

# SECTION 14: STEERING

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## 1. STEERING SYSTEM

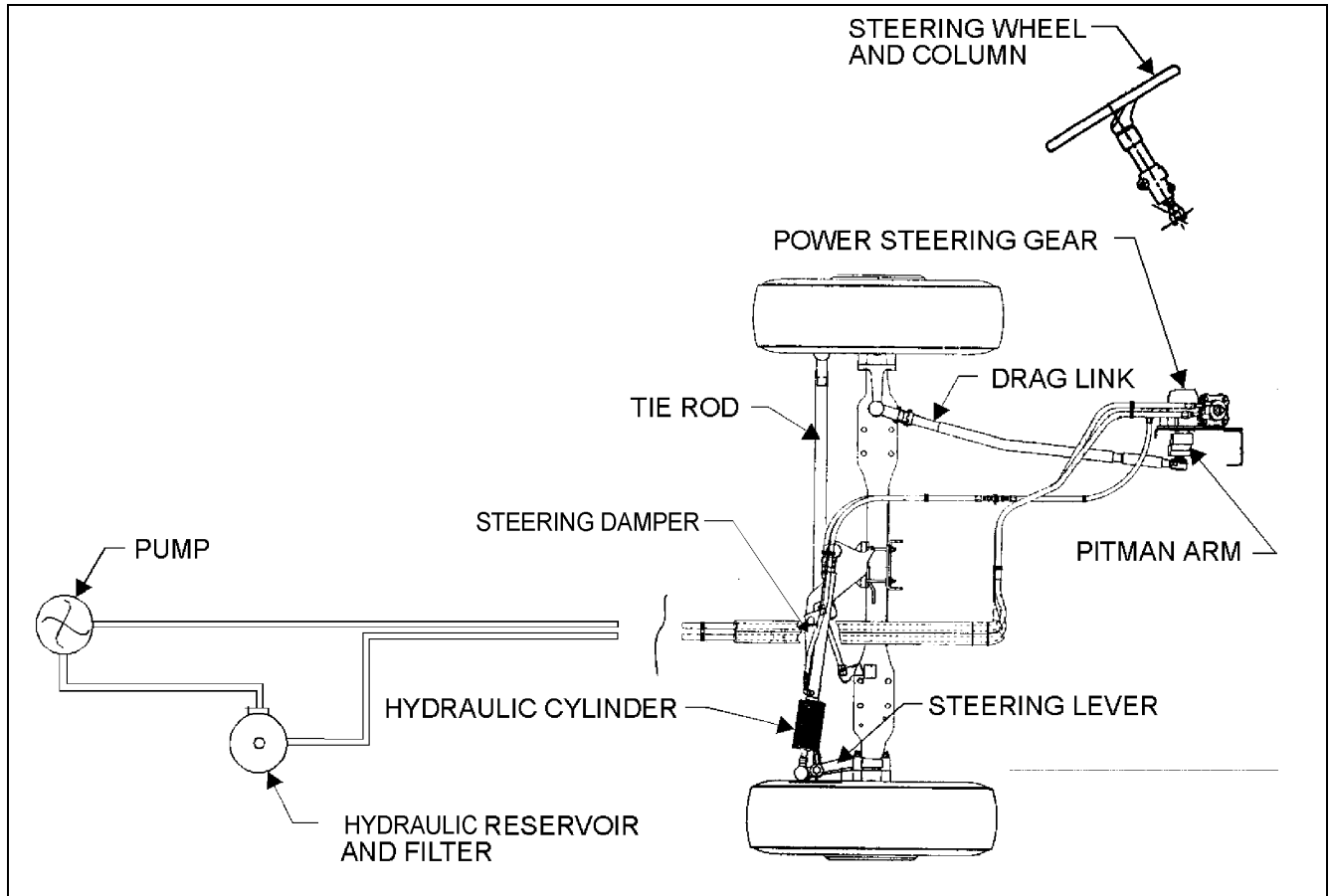


FIGURE 1: STEERING SYSTEM AXLE SETUP

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### 1.1 Description

The steering system is made up of following components, namely the steering wheel, steering column, shaft assembly, power steering gear, tie rod, pitman arm and drag link (Fig. 1).

Hydraulic components are added to transmit, increase and regulate steering control forces. These elements are:

1. Hydraulic cylinder ;
2. Steering stabilizer (damper);
3. A vane type hydraulic pump;and
4. Hydraulic reservoir and hoses.

The steering stabilizer reduces road shocks and vibrations in the system. The steering

gearbox is self powered and provides movement with power assistance mainly to the left wheel. The hydraulic cylinder provides an added source of assistance and, being connected to the right wheel, makes it such that the total steering forces are produced with minimal stress on mechanical linkages.

Wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment are covered in their respective sections in this manual.

## 2. POWER STEERING GEAR

### 2.1 Description

The power steering is located in the front lower service (Fig. 2). The integral power steering

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gear (TAS 85) incorporates a manual steering mechanism, a hydraulic control valve and a hydraulic power cylinder.

Refer to the "TAS 85 Steering Gear Service Manual" annexed to this section for the functional aspects and maintenance procedure of the power steering gear.

**Caution:** Before attempting to adjust the poppet valves of the power steering gear, properly set the steering stop screws as outlined in Section 10, "Front Axle", under heading "6.4 TURNING ANGLE ADJUSTMENT".

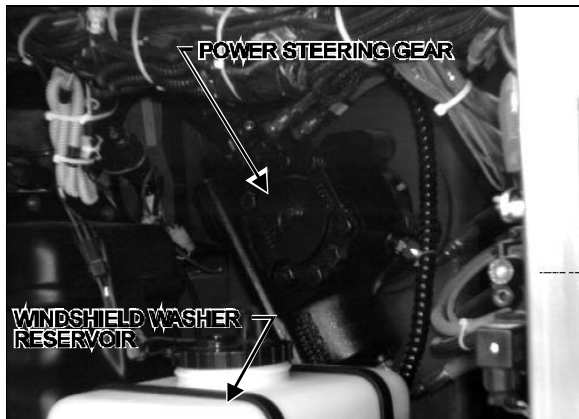


FIGURE 2: FRONT SERVICE COMPARTMENT 14005

### 3. BLEEDING POWER STEERING HYDRAULIC SYSTEM

To bleed the power steering hydraulic system, refer to the "TAS 85 Steering Gear Service Manual" annexed to this section, under heading "Filling and Air Bleeding the System".

### 4. HYDRAULIC PRESSURE TEST

Perform a pressure test as outlined in the "Chart your Way to Easy Steering" annexed to this section.

## 5. TROUBLESHOOTING

Perform troubleshooting of the steering gear as outlined in the "Chart your Way to Easy Steering" annexed to this section.

## 6. POWER STEERING HYDRAULIC PUMP

### 6.1 Description

The power steering pump is a vane type, gear driven, hydraulic unit which supplies hydraulic pressure for the operation of the steering gear.

The pump is mounted on the engine, beside the crankshaft pulley.

### 6.2 Removal and Installation

The pump is accessible through the engine compartment rear door. To remove the pump, disconnect the inlet and outlet hoses from the pump, then remove the two mounting screws. Cap hose openings to prevent contamination of hydraulic system. The mounting flange gasket should be replaced whenever pump is removed. To install pump, reverse the removal procedure.

## 7. STEERING WHEEL

### 7.1 Removal

1. Set the battery main disconnect switches to the "OFF" position.
2. Using a tool, such as a little flat head screwdriver, pry off the electric horn cap.
3. Loosen the small screw in center of cap and the other retaining the black wire, then disconnect the white terminal. Remove horn cap.
4. Loosen and remove the steering wheel nut.
5. Using a suitable puller, remove the steering wheel.

## 7.2 Installation

To install, reverse the removal procedure. Torque steering wheel nut to 35-45 lbf•ft (47-60 N•m).

## 8. STEERING COLUMN

### 8.1 Removal and Lubrication

To disassemble the steering column, refer to Figure 3 as a guide. The steering column has three lubrication points which must be serviced only when needed, using a good quality lithium-base grease NLGI No. 1 and 2. The lower steering column U-joint grease fitting is easily accessible through the front service compartment. The upper steering column U-joint and the steering slip joint grease fittings are accessible from the front driver's area. To access these fittings, proceed as follows:

1. From the front driver's area, unfasten and lift the steering column boot, then remove the four snap caps on front of upper steering column cover (Fig. 3).
2. Unscrew the four retaining screws on upper steering column cover. Remove the upper cover.
3. Unscrew the three retaining screws on lower steering column cover. Remove the lower cover.
4. Position the steering wheel in order to gain access to the grease fittings.

**Note:** For an easier access to the slip joint grease fitting, lift steering wheel to its maximum position using the release handle located on the left-hand side of the steering column.

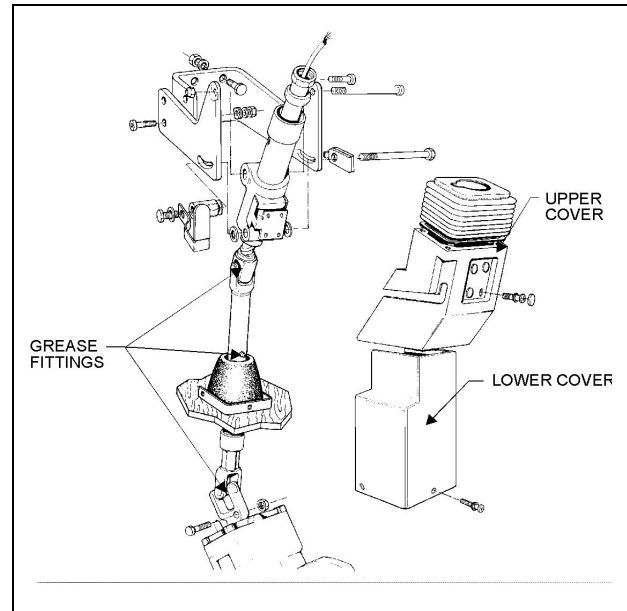


FIGURE 3: STEERING COLUMN

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## 9. TURNING ANGLE ADJUSTMENT

To adjust the turning angle, refer to Section 10, "Front Axle", under heading "6.4 TURNING ANGLE ADJUSTMENT".

## 10. STEERING LINKAGE ADJUSTMENT

To adjust the steering linkage, refer to Section 10, "Front Axle", under heading "6. FRONT WHEEL ALIGNMENT".

## 11. PITMAN ARM

### 11.1 Removal

1. Remove cotter pin, nut and washers from drag link ball stud at pitman arm.
2. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

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**Warning:** Always wear approved eye protection when operating pullers.

**Caution:** Do not drive pitman arm on or off pitman shaft as this can damage the steering gear.

**Caution:** Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

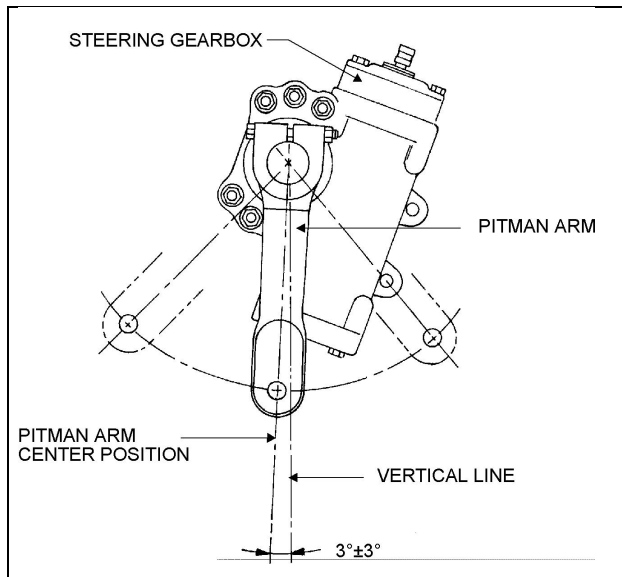


FIGURE 4: PITMAN ARM ADJUSTMENT

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3. Remove pitman arm clamp bolt nut, washer and bolt.
4. Check the radial position of the pitman arm in relation to the sector shaft prior to removal of pitman arm.
5. Add reference marks to the arm and shaft if necessary to ensure correct alignment at reassembly.
6. Remove pitman arm. A chisel will help you loosen the pitman arm. Use a puller if you cannot remove the pitman arm manually.

## 11.2 Installation

1. Position pitman arm on sector gear shaft with reference marks aligned. Ensure that the clamp bolt groove matches.
2. Install bolt, washer and nut. Tighten nut to 280-300 lbf•ft (380-408 N•m).
3. Connect drag link to pitman arm. Install washers. Tighten nut to 200-220 lbf•ft (272-300 N•m). Afterwards, install a new cotter pin.

## 11.3 Adjustment

1. Disconnect the drag link from pitman arm. Center steering wheel by dividing the total number of steering wheel turns in two. Scribe a reference mark on steering gearbox at the center previously determined.
2. Using a protractor, check the angle of the pitman arm.
3. The pitman arm should be adjusted to an angle of  $3^{\circ} \pm 3^{\circ}$  in relation with the vertical axis (towards rear of vehicle), refer to Fig. 4 for details. If not, unscrew and remove bolt, nut and washer. Remove the pitman arm according to the procedure outlined under previous heading "11.1 REMOVAL". Adjust to the proper angle.
4. When adjustment is achieved, replace bolt, nut and washer, and torque to 280-300 lbf•ft (380-408 N•m).

## 12. MAINTENANCE

The power steering system requires little maintenance. However, the system should be kept clean to ensure maximum operating performance and troublefree service. Periodic inspections should also be made to check leakage.

When the slightest evidence of dirt, sludge or water is discovered in the system, disconnect fluid lines at the power steering gear to drain the system. Drain and refill the system with "Dexron-II or Dexron-III" automatic transmission oil.

Air in the hydraulic system will cause spongy action and noisy operation. When any hose has been disconnected or when fluid has been lost for any reason, the system must be bled. Bleed system as outlined under heading "3. BLEEDING POWER STEERING HYDRAULIC SYSTEM" in this section.

**Warning:** Do not operate the pump without fluid in the power steering fluid reservoir.

If the steering linkage between the steering gear and the two front wheels is not properly adjusted, bent, twisted or worn, the steering of the vehicle will be seriously impaired. Whenever any steering linkage part is repaired, replaced or adjusted, steering geometry and front wheel alignment must be checked and necessary corrections made. Refer to Section 10, entitled "Front Axle" for paragraph "6. FRONT WHEEL ALIGNMENT".

At regular lubrication intervals, the steering linkage should be thoroughly inspected for worn or loose components.

After the vehicle has been operated continually and high mileage figures have been reached, overhaul of the various steering units will be required. General overhaul procedure normally requires removal of the entire assembly, cleaning and inspection of all parts and final assembly. Careful inspection of all parts during overhaul is very important and must not be neglected.

All lubrication fittings must be cleaned before applying lubricant. Moreover, always be sure the equipment used in applying lubricant is clean. Every precaution should be taken to prevent entry of dirt, grit, lint or other foreign matter into lubricant containers. Replace fittings that have become broken or damaged. Lubrication intervals, as well as the recommended lubricants for the steering components, are

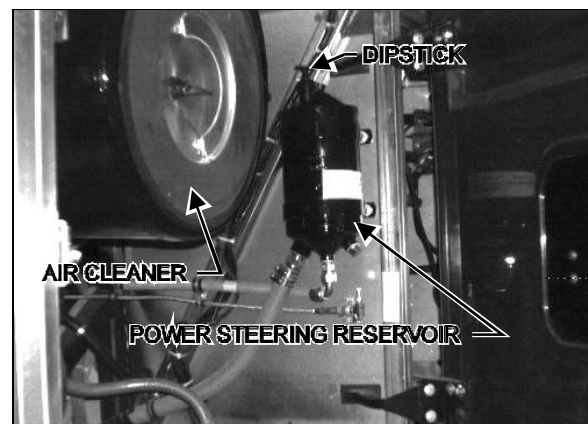
given in the "Lubrication and Servicing Schedule" in Section 24 of this manual. The intervals given in the schedule are recommended for normal service. More frequent intervals may be required under severe operating conditions.

## 12.1 Power Steering Reservoir and Filter

The power steering reservoir is located on R.H. side of engine compartment, on front wall (Fig. 5). At regular intervals, fluid level should be checked in the reservoir and filter assembly. Furthermore, the oil filter cartridge element in the power steering reservoir should be replaced every 50,000 miles (80 000 km) or once a year, whichever comes first.

### 12.1.1 Oil Level - Hot Check Procedure

1. Stop engine. Open engine compartment R.H. side door.
2. Unscrew and remove the dipstick located on top of reservoir and wipe with a clean rag.
3. Replace dipstick in reservoir. Remove it again to check fluid level.
4. Adjust level to "FULL" mark, using "Dexron-II or Dexron-III" automatic transmission oil.
5. Replace and tighten the dipstick.



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FIGURE 5: ENGINE COMPARTMENT R.H. SIDE DOOR

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### 12.1.2 Filter Replacement

1. Unscrew and remove the wing nut located on top of the power steering reservoir.
2. Remove the reservoir cover and gasket.
3. Remove the retaining spring and finally the filter cartridge element.

### 12.2 Steering Stabilizer Cylinder (Damper)

This vehicle is provided with a steering stabilizer cylinder installed on right-hand side of front axle. The cylinder is non-repairable, so if oil leakage is evident or cylinder has no resistance, the complete unit must be replaced. Lubricate the steering stabilizer cylinder rod end every 6,250 miles (10 000 km) or twice a year, whichever comes first. Good quality lithium-base grease NLGI No. 1 and 2 are recommended. Inspect the spherical joint regularly. In case of wear, replace rod end assembly.

### 12.3 Hydraulic Cylinder Assembly

The hydraulic cylinder is installed on the right hand side of front axle. Repair kit Prévost # 660902 containing seal is available. Lubricate the fittings at each cylinder end of the power steering cylinder every 6,250 miles (10 000 km) or twice a year, whichever comes first. Good quality lithium-base grease NLGI No. 1 and 2 are recommended

### 12.4 Drag Link

Lubricate the fittings every 6,250 miles (10 000 km) or twice a year, whichever comes first. Good quality lithium-base grease NLGI No. 1 and 2 are recommended.

### 12.5 Power Steering Hydraulic Pump

For the maintenance of the power steering hydraulic pump, refer to the *"Vickers Overhaul Manual"* annexed to this section.



### 13. TORQUE CHARTS

TORQUE (DRY)			
Descriptions	References	lbf•ft	N•m
Drag link end stud nut (on steering arm)	Fig. 1	160-300	218-409
Drag link end pinch bolt nuts	Fig. 1	50-65	68-88
Drag link end stud nut (on pitman arm)	Fig. 1	160-300	218-409
Tie rod end screw pin nut	Fig. 6, T1	100-175	136-237
Tie rod end pinch bolt nuts	Fig. 6, T2	65-75	88-102
Hydraulic cylinder fixation nuts	Fig. 6, T1	160-300	218-409
Steering stabilizer cylinder fixation nuts	Fig. 7, T2	100-120	136-164
Retaining rod support fixation nuts	Fig. 7, T3	150-200	204-273
Steering damper and hydraulic cylinder mounting support nuts	Fig. 7, T4	66-70	90-95
Steering top lever nuts	Fig. 7, T5	150-200	203-271

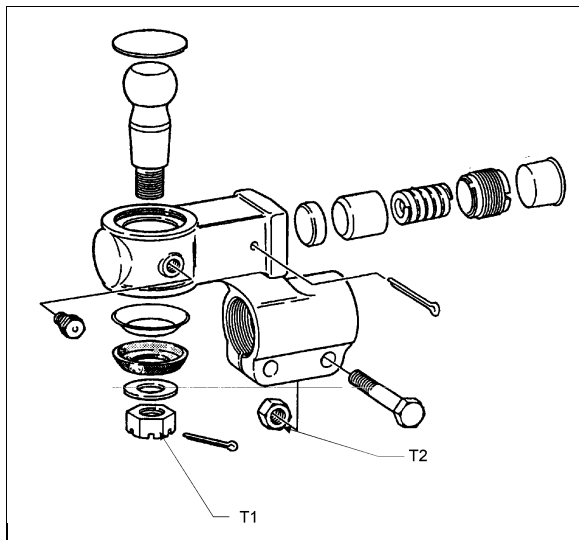


FIGURE 6: TIE ROD END

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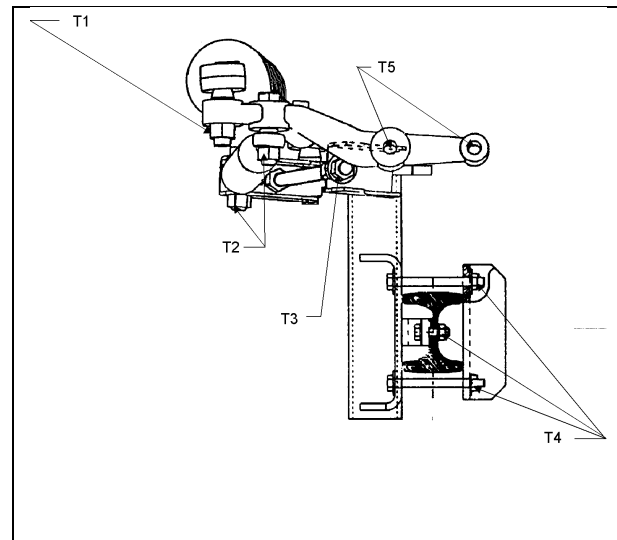


FIGURE 7: FRONT AXLE COMPONENTS

14010

## Section 14: STEERING

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### 14. SPECIFICATIONS

#### Power Steering Gear

Make ..... TWR  
Model ..... TAS 85  
Supplier number.....TAS85040  
Prevost number.....660927  
F.E.W. ....18,000 lbs (8 200 kg)  
Pressure rating..... 2,175 psi (150 Bar)  
Gear ratio ..... 23.3:1  
Minimum pump flow for 1.5 hwt/sec..... 3.5 gpm (13.2 lpm)

#### Power Steering Pump

Make ..... Vickers  
Type ..... V20  
Relief valve setting..... 2,250 psi (15 510 kPa)  
Supplier number.....V20NF-1R11T-38C6J-22-LH  
Prevost number.....661006

#### Power Steering Reservoir

Make ..... Nelson Muffler  
Oil capacity ..... 4 US qts (3.7 liters)  
Supplier number.....91410A  
Prevost number.....660982  
Make ..... Nelson Muffler  
Element filter - Supplier number .....83804 E  
Element filter - Prevost number .....660987

