Bent rack assembly. ● Broken gear housing. ● Damaged/failed input shaft support bearing. ● Damaged/failed pinion bearing. ● Misaligned steering column. ● Excessive lash in tie rod ends. ● Binding or looseness in ball joints. ● Deformed engine mounts (results in damage to the steering gear). ● Bent or broken No. 2 crossmember.	● Adjust yoke bearing preload to specification. ● Replace input shaft and valve assembly. ● Replace gear housing. ● Replace rack assembly. ● Replace gear housing. ● Replace input shaft support bearing. ● Replace pinion bearing. ● Align steering column. ● Replace as required. ● Replace as required. ● Inspect and replace as required. ● Inspect and replace as required.

DIAGNOSIS GUIDE — FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
■ Loss of Power Assist When loss of power assist occurs, heavy steering effort is required by the driver to steer the car.	● Piston disengaged from rack or improper depth of piston ring groove. ● Gear housing oil seal leak. ● Damaged gear housing tube. ● Valve seals cut, twisted. ● Rack piston seal cut, twisted. ● Input shaft oil seal failure. ● Rack bushing snap ring broken. ● Leakage from hose fittings.	● Replace rack assembly. ● Replace gear housing oil seals. ● Replace gear housing. ● Replace valve seals. ● Replace rack piston seal. ● Replace input shaft oil seal. ● Replace rack bushing snap ring. ● Tighten hose fittings to specification (10-15 ft.-lbs) and check for crossed or stripped threads. CAUTION: It is normal for the new design fittings to allow hose swivel. Overtightening may cause permanent damage to the pump, gear and hose fittings.

DIAGNOSIS GUIDE — FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
● External Leakage One of the most common conditions causing repeat repairs is fluid leaks. Make sure you clean off the steering gear first before any steering gear external leakage checks are performed.	● O-rings on rack bushing damaged or missing. ● Oil seals damaged or improperly installed: Pinion seal. Rack bushing seal. Input shaft seal. ● Rack bellows twisted, cut, clamps missing, clamps loose or damaged. ● Pressure line O-rings damaged or missing. Pressure fittings not torqued properly. ● Right and left turn P/S lines damaged/broken.	● Replace O-rings. ● Replace oil seals as required. ● Repair, replace as required. ● Replace O-rings and torque to specifications. ● Replace power steering lines.
● Hissing Sound 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.	● Hiss may be expected when the steering wheel is at the end of travel or when turning it at standstill.	● Hiss is a normal characteristic of rotary steering gears and in no way affects steering. Do not replace the input shaft and valve assembly unless the hiss is extremely objectionable. A replacement valve 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. Be sure steering column shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates.

ADJUSTMENTS

The power rack and pinion steering gear provides for only one service adjustment. The gear must be removed from the vehicle to perform this adjustment. Refer to section on Gear Removal.

RACK YOKE BEARING PRELOAD

1. Clean the exterior of the steering gear thoroughly.
2. Install two long bolts and washers through the bushings and attach to the bench mounted holding fixture, Tool T57L-500-B (Fig. 4).
3. Remove external pressure lines from gear to allow access to yoke plug locknut.
4. Drain the power steering fluid by rotating the input shaft lock-to-lock twice using Tool T74P-3504-R. (Cover ports on valve housing with shop cloth while draining gear).
5. Insert an in-lb torque wrench (max. capacity 30-60 in-lbs) into the input shaft torque adapter, Tool T74P-3504-R. Position the adapter and wrench on the input shaft splines.
6. Loosen the yoke plug locknut with wrench, Tool T78P-3504-H (Fig. 5).
7. Loosen yoke plug with a 3/4" socket wrench.
8. With the rack at the center of travel, tighten the yoke plug to 45-50 in-lb (Fig. 6). Clean the threads of the yoke plug prior to torquing to prevent a false reading.
9. Back off the yoke plug approximately 1/8 turn (42 degrees min.-45 degrees max.) until the torque required to initiate and sustain rotation of the input shaft is 7-18 in-lbs.
10. Place Tool T78P-3504-H on the yoke plug locknut. While holding the yoke plug, torque the locknut to specification (Fig. 5). **DO NOT ALLOW THE YOKE PLUG TO MOVE WHILE TORQUING OR THE PRELOAD WILL BE AFFECTED.** Recheck input shaft torque after tightening locknut.
11. Remove all tools and reinstall the external pressure line assemblies, making sure the O-rings are in good shape. Torque the fittings to specifications.

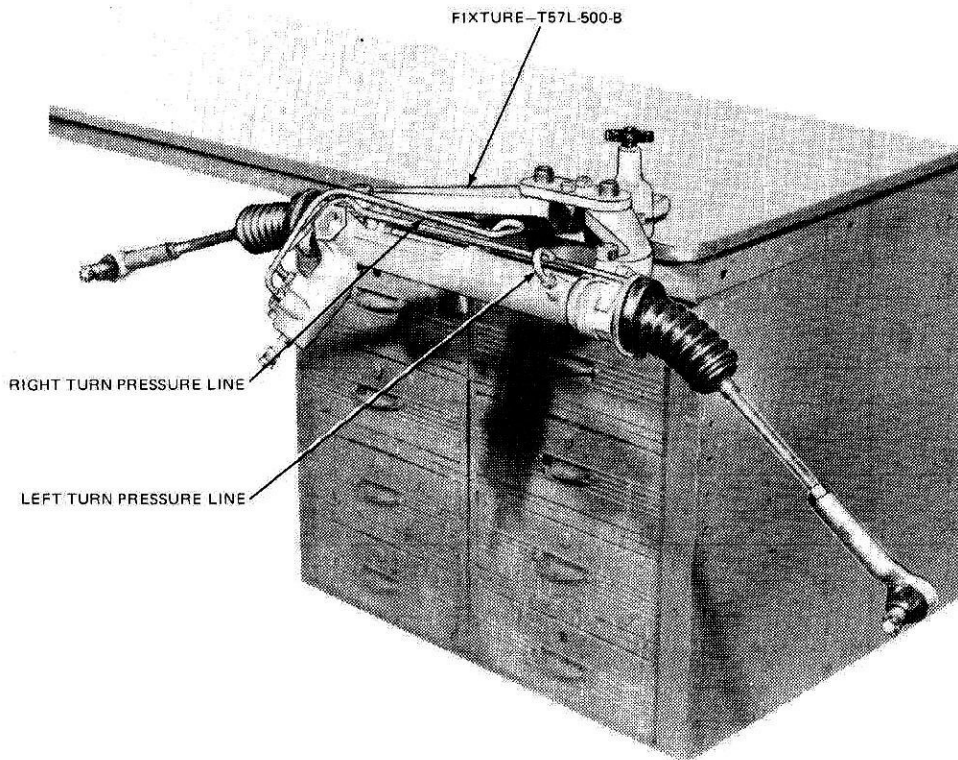


FIG. 4 Holding Fixture, Tool T57L-500-B