#### Steering Stabilizer Cylinder (Damper)

Make ..... Gabriel  
Extended length..... 32.73±0.12"  
Collapsed length..... 20.26±0.12"  
Stroke..... 12.47±0.12"  
Supplier number..... 651535  
Prevost number..... 660979  
Dust cap - Prevost number ..... 660980

#### Hydraulic Cylinder Assembly

Make ..... Hayes-Dana  
Bore..... 1 1/2"  
Stroke..... 17"  
Rod diameter.....0.875"  
Supplier number..... 006-9231-0  
Prevost number..... 16-0886  
Repair kit - Supplier number ..... 306-7200-00  
Repair kit - Prevost number ..... 660902

**TRW Automotive**  
Steering & Suspension Systems

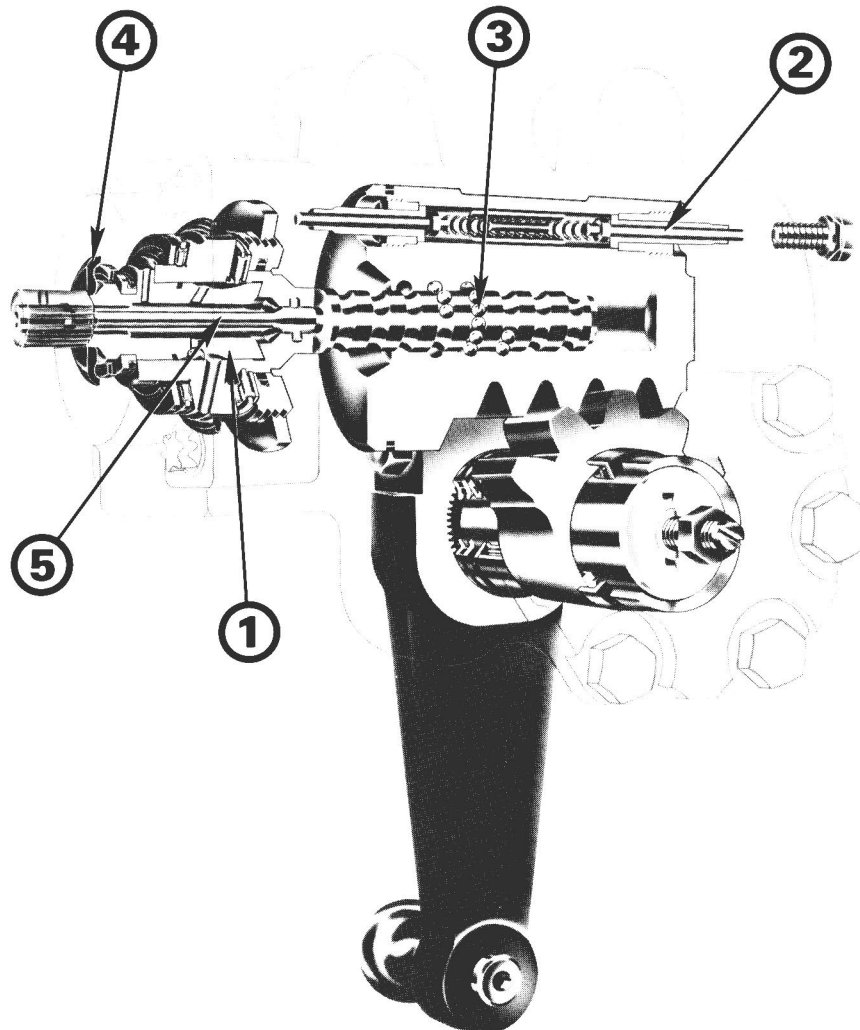
## TAS Steering Gear Service Manual





**TAS 40,55,65 and 85 Series**

# Design Features

- ① **Rotary Valve** - This device provides responsive steering control.
  - ② **Poppets (optional)**- These unloading valves are automatically set to furnish power steering pump protection and reduce pressure to unload steering linkage at vehicle axle stop settings.
  - ③ **Recirculating Balls** - Combine high mechanical efficiency with smooth operation.
  - ④ **Dirt & Water Seals** - Lip-type seals on both input and output shafts.
  - ⑤ **Torsion Bar** - Provides positive valve centering with definitive "feel of the road".
- Relief valves furnish pump protection by limiting maximum pressure (optional).
  - Balanced area cylinder so back pressures cannot affect steering stability.
  - High temperature seals were developed to withstand temperatures of 250°F,
  - Manual steering capability provides for steering control in the event of hydraulic failure
  - Auxiliary porting available for auxiliary cylinder control
  - Seal protectors provide protection from harsh environment conditions



# Hazard Warning Definitions

 <b>WARNING</b>	A warning describes hazards or unsafe practices which could result in severe personal injury or death.
 <b>CAUTION</b>	A caution describes hazards or unsafe practices which could result in personal injury or product or property damage.
<b>NOTE</b>	A note gives key information to make following a procedure easier or quicker.

## Disclaimer

This Service Manual has been prepared by TRW Commercial Steering Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Commercial Steering Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the TRW Commercial Steering TAS Series Integral Power Steering Gears. Since this is a general Service Manual, the photographs and illustrations may not look exactly like the steering gear being serviced. The procedures, therefore, must be carefully read and understood before servicing,

If inspection or testing reveals evidence of abnormal wear or damage to the TAS steering gear or if you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURER'S SERVICE MANUAL AND WARRANTY DO NOT TRY TO REPAIR OR SERVICE ATAS STEERING GEAR WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE TAS STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular TAS steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the TAS steering gear and the vehicle steering system to ensure that the repair or service of the steering gear has been properly performed and that the steering gear and system will function properly.

## Patents

TRW Commercial Steering Division TAS power steering gears are covered by several United States and foreign patents, either issued or pending,

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<b>⚠ WARNING</b>	All steering mechanisms are safety critical items. As such, it is imperative that the instructions in this booklet be followed to the letter. Failure to observe the procedures set forth in this pamphlet may result in a loss of steering.
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## Section 1      General Information

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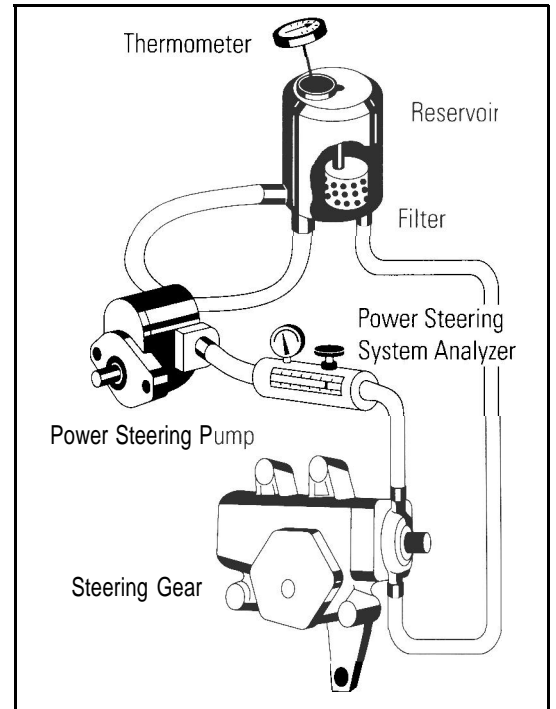




# Chart Your Way to Easy Steering Directory

Chart Your Way to Easy Steering is a separate publication (actually a Manual, Flow Charts and two Videotapes) that facilitates troubleshooting steering system complaints. If while using this tool, your system has failed one or more tests, you probably have been directed to this Service Manual for repairs. The following directory will help you locate the specific repairs you will need to make to proceed with the Chart Your Way to Easy Steering process.

**Use Example:** The driver of the vehicle you are working on complains of "Steering Wheel Kick". You have first determined (using Chart Your Way to Easy Steering that there is no air in the system, The book then directs you to perform test #18 to check for lash in the system. While performing this test you detected lash or lost motion from the input shaft to the output shaft. Since this looseness is inside the steering gear you would refer to this Service Manual and locate the test number of the failed test, test #18. The problem listed below is "Input shaft - Output shaft lash", and the solution is to make a sector shaft adjustment. You would then proceed to section 3 of this Service Manual and perform the Sector Shaft Adjustment procedure.



Failed Test	Problem	Solution	Section
Test 8	Excessive Internal Leakage	Replace damaged parts / reseal	4
Test 9	Excessive Internal Leakage	Replace damaged parts / reseal	4
Test 11	Intermittent loss of power assist	Reseal	4
Test 12	Air in hydraulic system	Bleed system	3
Test 17	Poppets improperly set	Reset poppets	3
Test 18	Input shaft - Output shaft lash	Adjust sector shaft	3
Test 19	Steering gear misadjusted	Adjust sector shaft first if required, replace worm assembly	3 4
Test 28	Gear control valve imbalance	Replace worm-valve assy / reseal	4
External Leakage	Porosity in housing, side cover or valve assy	Replace porous parts / reseal	4
	Input shaft seal	Replace seal	3
	Output shaft seal	Reseal	4
	Side cover seal, vent plug, bolts, gaskets	Replace parts / reseal	4
	Valve housing sealing area	Remove nicks or replace/ reseal	4
	Poppet screw or sealing nut	Replace with poppet adjusting screw kit / Reset poppets	3

# Introduction

This new TAS Service Manual replaces all previous editions of TRW's TAS40, 55, 65 and TAS85 Service Manuals.

Changes in the layout of this Service Manual reflect TRW's commitment to provide easily usable material and highly recognizable hazard notices. Some of the major changes are:

- Revised caution and warning definitions that conform to international standards.
- Revised torque, force, pressure and flow notations that conform to international standards.
- Service Manual divided into sections for easier reference.
- Directory for Chart Your Way to Easy Steering users to speed service of correctly diagnosed problems.
- Uninterrupted resealing instructions. Reference to damage section allows you to repair or replace damaged parts and return to the resealing procedures easily.
- Binding process that better allows the Service Manual to lay flat.

The three-column format used in the Service Manual will also help make it easy for you to service a steering gear. Column 1 illustrates the procedure with photographs, column 2 gives a brief key as well as tools to be used for each procedure, and column 3 explains in detail the procedure you should follow. **Pay special attention to the notes, cautions and warnings.**

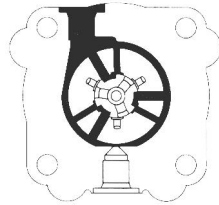
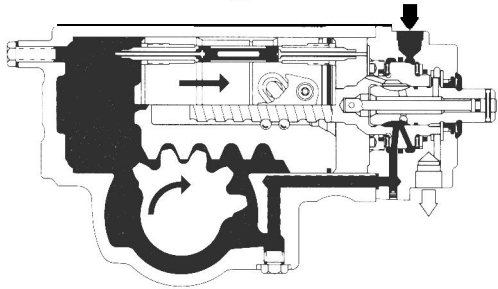
The exploded view is on a fold-out page so you can see it while reading through the procedures. Item numbers on the exploded view correspond with item numbers used throughout the Service Manual.

As you gain experience in servicing TAS steering gears, you may find that some information in this Service Manual could be clearer and more complete. If so, let us know about it. Don't try to second-guess the Service Manual; if you do not understand a procedure, or are stuck, contact our Field Service Department at 317.423.5377. Servicing TAS series steering gears should be safe and productive.

**A special thanks to our customers who took the time to review this document prior to printing. It's a better publication because of your effort.**

# Oil Flow Illustration

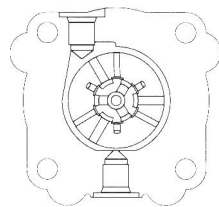
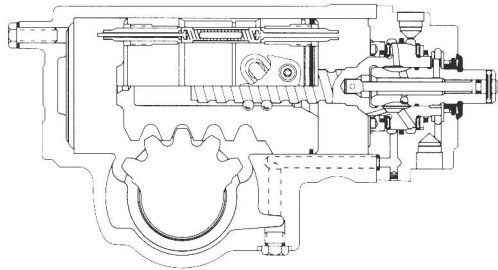
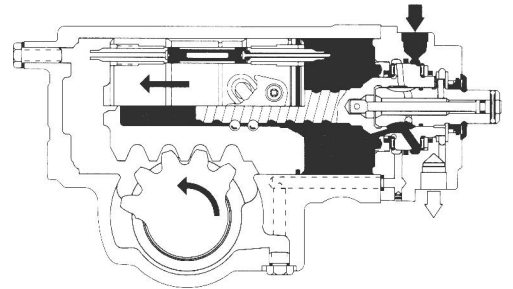
### Right Hand Lead



### Right Hand Turn

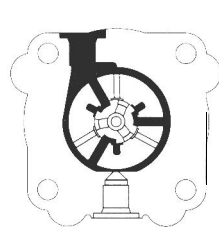
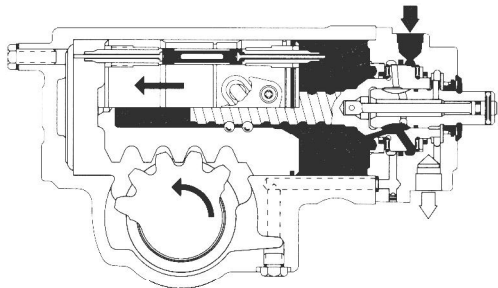
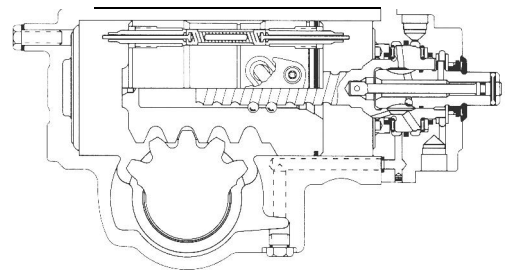
Steering Wheel Input:  
Clockwise Rotation

### Left Hand Lead



### Straightline Running

No Steering Action



### Left Hand Turn

Steering Wheel Input:  
Counter-Clockwise Rotation

■ Supply Pressure

□ Return Pressure

# General Design

## Integral Power Steering

TAS power steering gears are the latest design in the TRW Commercial Steering Division family of integral hydraulic power steering gears. Integral hydraulic power steering means that the gear contains a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder, all in a single, compact package

## Rotary Control Valve

The rotary control valve combines simplicity of construction with desirable performance characteristics. The speed at which the driver can turn the steering wheel with power assist is dependent upon the pump flow (measured in gallons per minute or liters per minute) directed to a cylinder cavity. The control valve controls flow through the steering gear.

The pressure (measured in pounds per square inch, or bar) required for the gear to steer the vehicle is created by the power steering pump to overcome resistance at the steered wheels. The control valve senses these requirements and directs fluid to the appropriate cylinder cavity in the steering gear (and in the auxiliary cylinder if it is a dual steering system) at the proper flow rate and pressure,

## Pressure Means Work, Flow Means Speed

The higher pressure a steering gear can withstand, the more work it can perform. The maximum operating pressure for all TAS gears is 2,175 psi (150 bar), maximum flow rate for all TAS gears is 8 gal/min (30.3 L/min).

The TAS series gears can steer a vehicle within its front-end weight rating through a turn at low speed and engine idle. As the driver turns the steering wheel faster or slower, more or less fluid will be required by the gear. TAS series vehicle front-end weight ratings are as follows:

Gear	Front Axle Rating
TAS40	9,000 lb (4,100 kg)
TAS55	12,000 lb (5,400 kg)
TAS65	14,300 lb (6,500 kg)
TAS85	18,000 lb (8,200 kg)

The recommended minimum flow at 1½ steering wheel turns per second is as follows:

Gear	Minimum Flow Rate
TAS40	2.2 gal/min (8.3 L/min)
TAS55	2.6 gal/min (9.8 L/min)
TAS65	3.0 gal/min (11.4 L/min)
TAS85	3.6 gal/min (13.6 L/min)

If the steering gear valve is controlling an auxiliary cylinder, increased minimum flow is required (generally at least 75%) based on the size of the auxiliary cylinder and the vehicle's steering geometry.

# General Operation

## What Happens During a Steering Maneuver

When the driver turns the steering wheel, he transmits force from the steering wheel to the steering gear input shaft. A torsion bar, pinned at its one end to the input shaft and at its other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force, the worm shaft, acting through the recirculating ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

The rack piston's axial movement is resisted by its engagement to the sector shaft, which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurized fluid, directed by the control valve, assists in moving the rack piston axially through the cylinder bore. The rack piston then turns the sector shaft to steer the vehicle.

## Shock Loads to the Gear

If the steered wheels receive a shock load, the shock forces are transmitted through the sector shaft to the rack piston, and on to the worm shaft. The internal geometry of the steering gear causes the control valve to send high-pressure fluid to the correct cylinder cavity to resist the shock forces. By absorbing the shock forces hydraulically, the steering gear prevents objectionable kickback at the steering wheel.

## Unloading (Poppet) Valves

Most TAS gears are equipped with two unloading valves, one at each end of the rack piston. One valve or the other, depending on the direction of turn, will trip as the steered wheels approach the axle stops (which must be set according to manufacturer's specification). The tripped valve reduces pressure in the gear and helps to reduce heat generated by the pump. At the same time, the valves also reduce forces on the steering linkage. These valves are automatically set to axle stops after installation in vehicle at first full right and left turn.

## Relief Valve

Some TAS gears, (with or without poppets), are supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering gear, but it does not reduce pressure as the steered wheels approach the axle stops.

## Bleed Systems

Some TAS gears which are mounted with the output shaft above the rack piston bore are equipped with either an automatic bleed system or a manual bleed screw.

The procedure for air bleeding the system is on page 13 of this manual. Replacement of damaged automatic bleed plugs, and manual bleed screws is described on page 51.

# Approved Hydraulic Fluids

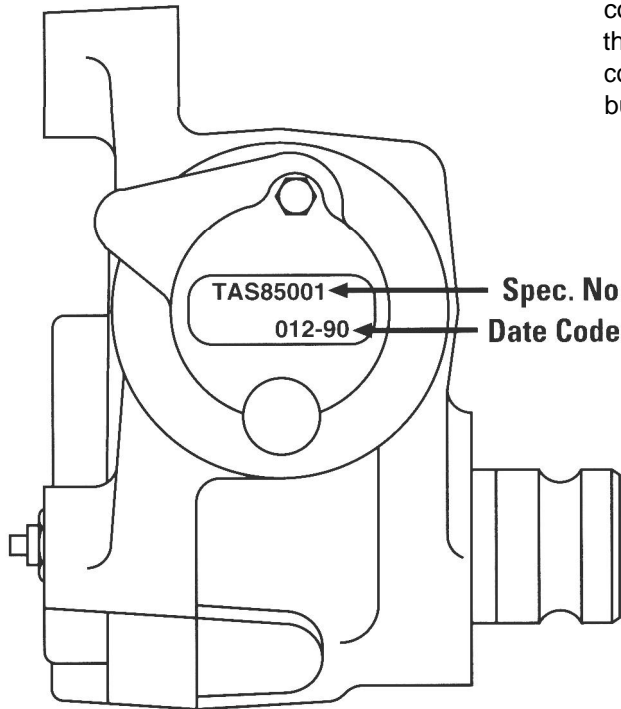
Automatic Transmission Fluid Dexron II  
Automatic Transmission Fluid Type "E" or "F"  
Chevron 10W-40  
Chevron Custom 10W-40 Motor 011  
Chevron Torque 5 Fluid  
Exxon Nuto H32 Hydraulic Fluid  
Fleetrite PSF (Can #990625C2)  
Ford Spec. M2CI 38CJ  
Mack EO-K2 Engine Oil

Mobil ATF 210  
Mobil Super 10W-40 Motor 011  
Shell Rotella T30W  
Shell Rotella T SAE 30  
Texaco 10W-40  
Texaco TL-I 833 Power Steering Fluid  
Union 10W-40  
Union 15W-40  
Unocal Guardol 15W-40 Motor Oil

The steering system should be kept filled with one of the above fluids.

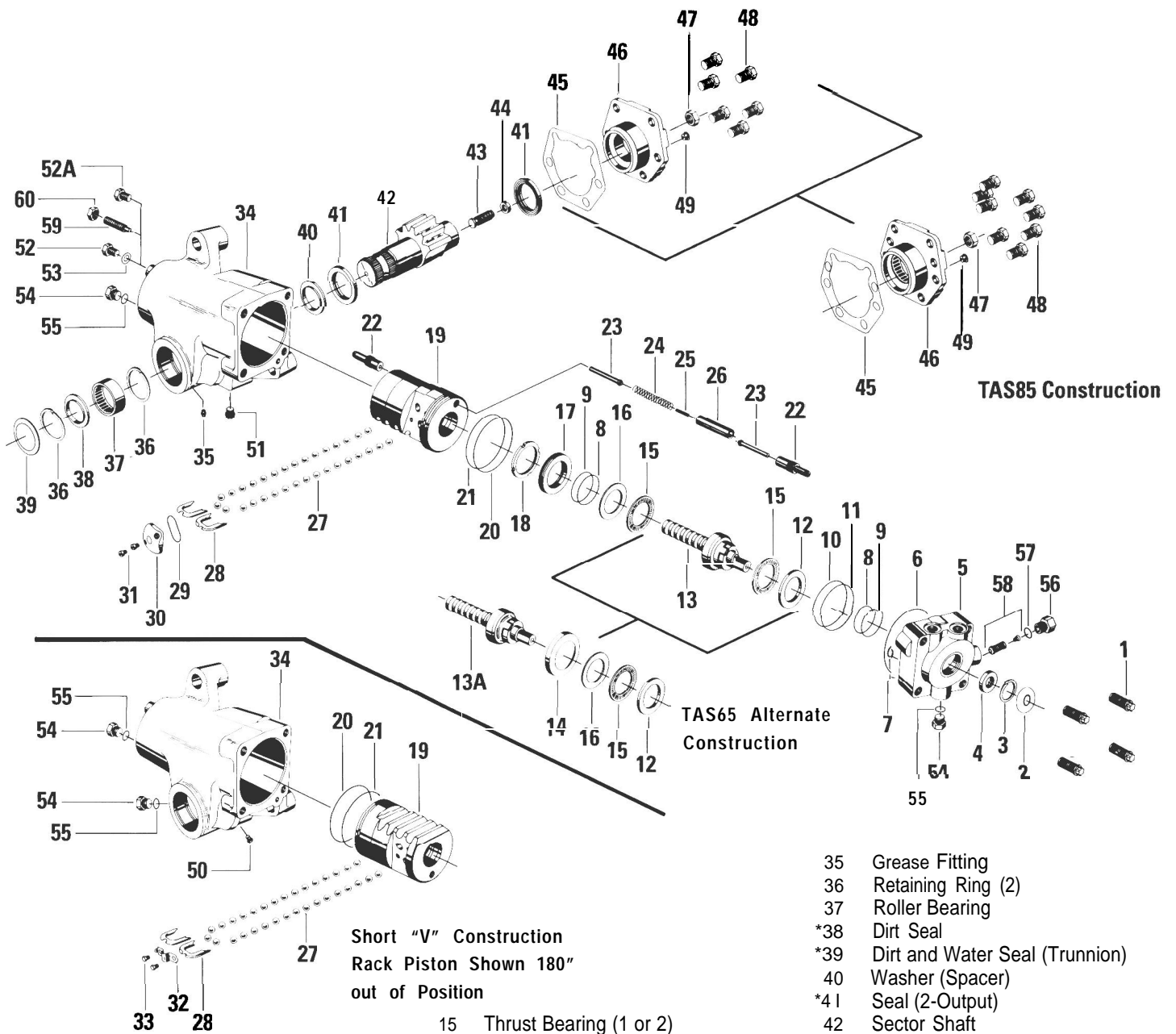
**WARNING** Completely flush the steering system with one of the recommended fluids above only. Do not mix oil types. Any mixture or any unapproved oil could lead to seal deterioration and leaks. A leak could ultimately cause the loss of fluid, which could result in a loss of power steering assist.

## Specification Numbers



The steering gear specification number and date code are stamped on a machined surface opposite the input shaft of every TAS gear. An example date code would be 01 2-90; this means the gear was built on the 12th day of 1990.

# TAS Series Exploded View -- Typical



## Item Description

- Item Description
- 34 Housing
- 35 Grease Fitting
- 36 Retaining Ring (2)
- 37 Roller Bearing
- \*38 Dirt Seal
- \*39 Dirt and Water Seal (Trunnion)
- 40 Washer (Spacer)
- \*41 Seal (2-Output)
- 42 Sector Shaft
- 43 Adjusting Screw (Sector Shaft)
- 44 Retainer (Adjusting Screw)
- \*45 Gasket (Side Cover)
- 46 Side Cover Assembly
- 47 Jam Nut
- 48 Special Bolts (6 or 8-Side Cover)
- \*49 Vent Plug (Side Cover)
- 50 Bleed Screw (Manual)
- 51 Plug (Auto Bleed)
- 52 Fixed Stop Screw (Poppet)
- 52A Fixed Stop Screw (Poppet-Alt)
- 53 Washer (Stop Screw)
- 54 Auxiliary Port Plug (2)
- \*55 O-ring (2-Aux Port Plug)
- 56 Relief Valve Cap
- \*57 O-ring (Relief Valve)
- 58 Relief Valve (2 piece)
- 59 Service Poppet Adjusting Screw
- 60 Service Sealing Jam Nut

## Short "V" Construction Rack Piston Shown 180° out of Position

- 15 Thrust Bearing (1 or 2)
- 16 Thrust Washer (Thin)
- 17 Bearing Adjuster
- \*18 Adjuster Locknut
- 19 Rack Piston
- \*20 Teflon Seal Ring
- \*21 O-ring (Back up, Rack Piston)
- 22 Poppet Seat and Sleeve Assy (2)
- 23 Poppet (2)
- 24 Poppet Spring
- 25 Spacer Rod
- 26 Push Tube
- 27 Balls
- \*28 Ball Return Guide Halves (2)
- \*29 Seal (Cap)
- 30 Ball Return Guide Cap
- \*31 Torx Screws (2-Cap)
- \*32 Ball Return Guide Clip
- 33 Hex Screws (2-Clip)
- 34 Housing

- 35 Grease Fitting
- 36 Retaining Ring (2)
- 37 Roller Bearing
- \*38 Dirt Seal
- \*39 Dirt and Water Seal (Trunnion)
- 40 Washer (Spacer)
- \*41 Seal (2-Output)
- 42 Sector Shaft
- 43 Adjusting Screw (Sector Shaft)
- 44 Retainer (Adjusting Screw)
- \*45 Gasket (Side Cover)
- 46 Side Cover Assembly
- 47 Jam Nut
- 48 Special Bolts (6 or 8-Side Cover)
- \*49 Vent Plug (Side Cover)
- 50 Bleed Screw (Manual)
- 51 Plug (Auto Bleed)
- 52 Fixed Stop Screw (Poppet)
- 52A Fixed Stop Screw (Poppet-Alt)
- 53 Washer (Stop Screw)
- 54 Auxiliary Port Plug (2)
- \*55 O-ring (2-Aux Port Plug)
- 56 Relief Valve Cap
- \*57 O-ring (Relief Valve)
- 58 Relief Valve (2 piece)
- 59 Service Poppet Adjusting Screw
- 60 Service Sealing Jam Nut

\*These items are included in seal kits. Kits also include 406015 lubricant and a service bulletin.

# Service Parts List

## Common Parts

Item	Description	Part Number
1	Bolts (4-Valve Housing)	020251
2	Dirt and Water Seal	478044
3	Retaining Ring	401637
4	Seal (Input Shaft) (High Temp)	478076
7	Seal Ring (Valve Housing)	032823
8	Seal Ring (2)	029123
9	O-ring (2) (High Temp)	032200-158
10	Seal Ring	029116
11	O-ring (Valve Housing) (High Temp)	032200-152
12	Thrust Washer (Thick)	400143
15	Thrust Bearing (2)	070027
16	Thrust Washer (Thin)	400144
17	Bearing Adjuster	400149
18	Adjuster Locknut	027007
27	Balls	216191-XI
29	Seal (Cap)	478042
30	Ball Return Guide Cap	400161
31	Torx Screws (2-Cap)	020228
32	Ball Return Guide Clip	402448
33	Hex Screws (2-Clip)	G179810
35	Grease Fitting	037027
43	Adjusting Screw (Sector Shaft)	021200
44	Retainer (Adjusting Screw)	062005
47	Jam Nut	G941 9666
49	Vent Plug (Side Cover)	036201
50	Bleed Screw (Manual)	213705
51	Plug (Auto Bleed)	021397
52A	Fixed stop screw	021426
54	Auxiliary Port Plug (2)	G941 0358
55	O-ring (2-Aux Port Plug)	032229
57	O-ring (Relief Valve)	032200-153
59	Service Poppet Adjusting Screw	021407
60	Service Sealing Jam Nut	025119

## Parts Vary by Specification\*

Item	Description
5	Valve Housing
13	Input Shaft, Valve, Worm Assy
13A	Input Shaft, Valve, Worm Assy. (Alt)"
14	Spacer Sleeve (Alt.)**
19	Rack Piston
34	Housing
42	Sector Shaft
46	Side Cover Assembly
56	Relief Valve Cap
58	Relief Valve (2 piece)

\*Contact Service/Sales for part numbers

\*\*Applicable to TAS65 gears only

## Kits

Items	Description	Part Number
54 & 55	Port Plug & O-ring	415437-AI
56 & 57	Relief Valve Cap & O-ring	411061-AI
59 & 60	Poppet Adj. Ser. & Jam Nut	021407-XI
	TAS40 Seal Kit	TAS400002
	TAS55 Seal Kit	TAS550002
	TAS65 Seal Kit	TAS650006
	TAS85 Seal Kit	TAS850002

## Parts Vary by Gear Size

Item Description	TAS40	TAS55	TAS65	TAS85
6 Seal Ring (Valve Housing)	032829	032829	032616	032834
20 Teflon Seal Ring	032828	032830	032590	032547
21 O-ring (Back up; Rack Piston)	032827	032831	032615	032556
22 Poppet Seat and Sleeve Assy. (2)	4091 18-A2	4091 18-A2	4091 18-A2	4091 18-A6
23 Poppet (2)	040210	040210	040210	040217
24 Poppet Spring	401662	401662	401662	401684
25 Spacer Rod	040209	040209	040209	040218
26 Push Tube	080154	080154	080154	080158
28 Ball Return Guide Halves (2) R H.	400158	400160	400156	400162
L.H	400159	400165	400157	400163
36 Retaining Ring (2)	401674	401650	401650	401685
37 Roller Bearing	070028	071025	071020	072003
38 Dirt Seal	478052	478041	478041	478057
39 Dirt and Water Seal (Trunnion)	478053	478045	478045	478059
40 Washer (Spacer)	028527	028519	028519	028534
41 Seal (2-Output)	478051	478040	478040	478058
45 Gasket (Side Cover)	HFB529000	HFB649000	HFB649000	TAS859000
48 Special Bolts (6 or 8-Side Cover)	021277	G223734	G223734	G223734



## **Section 2      Initial Installation**

installation.....	11
Poppet Setting ...	11
Maintenance Tips .	12



# Initial TAS Installation

- Bolt gear to frame, torque to vehicle manufacturer's recommendation,
- Connect return line to TAS return port.
- Connect hydraulic line from pump to pressure port in TAS unit,
- Connect steering column to input shaft, torque pinch bolt to vehicle manufacturer's recommendation.
- Install pitman arm on output shaft, torque bolt to vehicle manufacturer's recommendation,

## Initial Poppet Setting

For this procedure to work correctly, you must have: A new gear received from TRW or your vehicle manufacturer's aftermarket system, or a used gear on which poppet seats have been replaced or reset during gear disassembly procedures, **ALSO:** Fixed stop screw Installed in housing, or poppet adjusting screw Installed so that it duplicates fixed stop screw length.

<b>⚠ CAUTION</b>	<b>The axle stops and all steering linkage must be set according to vehicle manufacturer's specifications, and the pitman arm must be correctly aligned on the sector shaft for poppets to be set correctly.</b>
------------------	--

Full turn in one direction

1. With the engine at idle and the vehicle unloaded, turn steering wheel to full travel in one direction until axle stop contact is made. Maximum input torque to be applied during this procedure is 40 lb rim pull (178 N) on a 20 in, (508mm) diameter steering wheel.

<b>NOTE</b>	If you encounter excess rim pull effort, allow vehicle to roll forward or jack up the vehicle at the front axle.
-------------	--

Full turn in other direction

2. Follow the same procedure while turning the steering wheel in the other direction, The poppets are now positioned to trip and reduce pressure as the steered wheels approach the axle stops in either direction,

# Maintenance Tips

Never high-pressure wash or steam clean a power steering gear while on or off the vehicle. Doing so could force contaminants inside the gear and cause it to malfunction.

Make sure vehicle wheel cut or clearances meet manufacturer's specifications, and make sure pitman arm timing marks are aligned properly to prevent internal bottoming of the steering gear.

Regularly check the fluid and the fluid level in the power steering reservoir.

Keep tires inflated to correct pressure.

Never use a torch to remove pitman arm.

Investigate and immediately correct the cause of any play, rattle, or shimmy in any part of the steering system.

Make sure the steering column is aligned properly.

Encourage drivers to report any malfunctions or accidents that could have damaged steering components.

Do not attempt to weld any broken steering component. Replace the component with original equipment only.

Do not cold straighten, hot straighten, or bend any steering system component.

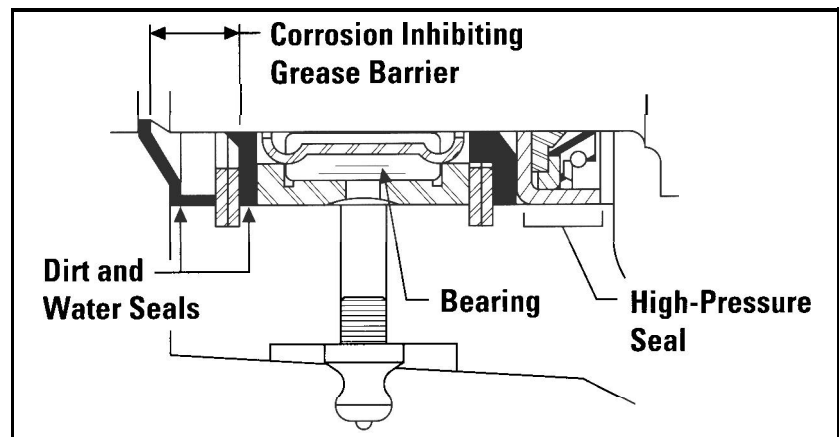
Always clean off around the reservoir filler cap before you remove it. Prevent dirt or other foreign matter from entering the hydraulic system.

Investigate and correct any external leaks, no matter how minor.

Replace reservoir filters according to requirements.

If you feel the vehicle is developing excessively high hydraulic fluid temperatures, consult with your vehicle manufacturer for recommendations.

Maintain grease pack behind the output shaft dirt and water seal as a general maintenance procedure at least twice a year, in the Spring and Fall. Grease fitting is provided in housing trunnion. Use only NLGI grade 2 or 3 multipurpose chassis lube, and use only a hand operated grease gun on fitting. Add grease until it begins to extrude past the sector shaft dirt and water seal.



## Section 3      On-Vehicle Service

Filling and Air Bleeding the System .....	13
input Shaft Seal Replacement .....	14
Sector Shaft Adjustment .....	18
Poppet Readjustment .....	20



# Filling and Air Bleeding the System

Tools Required	Materials Required
$\frac{5}{16}$ " Socket Lbf*in. Torque wrench	Hydraulic fluid

**CAUTION** Make sure poppets are set correctly before beginning this procedure.

Run engine for 10 seconds, turn off and fill reservoir

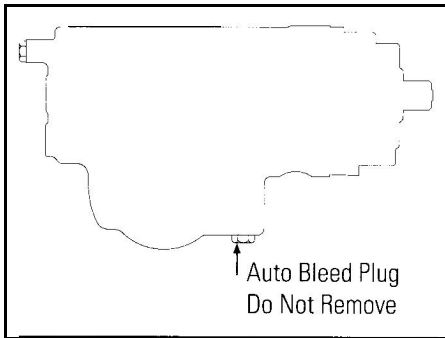
1. Fill the reservoir nearly full. Do not steer. Start and run the engine for 10 seconds, then shut it off. Check and refill the reservoir Repeat at least three times, checking the reservoir each time

I Hydraulic fluid I

**CAUTION** Do not allow the fluid level to drop significantly or run out of the reservoir. This may induce air into the system.

Run engine for 2 minutes, turn off and fill reservoir

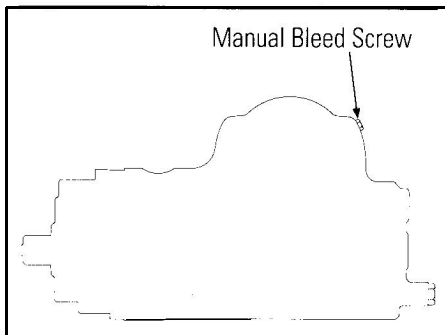
2. Start the engine and let it idle for 2 minutes, Do not steer, Shut off the engine and check the fluid level in the reservoir. Refill as required,



Steer vehicle

3. Start the engine again. Steer the vehicle from full left to full right several times, Add fluid, as necessary, to the full line on the dip stick,

Automatic bleed systems should now be free from trapped air, Manual bleed systems continue with step 4.



Allow air to bleed out from bleed screw

Lbf\*in. Torque wrench  
 $\frac{5}{16}$ " Socket

4. With engine idling, steer from full left turn to full right turn several times. Stop steering and loosen the manual bleed screw about one turn. Allow air and aerated fluid to "bleed out" until only clear fluid is seen. Close the bleed screw, refill the reservoir if required,

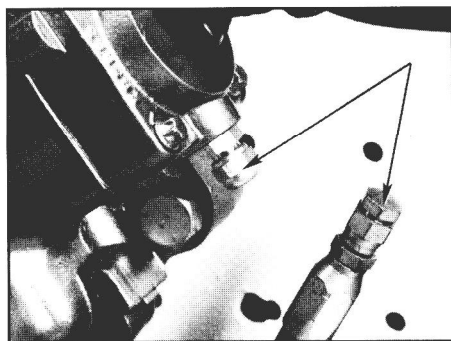
Repeat step 4 three to four times until all the air is discharged, Torque manual bleed screw to 30 lbf\*in.

**CAUTION** Do not turn steering wheel with bleed screw loosened.

# Input Shaft Seal Replacement

Tools Required	Materials Required
Hammer J37073 Screwdriver	Clean cloth Drip pan High pressure fitting Hydraulic fluid Plug Shop towel

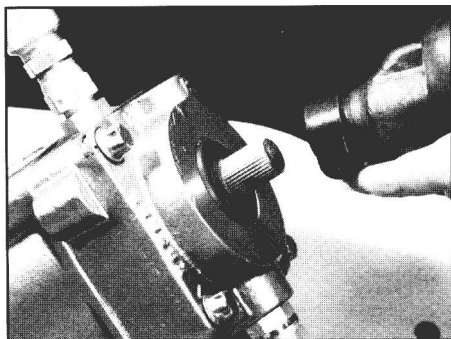
This procedure uses the vehicle's power steering pump to force out the input shaft seal. To use this procedure, the power steering pump should have a minimum of 1,500 PSI available.



Disconnect return line

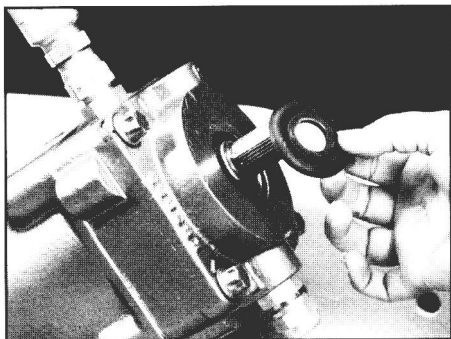
High pressure fitting  
Plug

1. Disconnect return line from the steering gear and plug the line. Also cap the return port of the gear with a high pressure fitting.



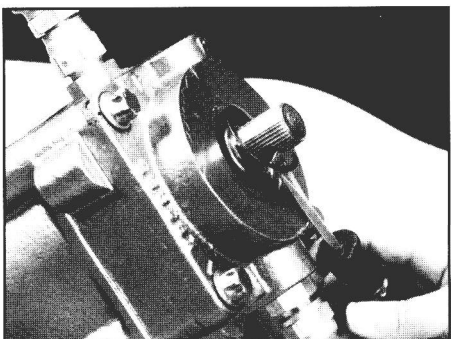
Disconnect column

2. Remove the steering column from the gear input shaft.



Remove dirt & water seal

3. Remove the dirt and water seal from the steering gear.

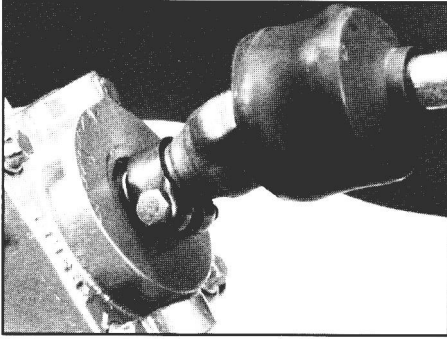


Remove retaining ring

Clean cloth  
Screwdriver

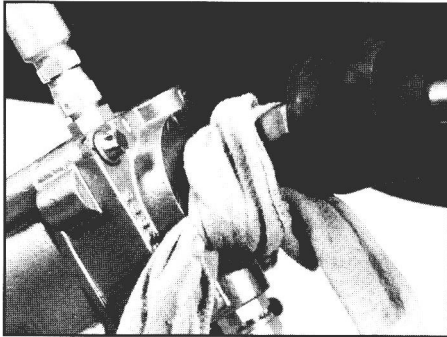
4. Wipe out the grease and then remove the spiral retaining ring. Use a screwdriver inserted into the notch formed in the end of the ring. Be careful not to scratch the bore with the screwdriver.





Replace column

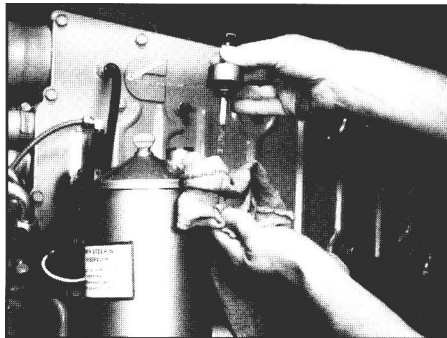
5 Slip the steering column back onto the input shaft with the pinch bolt installed, but not tightened.



Wrap exposed area

6. Tie or wrap a shop towel around the input shaft area and place a drip pan under the vehicle to catch the oil.

Drip pan  
Shop towel



Fill reservoir

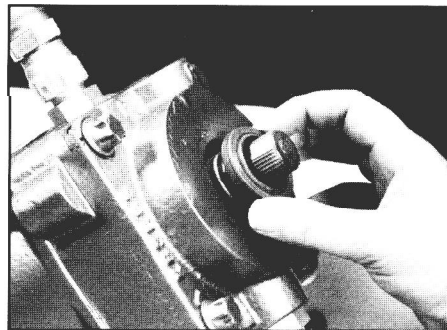
7. Add fluid as necessary, to the full line on the dipstick. Do not mix fluid types.

Hydraulic fluid

**⚠ WARNING** Any mixture of fluid types, or use of any unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause the loss of fluid, which could result in a loss of power steering assist.

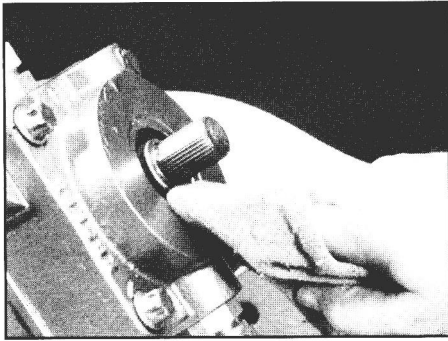
Force out the seal

8. With the vehicle in neutral, momentarily turn the starter (quickly turn off the engine if it starts).



Remove input shaft seal

9. Remove the shop towel. Disconnect the steering column, and remove the input shaft seal.



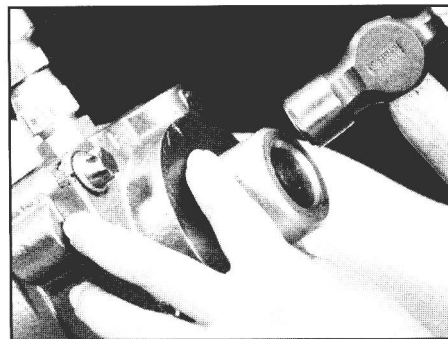
Inspect seal area

10. Check the seal area of the valve housing for any seal fragments, Remove any that are found.



Inspect old seal

11. Check the seal for heat damage, If the seal is stiff and brittle, and not pliable like the new seal, it is probably heat damaged. Determine and fix the cause of excessive heat in the vehicle.

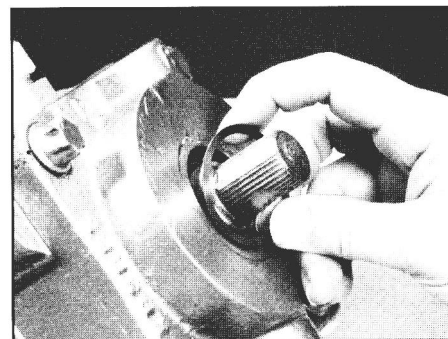


Install new seal

Hammer  
J37073

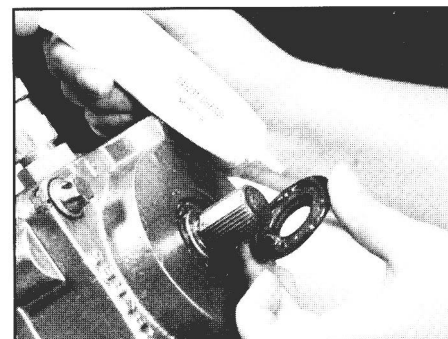
12 Put clean grease (Mobil Temp' 1 or 2 or equivalent) on the inside dia. of the new input shaft seal, and place it over the input shaft. With the small dia. of tool J37073 against the seal, tap the tool until the tool shoulder is square against the valve housing. Remove any seal material that may have sheared off in the seal bore or retaining ring groove.

**CAUTION** Do not use a socket to install this seal because you will not be able to control seal installation depth, possibly causing a leak.



Install retaining ring

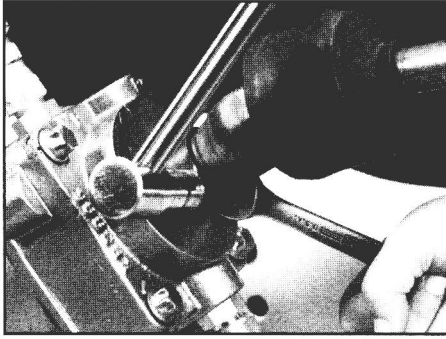
13. Insert new retaining ring into the groove



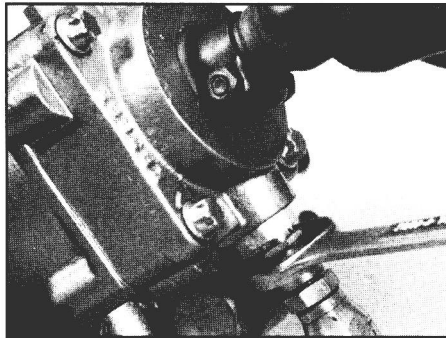
Install dirt & water seal

14. Pack the end of the valve housing bore around the input shaft with clean, high temperature industrial grease (Mobil Temp\* 1 or 2 or equivalent). Apply more of the grease to a new dirt & water seal and install it over the input shaft. Seat it in the groove behind the serrations and against the valve housing.

\*Trademark of Mobil Oil Corp.



**Reconnect column** 15. Reconnect the steering column to the input shaft and tighten the pinch bolt to torque level specified



**Reconnect return line** 16. Reconnect the return line to the steering gear return port.

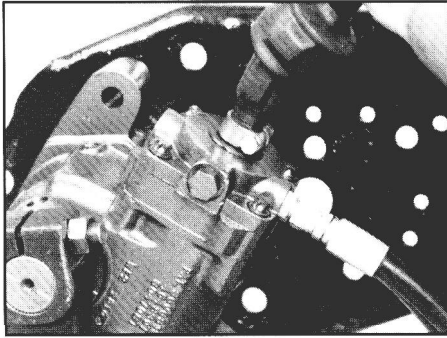
**Air bleed system** 17. Air bleed the system using the procedure on page 13.

# Sector Shaft Adjustment

Tools Required	Materials Required
Screwdriver 3/4" Socket 3/4" Open end wrench	

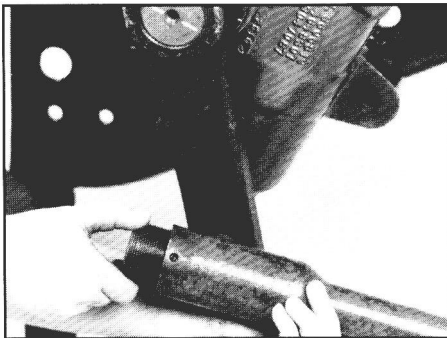
This adjustment can only be completed on the vehicle if the adjusting screw jam nut is accessible. This nut is located on the side cover.

Photos in this section were taken on a mock frame rail for clarity.



Center the sector shaft

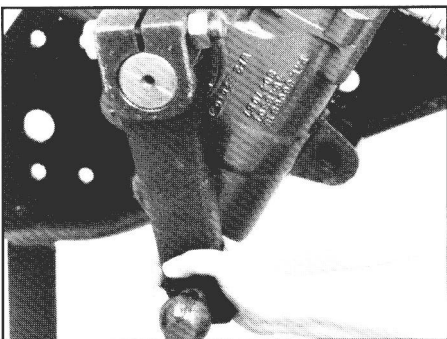
1. With the engine off, rotate the steering wheel (input shaft) until the timing mark on the sector shaft lines up with the mark on the housing. The line on the sector shaft should be at a 90° angle from the input shaft. The sector shaft is now on its "center of travel".



Remove the drag link

2. Remove the drag link from the pitman arm.

**⚠ CAUTION** To avoid resetting the poppets, do not rotate the input shaft more than 1½ turns from the "center of travel" position while the drag link is disconnected.



Check for sector shaft lash

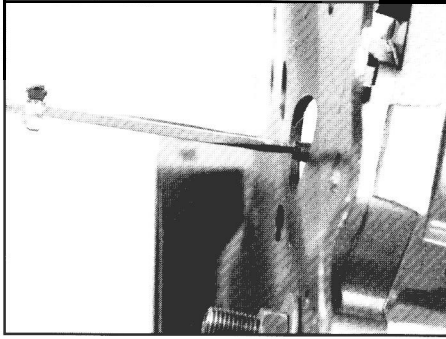
3. From the "center of travel" position, grasp the pitman arm and gently try to rotate it. If looseness or lash is felt at this point, the sector shaft is out of adjustment.



Loosen jam nut

3/4" Socket

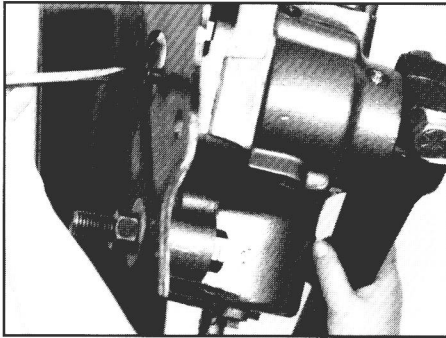
4. Loosen the jam nut



Position adjusting screw

Screwdriver

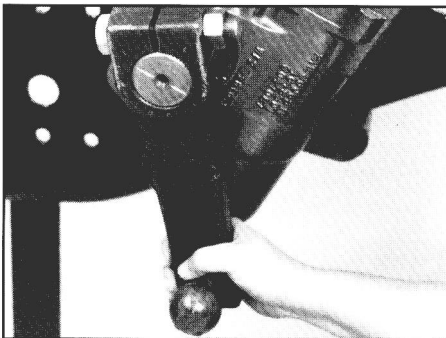
5 If no lash was detected in step 3, turn the shaft adjusting screw counterclockwise until you feel lash at the output shaft,



Adjust shaft

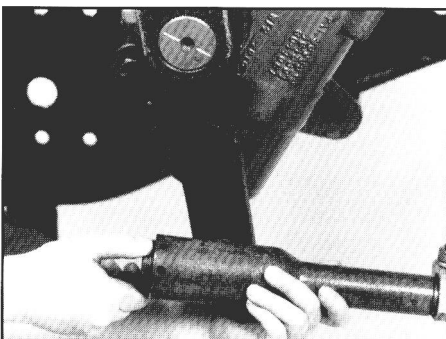
Screwdriver  
3/4" Open end wrench

6 Slowly turn the shaft adjusting screw clockwise until you feel no lash at the output shaft without using more than 10 lbf"ft (14 N-m) of torque, From this position, turn the screw clockwise 1/8 to 3/16 of a turn more. Hold the adjusting screw in place, and tighten the jam nut, Final torque 43 lbf+t (58 N-m).



Recheck for lash

7 Turn the steering wheel 1/4 turn each side of center, then back to center and recheck the pitman arm for lash, You should feel no lash; if there is lash, repeat steps 4, 6 and 7,



Connect drag link

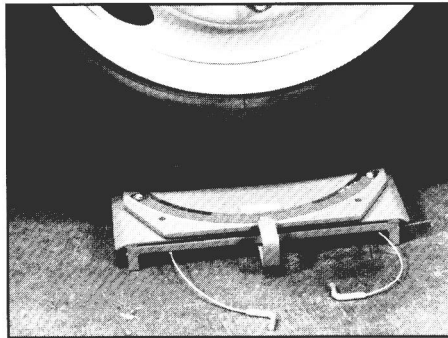
8 Reconnect the drag link to the pitman arm according to manufacturer's specifications.

**CAUTION** Maintain grease in the sector shaft bearing through the grease fitting in the housing using only a hand operated grease gun. Add grease until it begins to extrude past the dirt and water seal. Do not use a power grease gun because it will supply grease too fast this could adversely affect the high pressure seal and contaminate the hydraulic fluid.

# Poppet Readjustment

Tools Required	Materials Required
7/32" Allen wrench 5/8" Open end wrench 3/4" Open end wrench 3/4" Socket Lbf*lb Torque wrench	Hydraulic fluid Jack

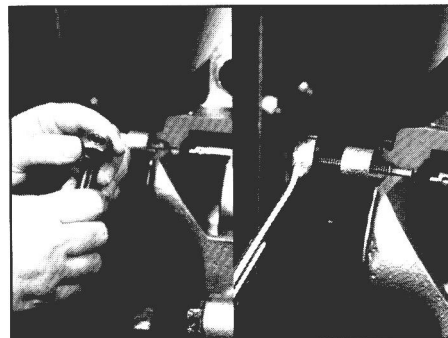
This resetting procedure will work in most cases with at least 1 3/4 hand-wheel-turns from each side of center. If you're making a large reduction in wheelcut and this procedure does not work, you may have to replace or internally reset the poppets using the procedure described in the Poppet Component section of this Service Manual



Set axle stops, warm-up system

1. Set the axle stops to vehicle manufacturer's wheelcut or clearance specifications.

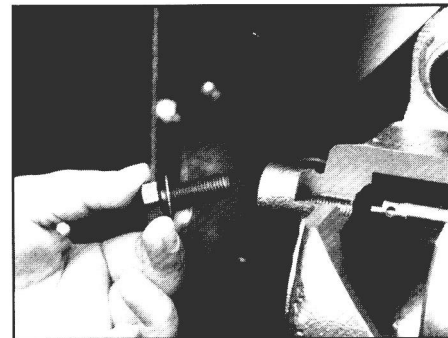
Start the engine and allow the vehicle to idle for 5-10 minutes to warm the hydraulic fluid. Shut off the engine.



Assemble adjusting screw into nut

2. If a new poppet adjusting screw and nut are being used, turn the screw into the non-sealing end of the jam nut until the drive end of screw is flush with the nut.

Your steering gear will have either a fixed stop bolt or an adjusting screw. If the adjusting screw is already part of the steering gear, back the nut off of the adjusting screw until it is flush with the end of the adjusting screw.

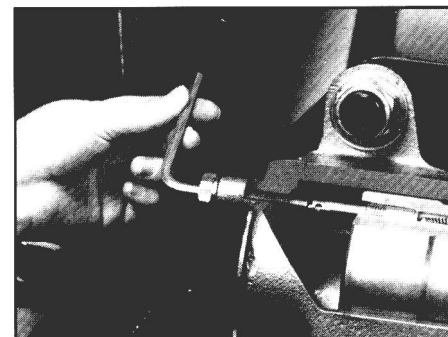


Remove poppet stop bolt

3. Make sure the engine is off and the road wheels are in straight ahead position. Remove and discard the poppet fixed stop bolt (if equipped) and washer (if equipped) from the lower end of the housing.

If the unit has a poppet adjusting screw and sealing nut that need to be replaced, remove and discard them.

5/8" Open end wrench



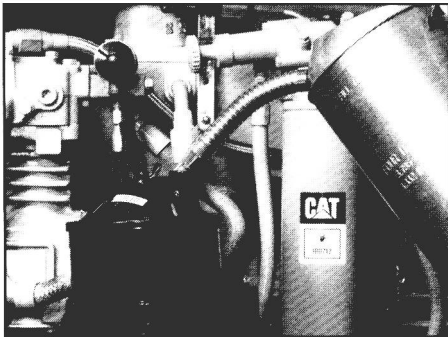
Turn adjusting screw assembly into housing

4. Turn the adjusting screw and sealing nut assembly, without rotating the nut on the screw, into the housing until the nut is firmly against the housing using a 7/32" Allen wrench. Tighten the sealing nut against the housing.

7/32" Allen wrench

1

**CAUTION** If the drive end of the screw is below the face of the nut, the poppet seat flange will break during step 7d.

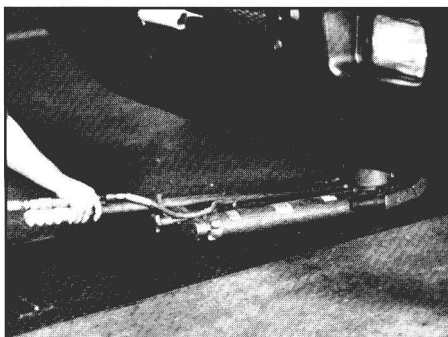


**Refill reservoir**

Hydraulic fluid

5. Refill the system reservoir with approved hydraulic fluid.

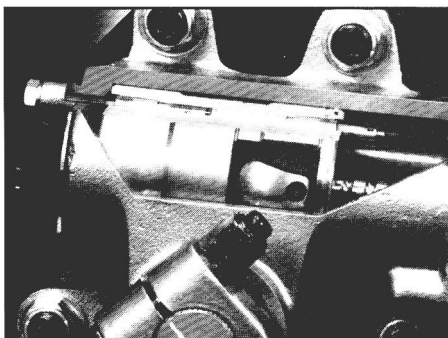
**CAUTION** Do not mix fluid types. Mixing of transmission fluid, motor oil, or other hydraulic fluids will cause seals to deteriorate faster.



**Jack up vehicle**

Jack

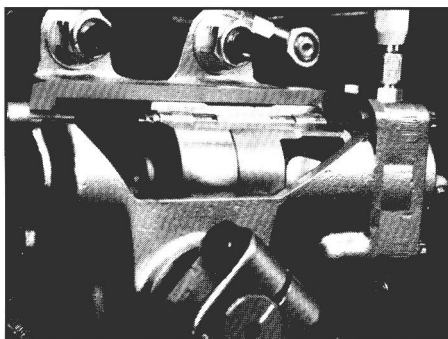
6. Place a jack under the center of the front axle and jack up the front end of the vehicle so the steer axle tires are off the ground.



**Push upper poppet**

7, out to prepare it for setting

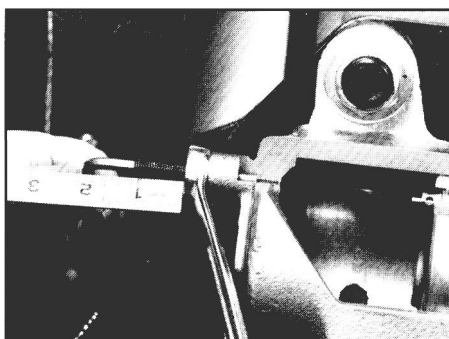
- a) Start the engine and let it run at idle speed,
- b) Note which output shaft timing mark is nearest the housing piston bore,
- c) Turn the steering wheel in the direction that makes this timing mark move toward the adjusting screw just installed. Turn in this direction until axle stop contact is made.
- d) Pull hard on the steering wheel (put up to 40 lb rim pull on a 20" dia. steering wheel) after the axle stop is contacted.



**Set upper poppet**

8.

- a) Turn the steering wheel in the opposite direction (end of timing mark away from adjusting screw) until the other axle stop is contacted.
- b) Pull hard on the steering wheel (put up to 40 lb rim pull on a 20" dia. steering wheel).
- c) Release the steering wheel and shut off the engine.



**Back out adjusting screw**

7/32" Allen wrench  
3/4" Open end wrench

9. Loosen the sealing nut and back out the adjusting screw until 1" is past the nut, Tighten the sealing nut against the housing.

**CAUTION** Do not hold the steering wheel at full turn for more than 10 seconds at a time; the heat build-up at pump relief pressure may damage components.



Set lower poppet



Position adjusting screw

- 7/32" Allen wrench
- 3/4" Open end wrench
- 3/4" Socket
- Lbf•ft Torque wrench

The procedure is complete

10.
  - a) Start the engine and let it idle
  - b) Turn the steering wheel in the original direction (end of timing mark toward adjusting screw), until axle stop contact is made.
  - c) Hold the steering wheel in this position (with up to 40 lb rim pull) for 10 seconds, then release. Repeat this hold and release process as many times as necessary while completing step 11.
11.
  - a) With steering wheel held tightly at full turn loosen the jam nut and hold it in place with a wrench.
  - b) Turn the adjusting screw in (clockwise) using finger-pressure only (don't use a ratchet), until the Allen wrench stops. Do not attempt to turn it in further. Pause the turning-in process each time the driver releases the steering wheel; continue turning only while the wheel is held at full turn.
  - c) Back off the adjusting screw 3/4 turns and tighten the sealing nut. Torque sealing nut to **35 lbf•ft**
12. The poppets have now been completely reset. Lower the vehicle, Check the reservoir and fill if required.

**WARNING** The length of the adjusting screw beyond the nut must be no more than 1/16" for proper thread engagement.

**NOTE** The length of adjusting screw beyond the sealing nut may be different for each vehicle.

## Dual System

### TAS Gear with Linear Cylinder:

Reset the TAS gear using the procedures described above

### TAS Gear with Rotary Cylinder:

Back out the poppet adjusting screws (leave any fixed stop bolts in place) on the assist cylinder as follows:

RCS Rotary - 1" to 1 1/16" of poppet adjusting screw protruding beyond the nut

RCB Rotary - Back both screws out completely, then screw back in 10-12 turns.

Set the main TAS gear using the procedures described above. Leave adjusting screws on rotary cylinders in place as described above after poppets on main gear have been reset.



## Section 4      Reseal & Repair

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Replace Housing Ports, Plugs, Screws, Fittings . . . . .	51
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# Disassembly Preparation

Stop the vehicle with wheels pointed straight ahead,

Clean off all outside dirt from around fittings and hose connections before you remove the gear,

Remove input and output shaft connections per vehicle manufacturer's instructions

**⚠ WARNING** When using a chisel to spread a pinch bolt-type pitman arm boss for assembly or removal from the shaft, maintain a firm grip on the chisel at all times. Failure to do this may result in the chisel flying loose which could cause an injury. Never leave the chisel wedged in the pitman arm boss. If you cannot remove the pitman arm from the shaft with a chisel and your hands, remove the chisel from the arm boss and use a puller only to remove pitman arm.

**⚠ CAUTION** Do not use a hammer on the pitman arm to remove it from sector shaft as internal damage to steering gear could result. Be sure there is no spreading wedge left in the pitman arm boss before tightening pitman arm clamp bolt after assembly on sector shaft. Do not pound the universal joint or input shaft coupling on or off the input shaft as internal damage to the steering gear can result.

**⚠ CAUTION** Unless the poppet adjuster seat and sleeve assemblies (22) are to be removed and replaced or reset for automatic poppet adjustment, or a manual adjustment with a service poppet adjuster screw (59) and nut (60) is anticipated, do not allow the input shaft on a steering gear with the automatic poppet adjustment feature to rotate more than 1.5 input shaft revolutions from "straight ahead position" when the output shaft is disconnected from the vehicle steering linkage; this could disrupt the poppet setting achieved at initial installation. The steering gear is in the "straight ahead position" when the timing marks on the end of the housing trunnion and sector shaft are aligned.

Remove the supply and return lines from the gear, and immediately plug all port holes and fluid lines

**⚠ WARNING** TAS steering gears can weigh up to 110 pounds dry. Exercise caution when you remove, lift, carry, or fix in a bench vise.

Remove the steering gear from the vehicle and take it to a clean work surface.

Clean and dry the gear before you start to disassemble it.

As you disassemble the gear, clean all parts in clean, OSHA approved solvent, and air blow-dry them only.

**⚠ WARNING** Because they are flammable, be extremely careful when using any solvents. Even a small explosion or fire could cause injury or death.

**⚠ WARNING** Wear eye protection and be sure to comply with OSHA or other maximum air pressure requirements.

**⚠ CAUTION** Never steam clean or high-pressure wash hydraulic steering components. Do not force or abuse closely fitted parts. Use care that bearing and sealing surfaces are not damaged by the assembly and disassembly procedures.

Keep each part separate to avoid nicks and burrs.

Discard all seals, o-rings, and gaskets removed from the gear. Replace them with new parts only.

The steering gear should be identified to the vehicle from which it was removed, The poppet adjuster seat and sleeve assemblies are set for that particular vehicle only.

# Disassembly

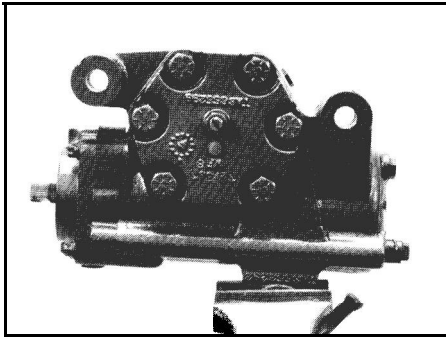
## Tools Required

Allen wrenches  
Pocket knife  
Ratchet  
Rolling head pry bar  
Rubber mallet

Screwdriver  
Sockets:  
● Standard  
● Torx  
Vise

## Materials Required

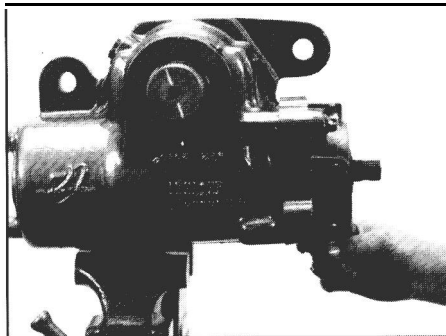
Emery cloth  
Masking tape



Position gear in vise

1. Put the steering gear in a vise, clamping firmly against the housing mounting flange or boss. Input shaft should be horizontal; side cover and valve housing are accessible for disassembly.

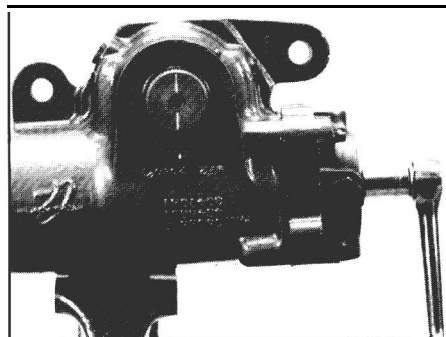
**CAUTION** Do not clamp against body of housing. If mounting boss or flange is not accessible, fabricate and attach a mounting plate to the housing mounting bosses.



Unplug ports

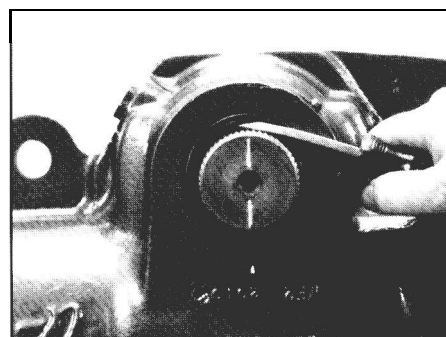
2. Prepare for fluid drainage and unplug hydraulic ports.

Appropriate size socket or open-end wrench



Position sector shaft

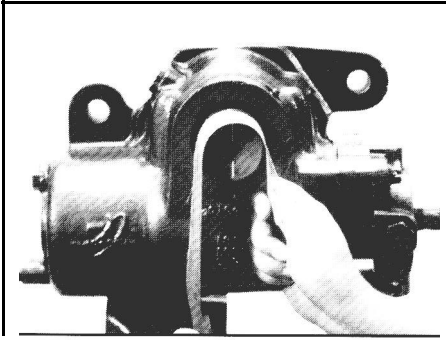
3. Rotate the input shaft until the timing mark on the end of the sector shaft is in line with the timing mark on the end of the housing. This will position the sector shaft for removal.



Remove dirt & water seal

4. Remove and discard dirt & water seal (39) from the housing trunnion.

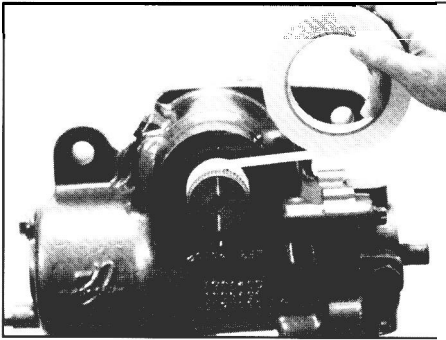
Small screwdriver



**Clean sector shaft** 5

Remove any paint or corrosion from the exposed area of the sector shaft (42).

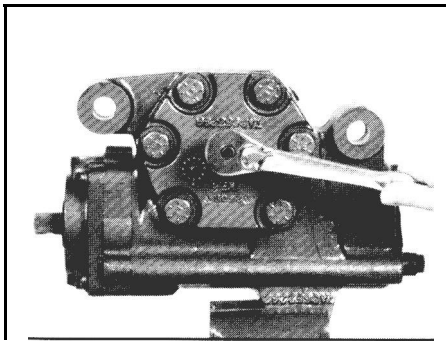
Fine grade emery cloth



**Tape sector shaft** 6

Tape the serrations and bolt groove of the sector shaft with one layer of masking tape. The tape should not extend onto the sector shaft bearing diameter.

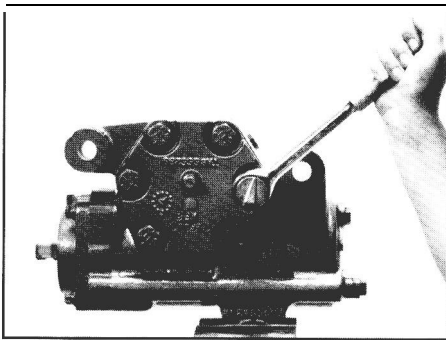
Masking tape



**Remove jam nut** 7.

Remove the sector shaft adjusting screw jam nut (47).

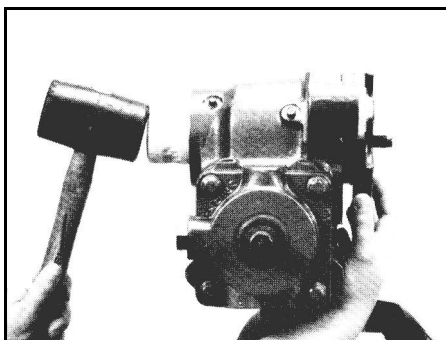
3/4" Socket



**Remove side cover bolts** 8

Be prepared for more fluid drainage and remove the six or eight special bolts (48) from the side cover (46)

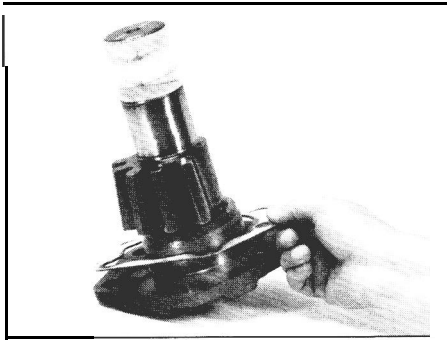
15/16" Socket or  
13/16" Socket



**Remove side cover** 9

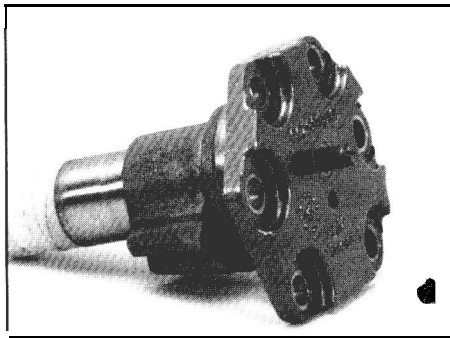
Be prepared for more fluid drainage and remove the side cover and sector shaft assembly from the gear. You may start the shaft and cover assembly removal by tapping the end of the shaft lightly with a soft mallet or wooden hammer handle,

Soft mallet



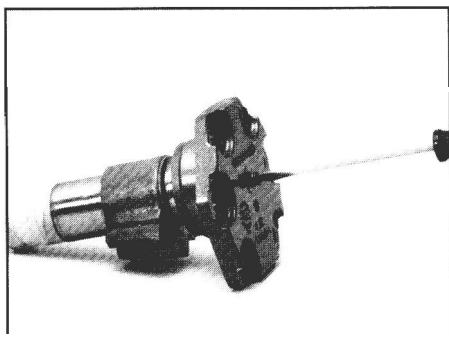
Discard gasket

10. Remove and discard the side cover gasket (45).



Remove vent plug

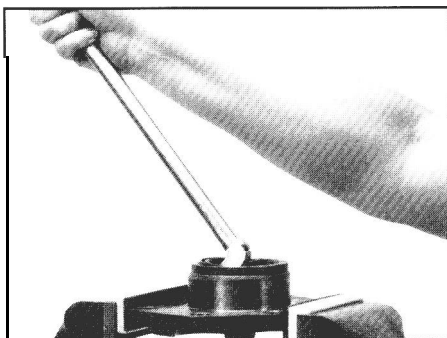
11. Remove and discard the vent plug (49).



Remove sector shaft from cover

Screwdriver

12. Screw sector shaft adjusting screw (43) clockwise through the side cover and pull the sector shaft out of the side cover.



Remove side cover seal

3/8" Drive socket  
Rolling head pry bar

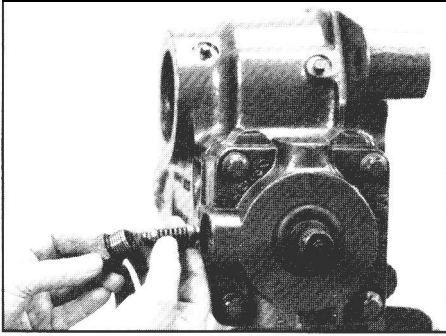
13. **CAUTION** Don't damage the bore or DU bushing when removing the seal. TAS85 gears are not equipped with the DU bushing.

Clamp the side cover in a vise. Place a standard 5/8" or 1 1/16" - 3/8 drive socket in the center of the side cover. pry the seal out with a rolling head pry bar, using the socket for support. Discard the seal and remove the socket.



Inspect adjusting screw and retainer

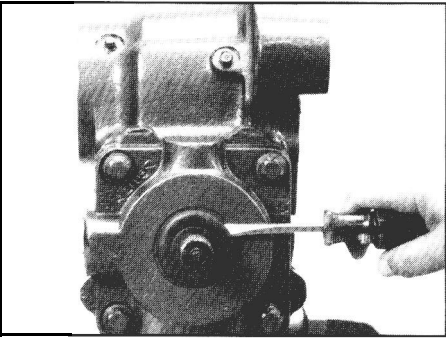
14. Inspect the sector shaft assembly for damaged adjusting screw threads. The retainer (44) must be securely staked in place The adjusting screw must rotate by hand with no perceptible end play (lash)



**Remove relief valve components**

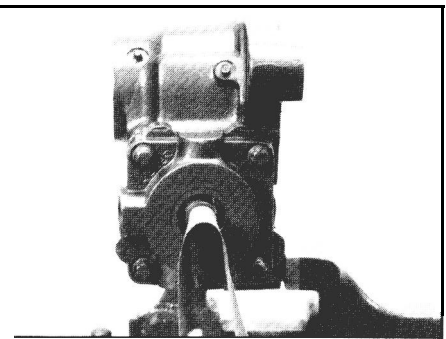
7/8" Socket

15. If equipped, remove relief valve cap (56), o-ring (57) and two-piece relief valve (58) from the valve housing. Discard the o-ring.



**Remove dirt & water seal**

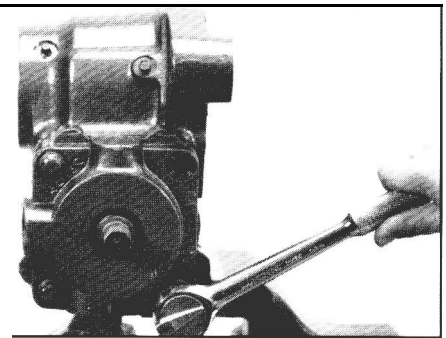
16. Remove and discard the dirt & water seal (2) from the input shaft (13 or 13A)



**Clean input shaft**

Fine grade emery cloth

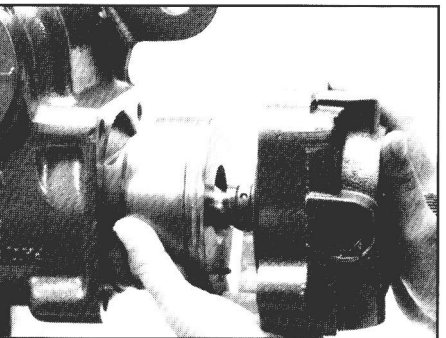
17. Clean any paint or corrosion from the exposed area of the input shaft.



**Remove valve housing bolts**

Torx socket  
E-16 or E-18

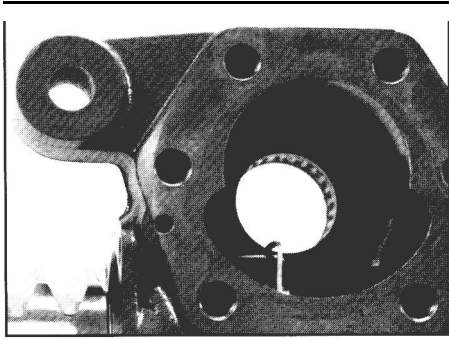
18. Remove the four torx head valve housing bolts (1),



**Remove valve housing, worm and rack subassembly**

19. Be prepared for more fluid drainage and remove the rack piston subassembly. Place the assembly on a clean cloth. For the TAS85 it may help to rotate the input shaft to move the rack piston toward the lower end of the housing. This will force the valve housing to exit the main housing.

**CAUTION** The set position of poppet seat and sleeve assemblies (22) must not be disturbed if the poppets are not going to be replaced or reset during disassembly.

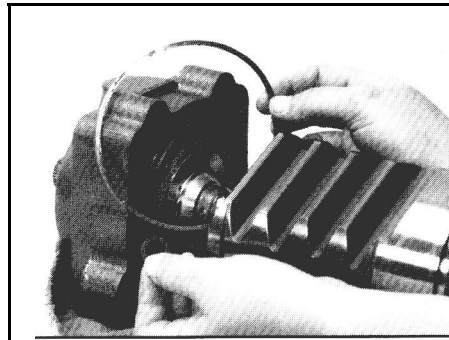


Pocket knife

19A.

**NOTE**

If your gear is short "V" construction, the rack piston seal is on the end of the rack piston farthest from the input shaft. Remove the seal before removing the valve housing assembly to prevent the Teflon rack piston seal ring (20) from "hanging up" when it exits the housing. Expose the seal through the sector shaft cavity, then cut and remove the seal ring from the rack piston.

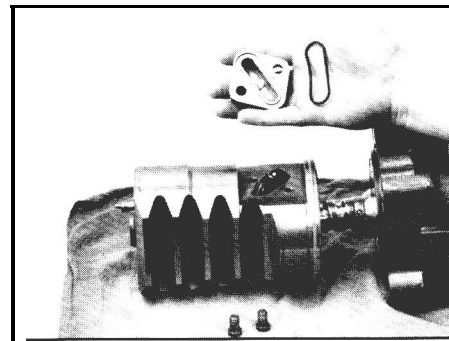


Remove seals

20 Remove and discard the valve housing seal rings (6 & 7).

**CAUTION**

Do not remove the input shaft, valve worm assembly or balls from the rack piston until the ball return guides are removed as damage to the ball guides will occur.

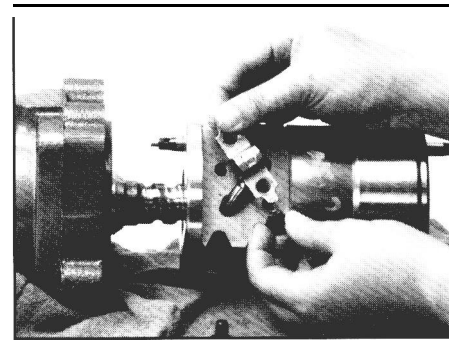


Remove ball return guide cap

21 Remove and discard the two special sealing screws (31). Remove the ball return cap (30) and cap seal (29), discard the seal.

$\frac{5}{32}$ " Allen wrench or T-30 Torx wrench

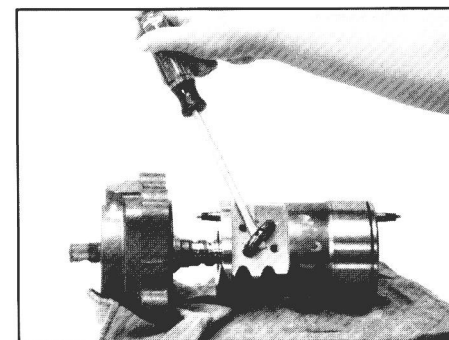
O R



Remove ball return guide clip

21A. Bend down the two tabs (tang) that are against the hex head bolts (33). Remove two bolts and the clip (32). Discard the clip.

$\frac{1}{2}$ " Socket



Remove ball return guides

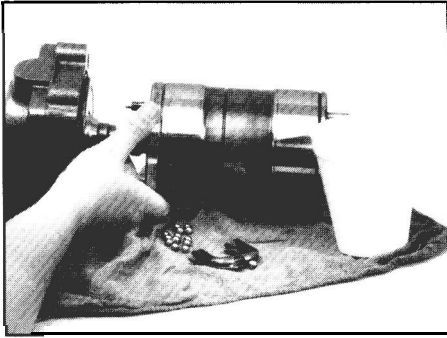
22. Make sure the rack piston is on a cloth so the steel balls that fall out won't roll very far. Remove ball return guide halves (28) by carefully inserting a screwdriver between the rack piston and guides.

Screwdriver

**NOTE**

Left hand ball return guide halves are copper plated for identification and right hand guides are not plated.

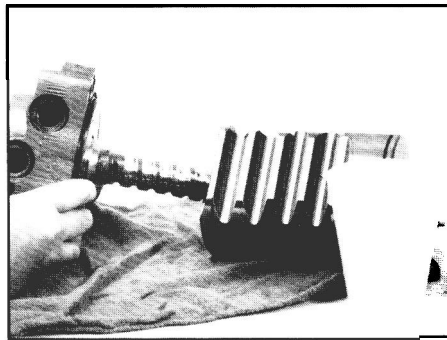




**Remove steel balls**

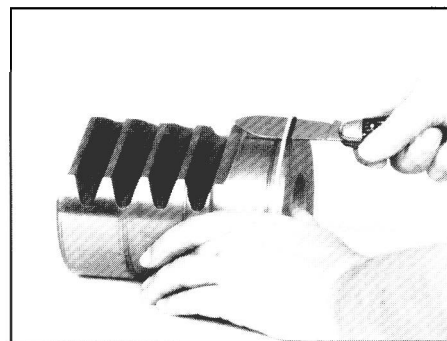
23. Remove the steel balls (27) from the rack piston (19) by rotating the input shaft, valve worm assembly until the balls fall out. Place the balls and return guides in a cup or other container. Count the balls, and make sure all have been removed.

**CAUTION** The steel balls are a matched set. If any are lost, the set must be replaced by service balls. Number or factory balls installed: TAS40-29, TAS55-31 (30 if date code is 337-89 or earlier), TAS65-32, TAS85-34.



**Separate rack piston from worm subassembly**

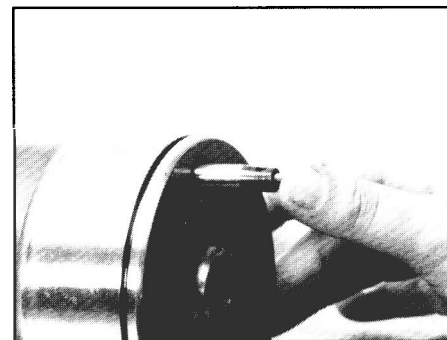
24. Remove the input shaft, valve/worm, valve housing subassembly from the rack piston.



**Remove seal ring and o-ring**

25. Cut and remove the Teflon seal ring (20) and o-ring (21) from the rack piston if not removed during disassembly step 19A.

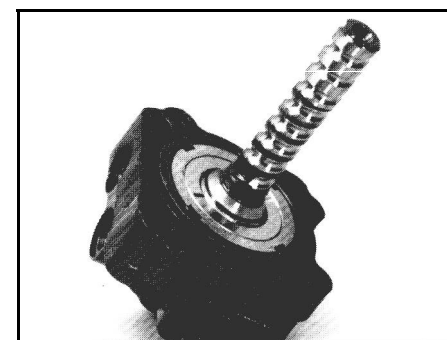
Pocket knife



**Inspect poppet assemblies**

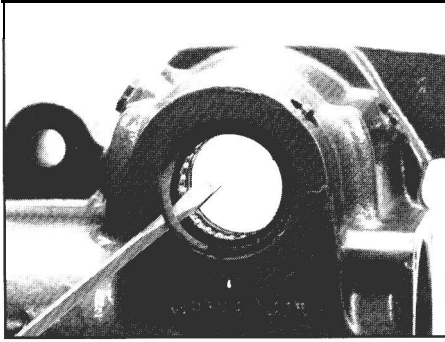
26. Push poppet stems, they should spring back. Push poppet seat, it should not move by hand. If components are bent or broken, poppet stems don't spring back, or poppet seat moves by hand, go to **Poppet Component Replacement** section on page 41. Otherwise, proceed to step 27.

**NOTE** TRW recommends the poppet adjuster seat and sleeve assemblies (22) not be removed unless replacement of poppet components is required.



**Inspect valve housing and worm screw**

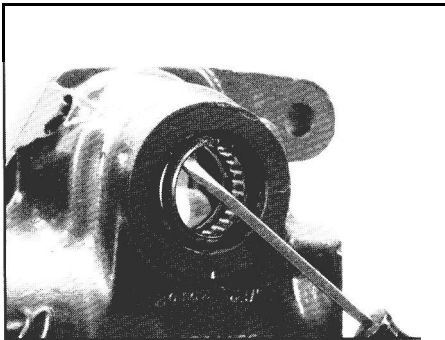
27. Inspect valve housing/worm screw subassembly for heat damage or bearing roughness, If these conditions are present, or if there was excessive internal leakage, or if preload adjustment is required, go to **Valve Housing/Worm Screw Disassembly** procedures on page 43. If not, proceed to step 28.



Remove retaining ring

Screwdriver

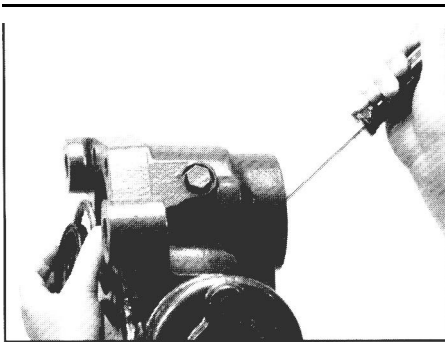
28. Remove the retaining ring (36) that is closest to the output end of the housing trunnion.



Remove dirt seal

Screwdriver

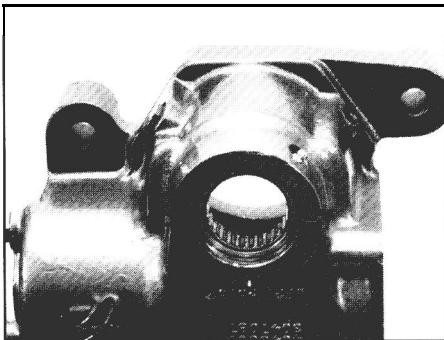
29. Remove and discard dirt seal (38)



Remove pressure seal and spacer washer

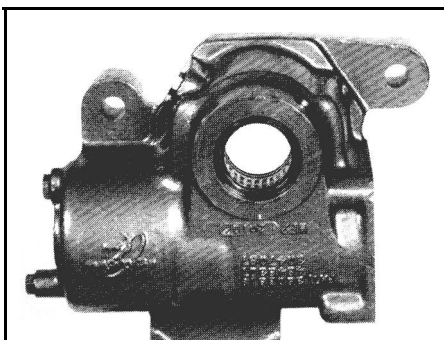
Screwdriver

30. Insert a screwdriver into housing bearing bore from the trunnion end and carefully push seal (41) and spacer washer (40) out of the other end of bearing bore without damaging the sealing area of the bore or the spacer washer. Discard the seal



Inspect roller bearing

31. Inspect roller bearing (37) in the housing for brinelling or spalling. Inspect retaining ring for damage: If replacement of either part is required, go to **Roller Bearing or Retaining Ring Replacement** on page 50. If not, proceed to step 32.



Inspect housing screws, and plugs

32. Inspect the following for damage:

- Poppet fixed stop screw (52 or 52A) and washer (53) if equipped.
- Poppet adjusting screw (59) and sealing nut (60)
- Auto-bleed plug (51)
- Manual bleed screw (50)
- Auxiliary port plugs (54) and o-rings (55)

If any are damaged, go to **Replace Housing Ports, Plugs and Screws** on page 51. If not, proceed to the Inspection Section.

# Inspection

Make sure all sealing surfaces and seal cavities are free from nicks and corrosion. Any nicked or corroded surface requires part replacement to ensure proper sealing.

Wash all parts in clean, OSHA approved solvent. Air blow them dry only

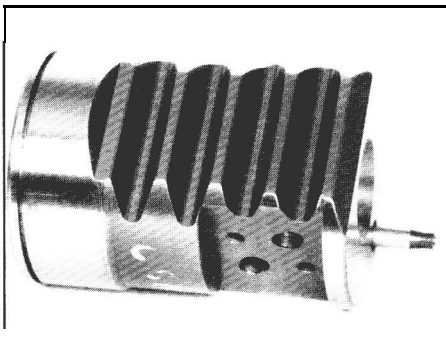
**⚠ WARNING** Because they are flammable, be extremely careful when using any solvents. Even a small explosion or fire could cause injury or death.

**⚠ WARNING** Wear eye protection and be sure to comply with OSHA or other maximum air pressure requirements.

**⚠ WARNING** Any of the following conditions present in the steering gear indicates impact damage.

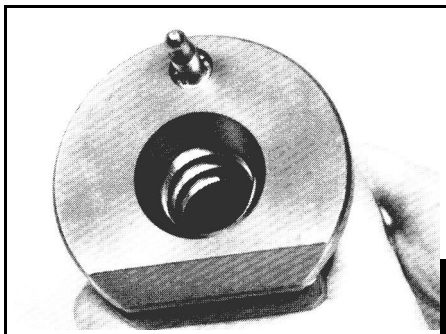
<u>Condition</u>	<u>Area</u>
Brinelling	<ul style="list-style-type: none"> <li>• Ball track grooves of rack piston</li> <li>• Ball track grooves of worm screw</li> <li>• Bearing area of sector shaft</li> <li>• Thrust washers and bearings in valve housing</li> </ul>
Cracks or Breaks	<ul style="list-style-type: none"> <li>• Bearing area of sector shaft</li> <li>• Sector shaft teeth</li> <li>• Rack piston teeth</li> <li>• Housing</li> <li>• Thrust washers and bearings in valve housing</li> <li>• Worm screw</li> </ul>
Twisted serrations	<ul style="list-style-type: none"> <li>• Output shaft serrations</li> </ul>

If one of these conditions is found in one component, be sure to inspect all components carefully for signs of impact damage. Replace components noted in individual inspection steps below if you suspect impact damage. Failure to replace all damaged components could result in a serious vehicle accident.



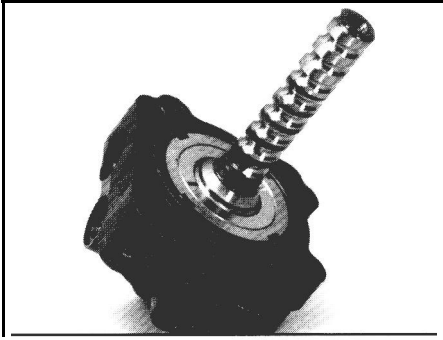
Inspect rack piston 1. teeth

Inspect the rack piston (19) teeth for cracks or obvious damage. If teeth are damaged, replace the rack piston, sector shaft (42) and set of balls (27)



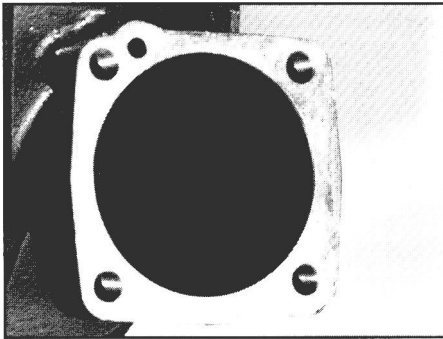
Inspect rack piston 2. ball track grooves

Inspect the rack piston (19) ball track grooves for brinelling or spalling. If either condition exists, replace the input shaft, valve/worm assembly, valve housing, rack piston subassembly and balls.



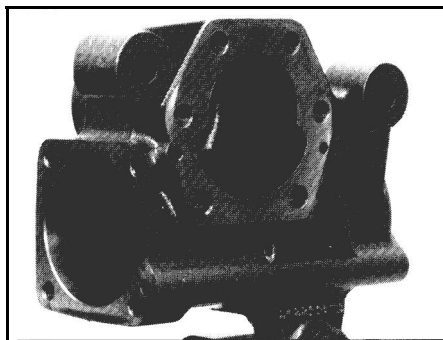
Inspect input shaft, valve/worm assembly sealing areas

3. Inspect the sealing area of input shaft and valve (13 or 13A) for recks, and damage. Inspect for discoloration from excess heat. Inspect input shaft ball-track grooves for brinelling or spalling. If any of these conditions exist, replace the input shaft, valve worm assembly, valve housing and balls. Also replace rack piston if brinelling or spalling is found.



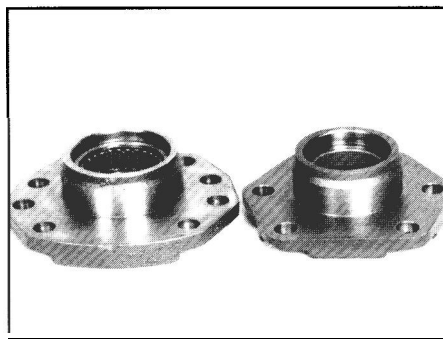
Inspect housing cylinder bore

4. Inspect the housing (34) cylinder bore. some scoring marks are normal, If there was internal leakage greater than 1 gal/rein, make sure there are no damaged seals before replacing the housing.



Inspect housing faces

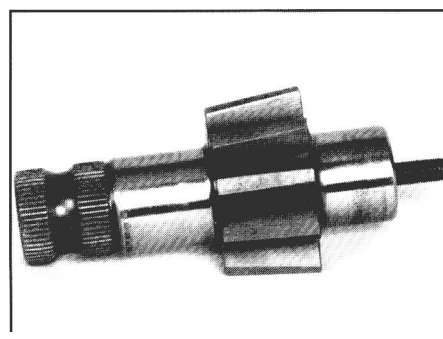
5. Inspect the housing faces for recks that would prevent proper sealing. Replace the gear housing if these recks are present and cannot be easily removed with a fine-tooth flat file without changing the dimensional characteristics.



Inspect side cover bushing/bearing

6. TAS40, 55,65: Inspect side cover (46) DU bushing for damage. Also check side cover bushing to sector shaft clearance. If damage exists, or if clearance exceeds .008" (0.20 mm) replace side cover/bushing assembly.

TAS85: Inspect roller bearing in side cover assembly (46) for brinelling or spalling. If either condition exists, replace the side cover and bearing assembly.



Inspect sector shaft assembly

7. Inspect the sector shaft (42) bearing and sealing areas and sector teeth contact surfaces for brinelling, spalling or cracks. Run your fingernail edge across these areas to detect steps. Remove masking tape from the shaft and inspect for twisted or otherwise damaged serrations. If any of these conditions exist, replace the sector shaft.

<b>NOTE</b>	A service sector shaft will come assembled with the adjusting screw (43) and retainer (44).
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# Assembly Preparation

Wash all parts in clean, OSHA approved solvent. Air blow-dry them only

**⚠ WARNING** Because they are flammable, be extremely careful when using any solvents. Even a small explosion or fire could cause injury or death.

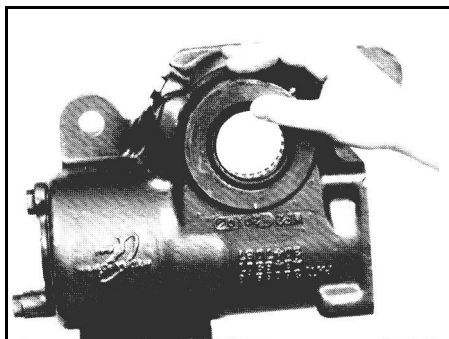
**⚠ WARNING** Wear eye protection and be sure to comply with OSHA or other maximum air pressure requirements.

Replace all seals, seal rings, and gaskets with new ones each time you disassemble the gear

TRW Commercial Steering Division does provide individual seals, seal rings, and gaskets, as well as complete seal kits. These parts should be available through most OEM parts distributors. Contact your local dealer for availability.

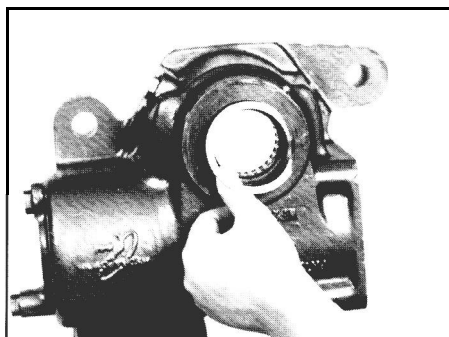
## Assembly

Tools Required		Materials Required		
5/32" Allen wrench	J37071 (TAS55/65)	Sockets	ATF oil	Seal kit: Ross TAS400002
Lbf*ft Torque wrench	J38779 (TAS85)	Torx sockets	Grease (Mobil Temp* 1 or 2 or equivalent)	TAS550002
Hammer	Press	Vise	Masking tape	TAS650006
J37705 (TAS40)	Punch		7/16"-14 x 7/4" All Thread	TAS850002
	Ratchet			
	Screwdriver			



Install dirt seal

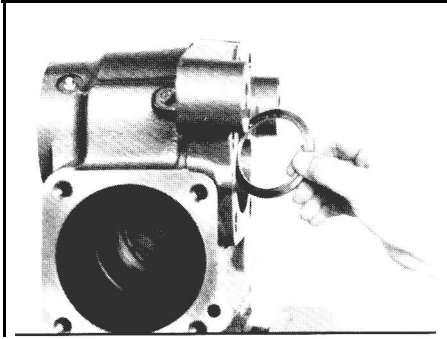
1. Install new dirt seal (38) into the trunnion end of housing sector shaft bore and against bearing with the seal lip out.



Install retaining 2 ring

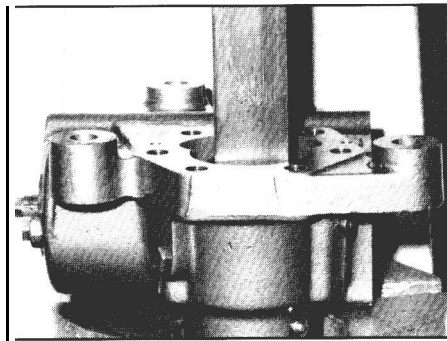
- Install the second retaining ring (36) seating it firmly in the housing retaining ring groove.

\*Trademark of Mobil Oil Corp.



**Install washer**

3. Install washer (40) into the side cover side of housing seal bore with small diameter piloted into retaining ring

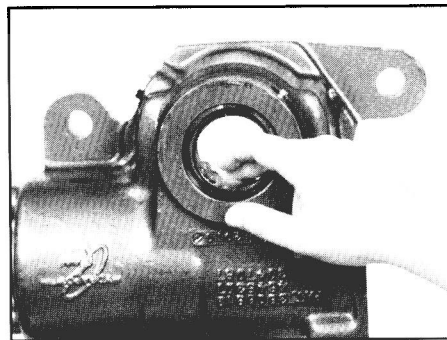


**Press seal into housing**

J37705 (TAS40)  
 J37071 (TAS55/65)  
 J38779 (TAS85)  
 Press

4. Assemble new seal (41) onto bearing and seal tool so the lip with the garter spring is toward the shoulder of the tool.

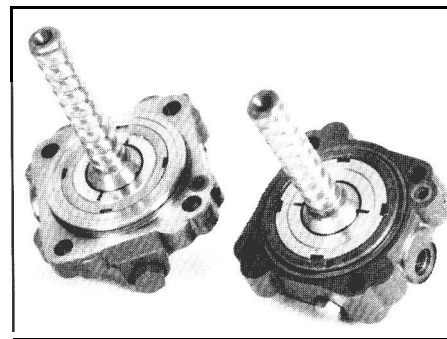
Working from the side cover side of the housing, pilot the seal tool into the washer and bearing and press with a force of 100-800 lb (445-3,560 N) until the seal is seated against washer.



**Pack bearing area with grease**

Grease

5. Liberally pack the area between dirt seal (38) and pressure seal (41) including roller bearing with clean, high temperature industrial grease, Mobil Temp\* 1 or 2 or equivalent.

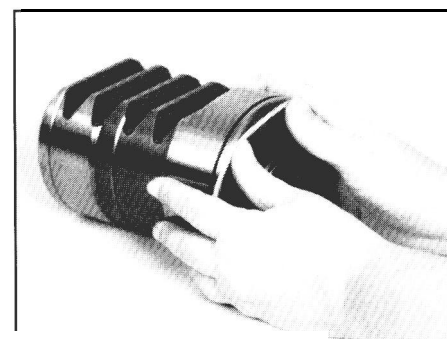


**Assemble seal rings**

6. Lightly oil new seal ring (7) and assemble in valve housing mounting face groove

TAS40, 55,65: Oil new seal ring (6) and assemble in valve housing mounting face groove

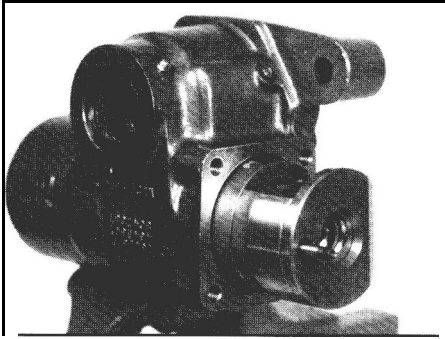
TAS85: Oil new seal ring (6) and assemble in valve housing pilot groove.



**Install rack piston o-ring and seal ring**

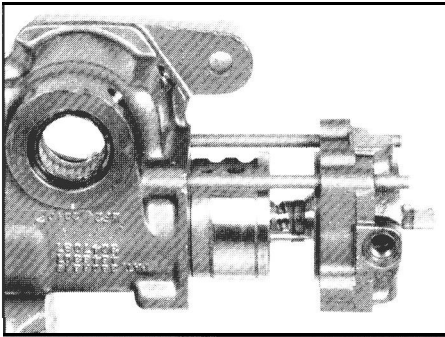
7. Install a new backup o-ring (21) and then a new Teflon seal ring (20) on rack piston (19), Do not over-stretch these rings as you install them. Do not allow the Teflon seal ring to be twisted.

\*Trademark of Mobil Oil Corp



Position rack piston in housing

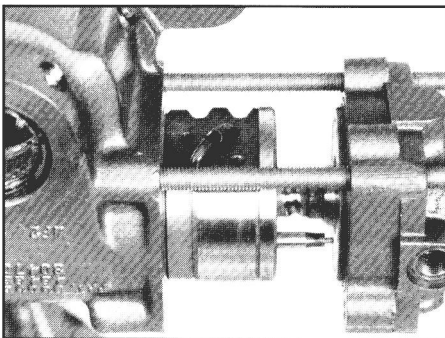
8. Apply clean 011 to housing cylinder bore. Place the rack piston (19) in the housing piston bore with ball return guide holes up.



Insert worm and valve assembly into rack piston

7/16"-14 x 7/4" All Thread

9. Insert the worm screw into the rack piston close to maximum depth, without the valve housing making contact with the poppet stem. Insert two 7/16"-14 All threads through valve housing bolt holes and tighten into housing to support the worm screw. Line up rack piston ball guide holes with the worm ball track grooves by rotating the input shaft.



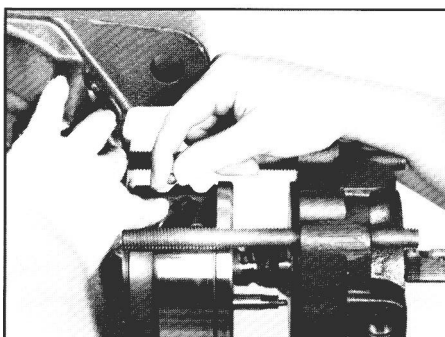
Assemble ball return guide halves

10. Compare the new guides with the guides removed from the gear, use the ones that look the same. Left hand guides are copper plated, right hand guides are unplated. Assemble the new ball return guide halves (28) into the rack piston until seated, rotate the input shaft slightly if necessary.

**WARNING** Do not seat guides with a hammer. Damage to guides can result in subsequent lockup or loss of steering.

**CAUTION** If a new rack piston (19) or a new input shaft, valve, worm subassembly (13 or 13A) is being assembled, the balls (27) removed from the unit must be discarded and a service ball kit utilized. The balls in a service ball kit are sized to function in the ball track guide path as altered by component replacement.

**CAUTION** When using the service ball kit, use the correct quantity of service balls: TAS40-29, TAS55-31, TAS65-32, TAS85-34.



Assemble balls

11. Hold the ball return guides (28) firmly in place during this entire procedure. Insert as many of the steel balls as you can through the hole in the top of the ball return guides. Rotate the input shaft to pull the balls down and around the ball track guide path. Continue until the correct number of balls are in the ball track guide path.

**⚠ WARNING** Hold down the ball return guides until cap or clip is reinstalled.

Failure to hold the guides will result in a trapped ball or balls, which could cause a vehicle accident. If the ball guides become unseated (raise up) at any time, repeat the procedure starting at step 9.

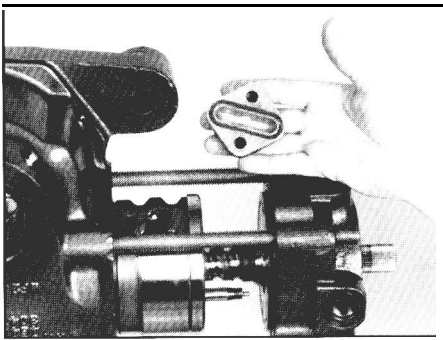
**⚠ WARNING** The correct number of balls are required for proper gear operation.

Count the balls and insert each carefully as in step 11.

	TAS40	TAS55	TAS65	TAS85
Original	29	30/31*	32	34
Service	29	31	32	34

\*TAS55 gears built prior to 338-89 were equipped with 30 balls.

**⚠ CAUTION** Do not allow valve housing to contact the poppet stem or move more than 2½ inches (69.1 mm) from upper end of rack piston during these procedures. This could incorrectly reset the poppet, or back out worm beyond closed ball loop, trapping balls.

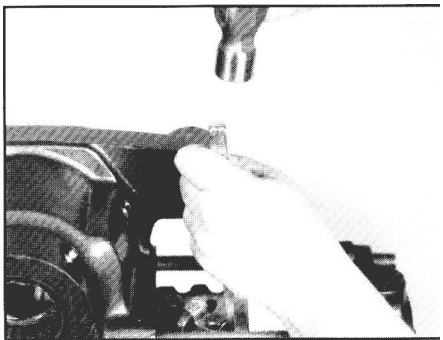


Assemble ball return guide cap, if equipped

5/32" Allen Or T-30 Torx socket  
Lbf\*in. Torque wrench  
Grease

- 12 If your gear is equipped with the ball return guide cap (30), grease a new ball return guide cap seal (29) and place it in the seal groove of the cap. Assemble the cap so the seal makes full contact with the rack piston surface. Install two new Allen or Torx head screws (31) and torque each screw alternately until a final torque of 18 lbf-ft (24.5 N-m) is achieved.

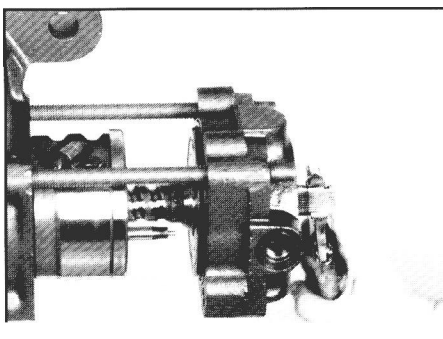
OR



Assemble ball return guide clip, if equipped

1/2" Socket  
Lbf\*in. Torque wrench  
Punch  
Hammer

- 13 If your gear is equipped with a ball return guide clip (32), instead of a cap, install a new clip so both bolt hole faces are in full contact with the rack piston surface. Install the two hex head bolts (33). Torque the bolts to 18 lbf.ft (24.5 Nom). Finish by bending the guide clip locking tabs up against the bolt head flats

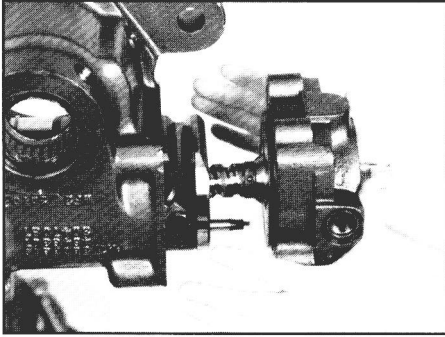


Rotate input shaft to check for proper installation of balls

14. Rotate the input shaft from one end of travel to the other without contacting the poppet stem to the valve housing, and without moving the valve housing face more than 2½" (69,1 mm) from input end (upper end) of rack piston. If you cannot rotate the input shaft, remove the balls and reassemble them.

**⚠ WARNING** If you install a gear on a vehicle with the worm shaft unable to rotate, the gear will not function correctly. Steering and gear failure may result.





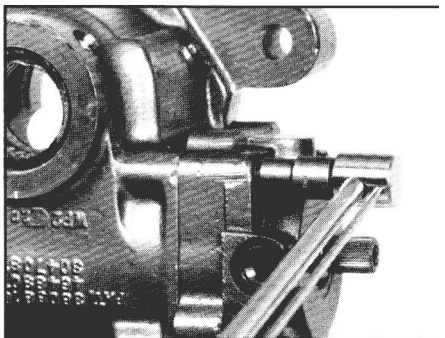
Install rack piston, worm, valve assembly

Oil

- 15 Apply clean oil to Teflon seal ring (20) on rack piston, Make sure there is a space of 3/8 - 1/2" (10,0-13,0 mm) between valve housing (5) and poppet stem to prevent poppet contact at either end. Remove the All Threads, and push the rack piston assembly into the housing with the rack piston teeth toward the sector shaft cavity, Line up the valve housing cylinder feed hole with the gear housing feed hole. Make sure both o-rings in the valve housing remain in position.

**CAUTION** Do not damage the seal ring (19) while installing the rack piston into housing. If the seal ring end of rack piston enters the housing first, the seal ring will be destroyed when the rack is removed.

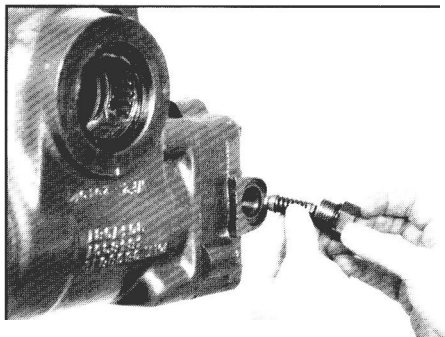
**CAUTION** The poppet seat and sleeve assemblies (22) must not bottom against the internal poppet stops in the steering gear until the gear is installed on the vehicle and the poppet adjustment procedures are performed.



Install valve housing bolts

E-16 Torx socket (TAS40, 55, 65)  
E-1 8 Torx socket (TAS85)  
Lbf\*ft Torque wrench

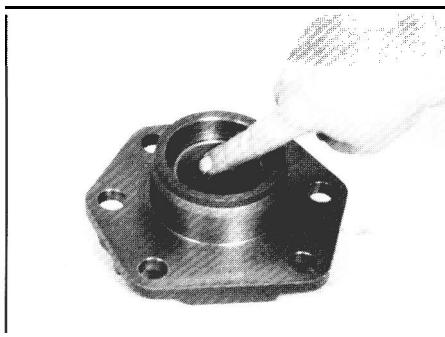
- 16 Lubricate and Install the four valve housing bolts (1) into the housing. Torque the **TAS40, 55** and **65** bolts alternately to **80 lbfdt** (1 08.5 Nom), Torque **TAS85** bolts to **118 lbf\*ft** (160 N-m)



Install relief valve parts

7/8" Socket  
Lbf\*ft Torque wrench

- 17 If the gear is equipped with a relief valve, assemble a new o-ring (57) on relief valve cap (53). Assemble the small end of tapered spring onto the pin on the relief valve cartridge and insert the assembly, (large end of tapered spring end first) into the relief valve cap cavity. Turn the relief valve cap as assembled into the valve housing and torque to **30 lbfdt** (41 N-m).

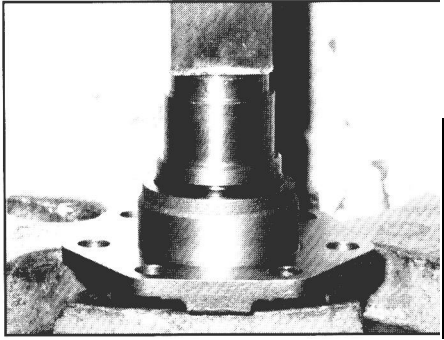


Lubricate side cover bushing/bearing

- 18 **TAS40, 55,65:** Lightly 011 DU bushing. Do not grease.  
**TAS85 only:** Apply a generous amount of Mobil Temp' 1 or 2 (do not substitute another type of grease) to the caged bearing assembly inside the side cover.

**CAUTION** This bearing is sealed and will receive no lubrication from the hydraulic fluid in the gear. Failure to use the proper grease could result in premature bearing wear.

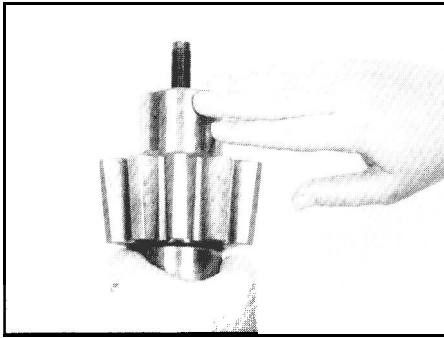
\*Trademark of Mobil Oil Corp.



Press seal in side cover

J37705 (TAS40)  
J37071 (TAS55, 65)  
J38779 (TAS85)  
Press

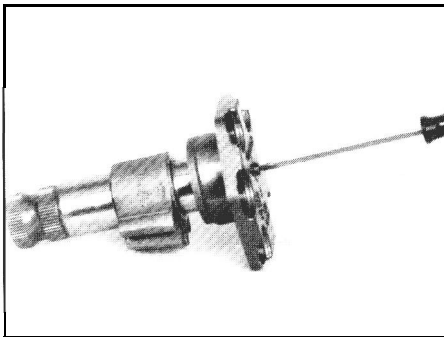
19. Grease and assemble new seal (41 ) onto installation tool so the side with the garter spring is against the shoulder of the tool. Pilot the tool into the side cover (46) with a force of 100-800 lb (445-3560 N) until it is seated against the bearing or bushing.



Lubricate sector shaft

20. **TAS40, 55,65:** Lightly oil short bearing area of sector shaft. Do not grease.

**TAS85only:** Apply a generous amount of Mobil Temp\* 1 or 2 or equivalent to the short bearing area of the sector shaft.

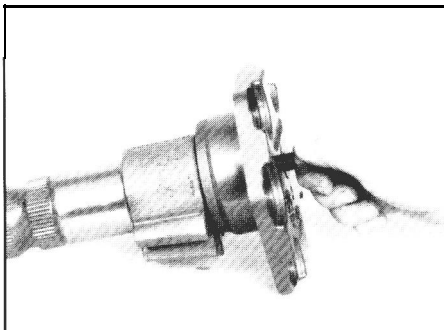


Install sector shaft into side cover

Screwdriver

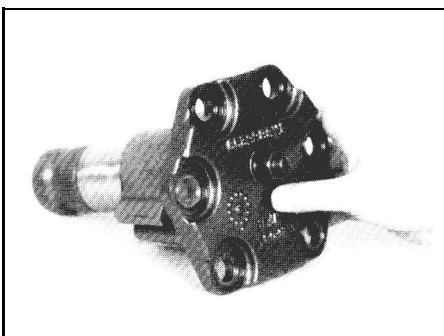
21. Insert the sector shaft (42) into the side cover subassembly (46), and screw the sector shaft adjusting screw (43) counterclockwise into the side cover until the screw reaches solid height.

Rotate the adjusting screw clockwise one half turn so the side cover will rotate freely on the sector shaft.



Install jam nut

22. Install the sector shaft adjusting screw jam nut (47) onto the sector shaft adjusting screw (43) a few threads. Final adjustment will be made later.

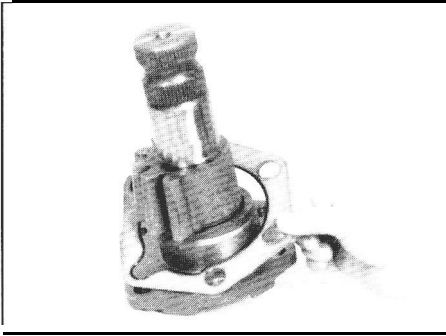


Assemble vent plug

23. Press the new vent plug (49) into the hole provided in the side cover until the plug is bottomed.

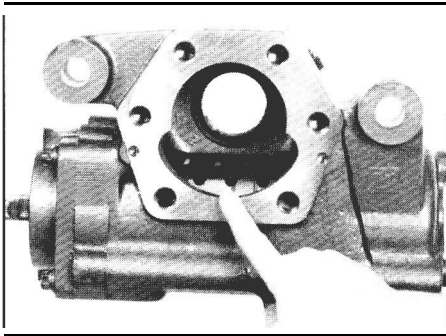
**WARNING** Do not weld or otherwise plug this hole in any permanent manner. This is a safety vent which functions only if the side cover seal fails. If the seal fails and the plug cannot vent, the steering gear may lock-up or otherwise malfunction.

\*Trademark of Mobil Oil Corp.



Install side cover gasket

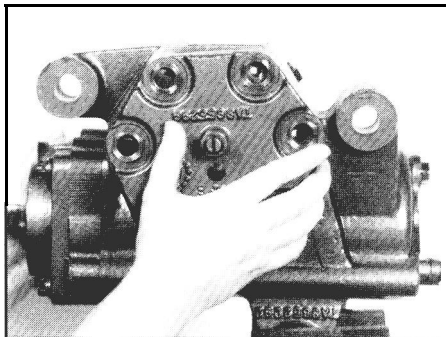
24. Apply clean grease to the new side cover gasket (45) to hold it in place and assemble it onto the side cover (46).



Center rack piston

25. There are four teeth on the rack piston. Rotate input shaft to position the rack piston so the space between the second and third tooth is in the center of the sector shaft opening. This will center the rack piston for assembly of sector shaft.

**WARNING** If the rack piston is not centered when sector shaft is installed, gear travel will be severely limited in one direction. This could result in an accident.

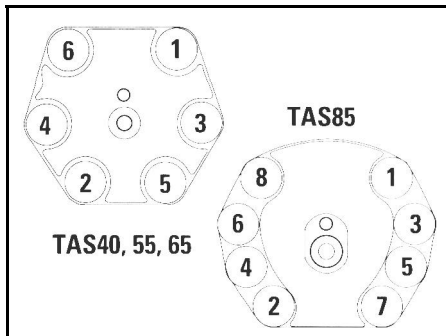


Install sector shaft and side cover into housing

Masking tape

26. Clean off any old tape on the serrations. Reapply one layer of masking tape. Install the sector shaft assembly into the housing. The center tooth of the sector shaft must engage the center space (between the second and third tooth) of the rack piston, with side cover gasket in place.

**CAUTION** If the serrations are not properly taped, they will damage the output seal (38) in housing, causing the seal to leak.

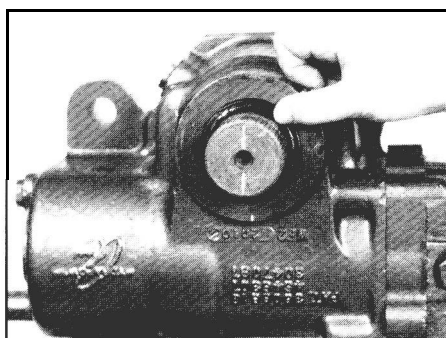


Install side cover bolts

13/16" Socket (TAS40)  
15/16" Socket (TAS55, 65, 85)  
Lbf\*ft Torque wrench

27. Install the special side cover bolts (48) into the side cover and torque them in the sequence shown. If bolts must be replaced, use bolts of the same design, type and length as those you removed. Do not use a substitute.

Lubricate side cover bolts and torque TAS40 bolts to 118 lbf\*ft (160 N\*m), TAS55, 65 and 85 bolts to 170 lbf\*ft (230 N\*m),

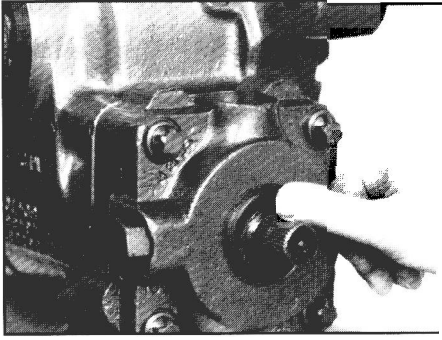


Assemble trunnion dirt seal

Mobil Temp\* 1 or 2 or equivalent

28. Remove tape from sector shaft and pack the end of housing trunnion area at the sector shaft with clean, high temperature industrial grease, Mobil Temp\* 1 or 2 or equivalent. Apply more of the grease to inside of the new trunnion dirt seal (39) and assemble it over the sector shaft and into the trunnion bore.

\*Trademark of Mobil 011 Corp.



Install dirt & water seal

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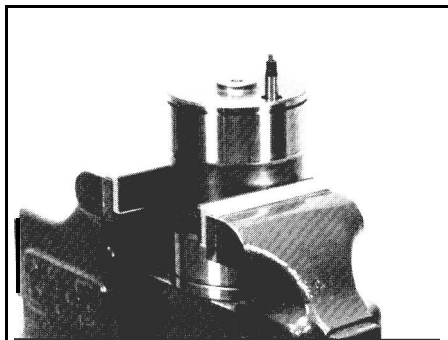
29. Pack the end of the valve housing bore around the input shaft with clean, high temperature industrial grease, Mobil Temp\* 1 or 2 or equivalent. Apply more of the grease to the inside of a new dirt and water seal (2) and install it over the input shaft and seat it in the groove behind the serrations and against the valve housing.

Proceed to Final Adjustments on page 52.

\*Trademark of Mobil Oil Corp.

# Poppet Component Replacement

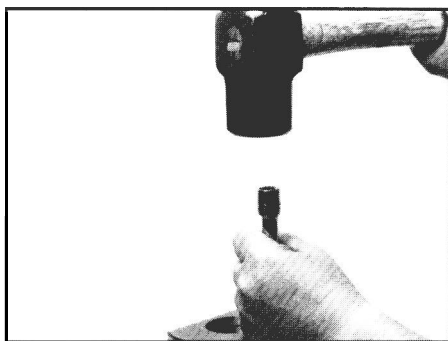
Tools Required	Materials Required
2 lb Sledge Lbf=ft Torque wrench J36452-A Press 3/8x6" drill rod	Locquic "T primer Loctite RC680



**Place rack piston in vise**

Soft-jawed vise

- 1 If the poppet assemblies are to be removed for replacement, place rack piston in a soft-jawed vise.

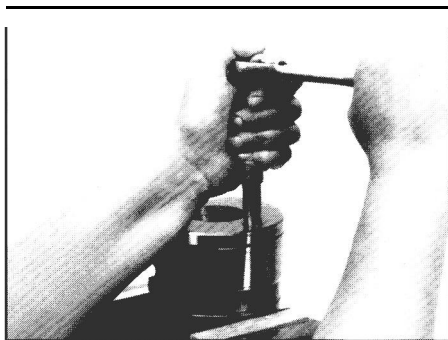


**Loosen poppet adjuster seat**

J36452-A  
 2 Lb Sledge

- 2 Slide special tool #J36452-A over the seat of poppet adjuster seat and sleeve assembly (22) and engage tool in the slots in the threaded sleeve, Hit the end of the tool firmly four or five times with a 2 lb sledge hammer to loosen Loctite,

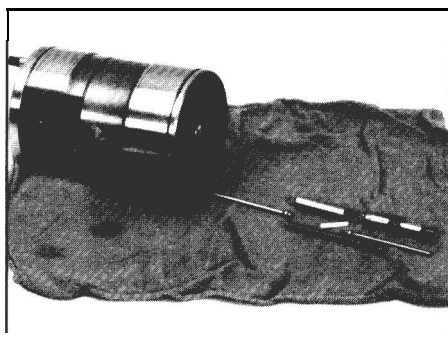
**CAUTION** Poppet adjuster seat and sleeve assemblies (22) are retained by Loctite applied to the threads which makes the assemblies difficult to remove.



**Remove poppet adjuster seat**

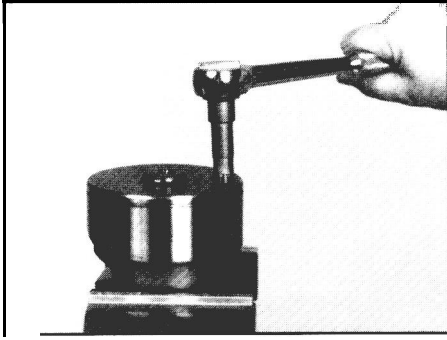
J36452-A

- 3 With a ratchet applied to the tool, turn one adjuster seat and sleeve assembly out of the rack piston. If the ratchet does not turn easily, strike the adjuster removal tool again with a hammer. If the engaging tangs won't stay in place while torquing, it might be necessary to hold in place with an arbor press while applying loosening torque. Discard poppet seat and sleeve assembly.



**Remove poppet components**

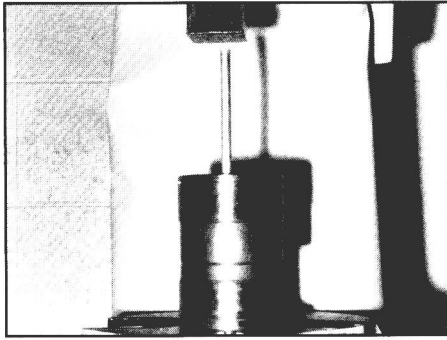
- 4 Remove the two poppets (23), spring (24), spacer rod (25), and push tube (26)



5 Remove other seat & sleeve if necessary

Remove and discard remaining poppet seat and sleeve assembly only if required

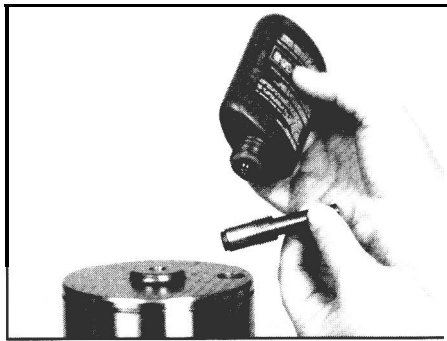
<b>NOTE</b>	It is possible to reset one poppet adjuster seat and sleeve assembly for automatic poppet adjustment while it is in the rack piston if one adjuster seat and sleeve assembly and the poppets, spring, spacer rod and push tube are removed.
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6, Reset remaining poppet seat and sleeve assembly

Press  
3/8" X 6" Drill rod

6, If one poppet seat and sleeve assy. (22) was left in rack piston, it can be reset for automatic poppet adjustment by inserting a 3/8" (9.52 mm) diameter X 6" (152.4 mm) drill rod down through the poppet seat hole at the opposite end of the rack piston and against the adjuster seat to press the seat in until it bottoms against the adjuster sleeve.

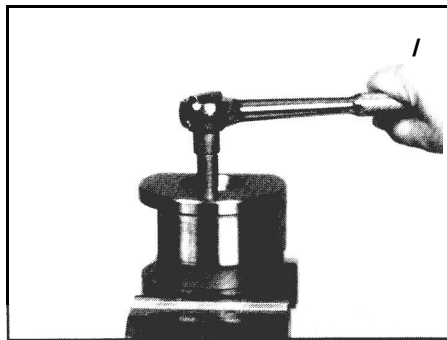


7, Apply Locquic "T" primer and Loctite RC680

Locquic "T" primer  
Loctite RC680

7, Carefully apply Locquic "T" primer to the threads in poppet holes, and threads on the new seat and sleeve assemblies (22). Allow to dry for ten minutes; then carefully apply Loctite RC680 to same threads.

<b>CAUTION</b>	Do not allow Loctite or Locquic to get on the adjuster seat component of the adjuster seat and sleeve assembly. The poppets will not function properly.
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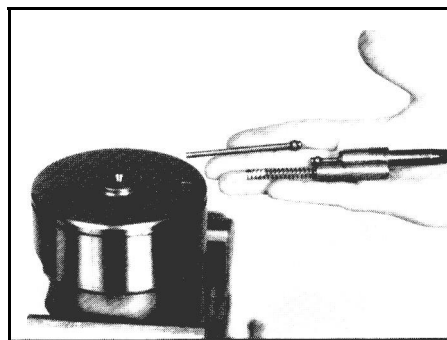


8, Install one poppet seat and sleeve assembly

Soft-jawed vise

<b>WARNING</b>	Wear eye protection while assembling poppets, as spring loaded poppets could eject and cause eye injury.
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Place rack piston (19) in a soft-jawed vise and turn one new poppet adjuster seat and sleeve assembly (22), (slotted end out) into the poppet hole in one end of rack piston.



9, Install remaining poppet components

J36452-A  
Lbf•ft Torque wrench

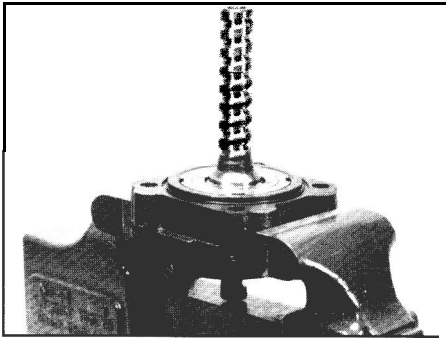
9. From the other end of the poppet hole in the rack piston, install: one poppet (23), poppet spring (24), nylon spacer rod (25), push tube (26), other poppet (23), and the other new poppet adjuster seat and sleeve assembly (22).

Torque both poppet seat and sleeve assemblies to 18 lbf.ft (25 N\*m).

Return to step 27, page 29.

# Valve Housing/Worm Screw Disassembly

Tools Required		Materials Required
Hammer	Lbf*in. Torque wrench	Small probe or pick
Lbf*ft Torque wrench	J37464	Sockets
Punch, center	J37070	12-point sockets
Punch, roll pin	J37073	
	Screwdriver	



Place valve housing and valve assembly in vise

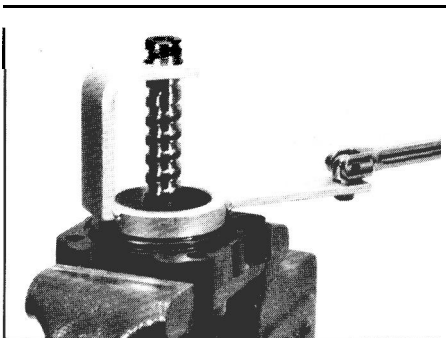
1. With worm vertical, place the valve housing, input shaft, valve/worm assembly in a vise.



**Unstake adjuster locknut**

Roll pin punch  
Hammer

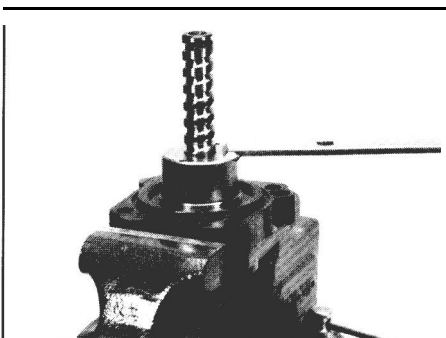
2. Unstake the valve housing (5) where it was upset into the adjuster locknut (1 8) slot, Also unstake adjuster nut from adjuster (1 7).



**Remove bearing adjuster locknut**

J 3 7 4 6 4

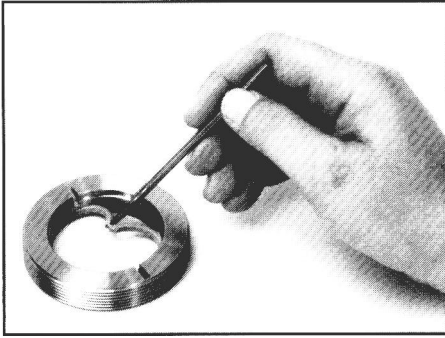
3. Turn bearing adjuster locknut (18) out of the valve housing



**Remove bearing adjuster**

J37070

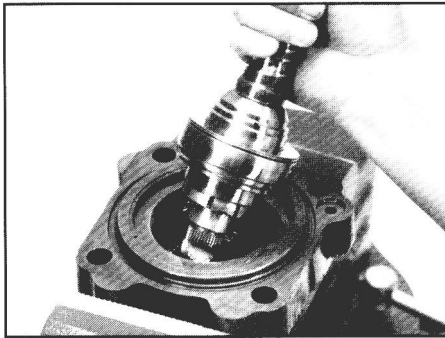
4. Turn bearing adjuster (17) out of the valve housing,



Remove seal ring and o-ring

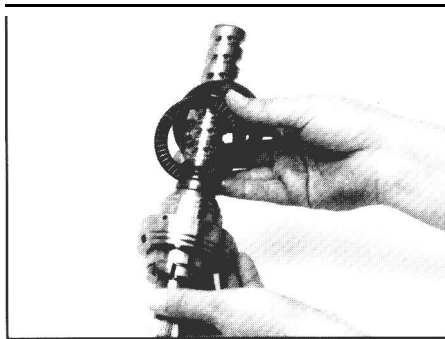
Small probe or pick

5. Remove and discard seal ring (8) and o-ring (9) from bearing adjuster.



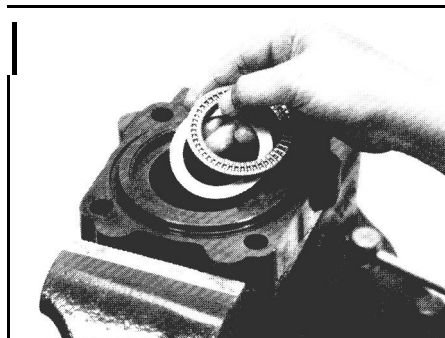
Remove input shaft

6. Remove the input shaft, valve/worm assembly (13 or 13A) from the valve housing



Remove thin washer and bearing

7. Remove thin thrust washer (16) and thrust bearing (15) from input shaft.

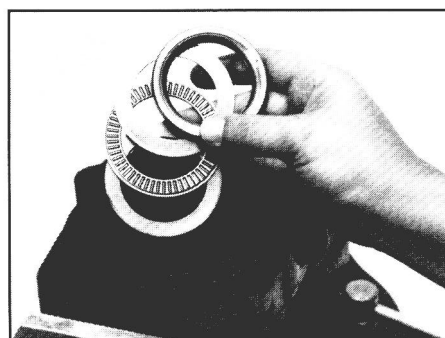


Remove thick washer and bearing

8. Remove thick thrust washer (12) and thrust bearing (15) from valve housing.

**CAUTION** Input shaft, valve worm assembly must not be disassembled further. The components were a select fit at assembly and are available only as part of this subassembly. If disassembled further, the subassembly must be replaced.

OR

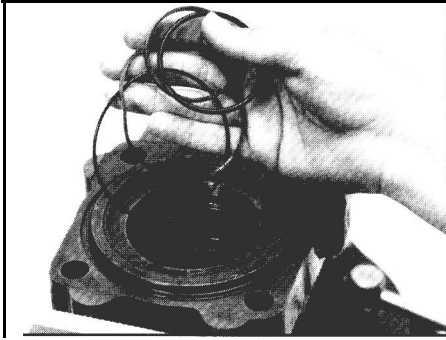


Remove bearing components

- 8 A For alternate construction TAS65 gears, remove spacer sleeve (14), thin washer (16), thrust bearing (15) and thick washer (12).

**WARNING** If the TAS65 gear has a ball bearing and ball race in the valve housing, remove them and call TRW for disposition. Do not rebuild the gear.

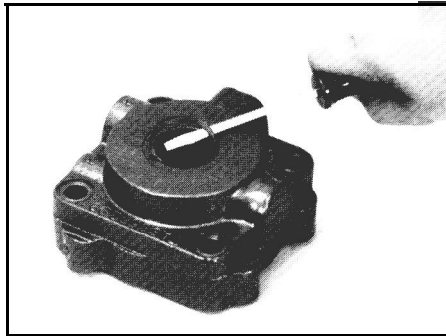




**Remove seal rings and o-rings**

Small probe or pick

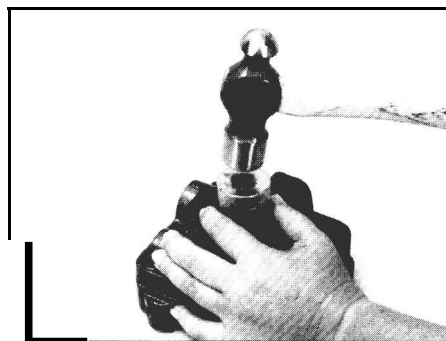
9. Remove and discard seal rings (10) and (8) and o-rings (11) and (9) from valve housing (5).



**Remove retaining ring**

Screwdriver

10. Turn over valve housing and remove retaining ring (3)



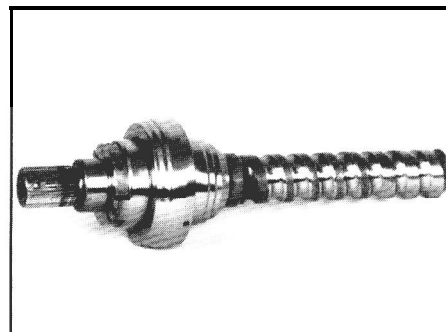
**Remove seal**

1 1/8" Socket Hammer

11. **CAUTION** Exercise special care when removing seal (4) to prevent damaging the valve housing seal bore.

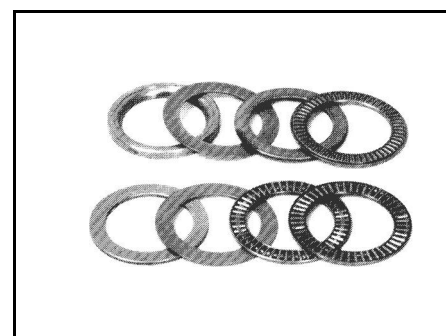
Tap input shaft seal (4) out of valve housing, Discard seal.

**NOTE** The valve housing also utilizes a ball plug for manufacturing purposes that must not be removed,



**Inspect input shaft, valve worm assembly sealing areas**

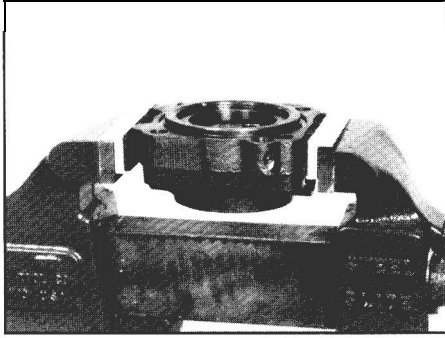
12. Inspect the sealing areas of input shaft and valve (13 or 13A) for nicks and run your fingernail edge across the sealing surfaces to detect steps. Inspect for discoloration from excess heat. Inspect input shaft ball-track grooves for brinelling or spalling, If any of these conditions exist, you must replace the input shaft, valve/worm assembly, valve housing and balls. Also replace rack piston if brinelling or spalling is found



**Inspect thrust washers and bearings**

13. Inspect the thrust bearing (15) rollers for any deterioration. Inspect thrust washers (12 & 16) for brinelling, spalling, or cracks. Replace any part with these conditions.

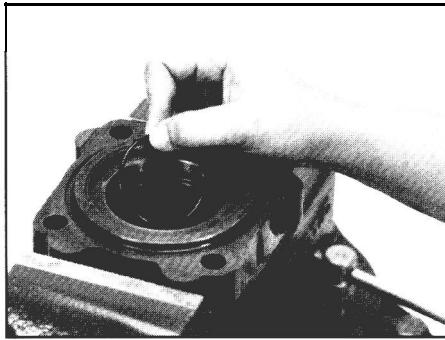
**Alternate Construction TAS65:** If spacer sleeve (14) is damaged, **replace the input shaft/valve/worm subassembly** and use thick washer and roller bearing only during reassembly.



**Place valve housing in vise**

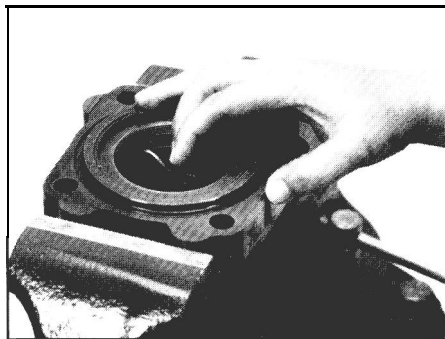
14. Place valve housing (5) firmly in a vise so the input shaft, valve/worm assembly (13 or 13A) can be assembled vertically with the worm end up

**CAUTION** Do not clamp against threaded port hole or relief valve hole sealing faces when placing valve housing in vise.



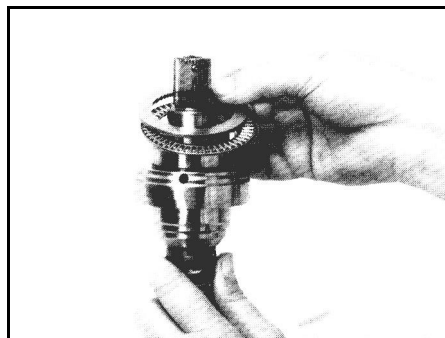
**Assemble o-ring**

15. Oil and assemble a new o-ring (9) into its counterbore in valve housing



**Assemble other o-ring and seal ring**

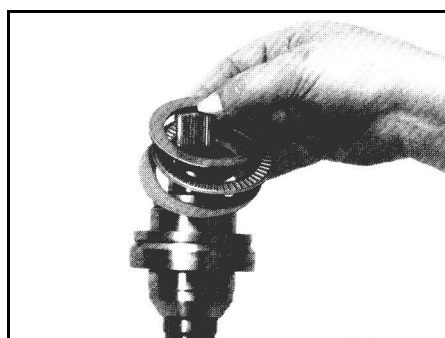
16. Lightly oil and assemble new o-ring (1 1) and new seal ring (10) into the large diameter seal ring groove in valve housing, bending and working them in and smoothing them out as necessary.



**Install roller thrust bearing and washer**

- 17 Install roller thrust bearing (15) and then the thick washer (12) (square side out) onto input shaft end of input shaft, valve, worm subassembly, seating them against the input shaft thrust face.

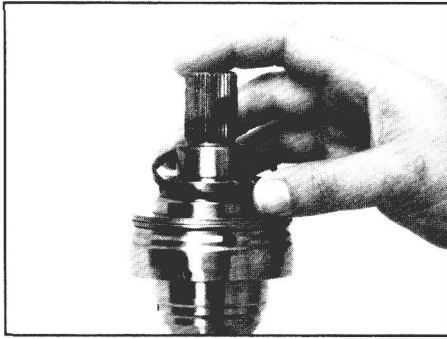
O R



**Install bearing components**

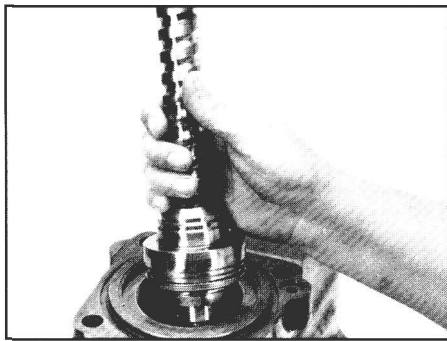
- 17A. Alternate construction TAS65: Assemble spacer sleeve (14) onto input shaft with radiused side toward valve. Make sure sleeve is square. Assemble thin washer (16), thrust bearing (15) and thick washer (12) onto input shaft behind spacer sleeve.

**CAUTION** If you are replacing the input shaft/valve/worm assembly, discard spacer sleeve and thin washer.



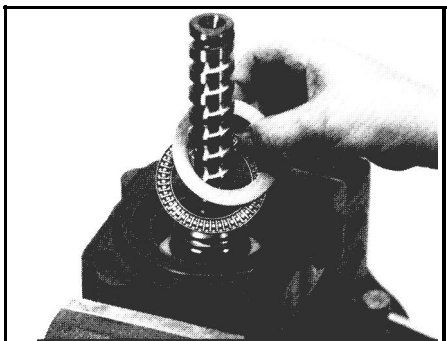
**Install seal ring**

18 Lightly 011 and assemble new seal ring (8) onto input shaft and against the thick thrust washer (12) to hold the bearing components in place.



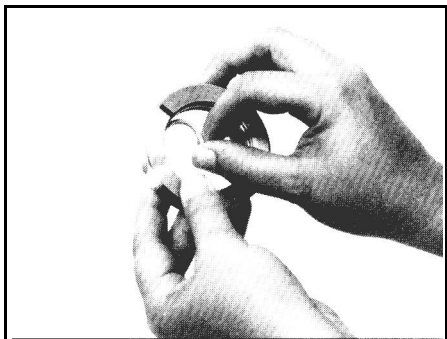
**Assemble input shaft, valve worm & bearing assembly**

19 Dip the input end of the input shaft, valve, worm assembly (13 or 13A) into oil up to the worm lead. Assemble the input shaft end of the assembly into the valve housing (5) until it is firmly seated.



**Assemble bearing and thrust washer**

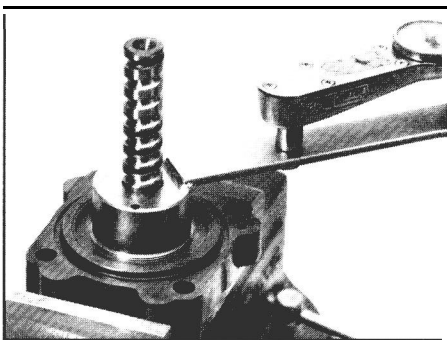
20 Apply oil and assemble the other thrust bearing (15) then the thin thrust washer (16) over the ball groove end of worm, and seat them against the shoulder of input shaft, valve, worm assembly,



**Assemble seals in bearing adjuster**

21 Lightly 011 a new o-ring (9) and assemble into the seal groove in bearing adjuster (17), 011 and work a new seal ring (8) into the same groove and smooth it out.

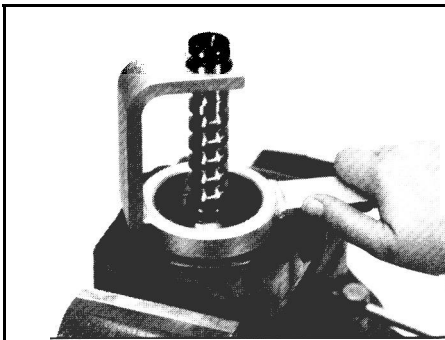
<b>NOTE</b>	Be sure the valve housing, adjuster locknut and bearing adjuster threads are clean and free of any staking burrs that would impede the locknut from turning freely on adjuster or the adjuster turning freely in valve housing.
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**Assemble bearing adjuster**

**J37070**  
Lbf\*ft Torque wrench

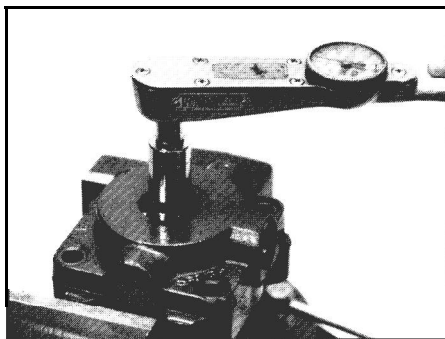
22 Lightly 011 and assemble bearing adjuster (17) over worm and into valve housing. Torque adjuster to **13 lbf\*ft** (18N\*m) Indicated torque using a torque wrench inserted in adjuster tool #J37070. This will seat the components. Back off adjuster ¼ to ½ of a turn.



**Assemble new locknut**

J37464

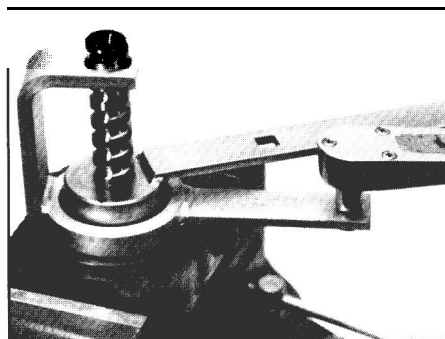
23. Lightly oil and assemble new locknut (18) onto bearing adjuster (17) with radius (slightly rounded) side down. Tighten slightly to keep the bearing adjuster in place.



**Adjust to required input torque**

3/4 or 1 1/16" 1 2-point socket  
Lbf\*in. Torque wrench

24. Reverse assembly in vise so the worm end is down. With an inch pound torque wrench on the input shaft, note torque required to rotate the input shaft 360° in each direction. Tighten the bearing adjuster to increase the maximum torque at the input shaft 5-10 lbf\*in. (.5-1.0 N\*m) over that which was previously noted.



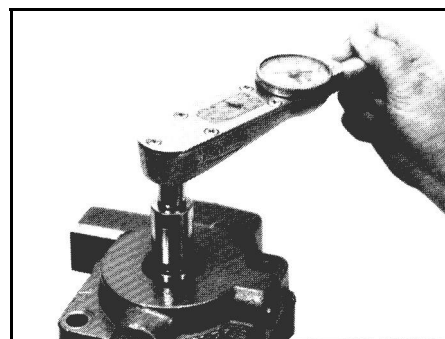
**Torque locknut**

J37070  
J37464  
Lbf\*ft Torque wrench

25. Again reverse the assembly in vise. Torque locknut while holding bearing adjuster in position established in step 24 with appropriate adjuster tool. When using a torque wrench in locknut tool J37464, the torque wrench reading should be **112 lbf.ft** (152 N\*m).

**NOTE**

The bearing adjuster, locknut and valve housing flange should be flush. If not, the seal ring (8) or o-ring (9) may be out of position; which will result in axial lash.



**Check input shaft torque**

26. Recheck input shaft torque. It should match torque measured in step 24. Repeat steps 24 and 25 if necessary.

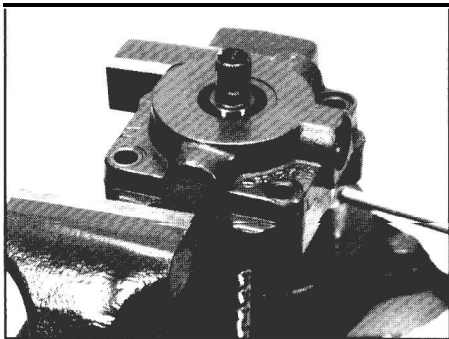


**Stake valve housing and locknut**

Center punch  
Hammer  
13/16" Socket  
Lbf\*in. Torque wrench

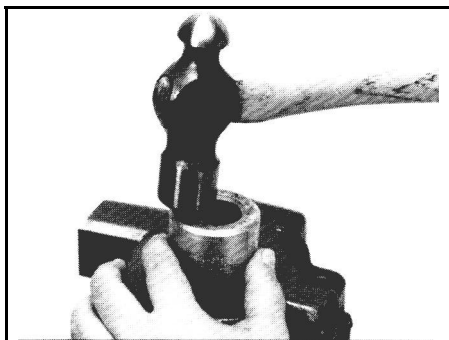
27. Stake valve housing into the clockwise most corner of two opposing slots in locknut (1 8). Stake the locknut into the adjuster (17) in two places (1 80° apart) at threaded area. Choose areas that have not been previously staked.

After staking, torque required to rotate input shaft must be between **5-10 lbf\*in.** (.5-1.0 N\*m) greater than the torque noted in step 24. Torque value must **not exceed 22 lbf\*in.** (2.5 N\*m). Unstake and readjust if necessary



**Reposition subassembly in vise**

- 28 Reposition worm screw/valve housing subassembly in soft-jawed vise, clamping tightly against valve housing, so the worm screw is pointing down,



**Install input shaft seal**

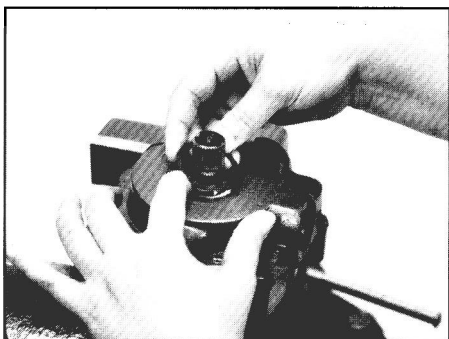
J37073  
Hammer

- 29 Apply clean grease to the outside and inside diameters (fill cavity between the lips) of the new input shaft seal (4) and assemble it, garter spring side first over the input shaft. Align seal in the valve housing seal bore.

Assemble seal installer tool #J37073, small diameter end first, over the input shaft and against the seal. Tap the seal installer tool until the tool shoulder is squarely against the valve housing. This will correctly position the seal in the housing bore just beyond the retaining ring groove.

Remove any seal material that may have sheared off and is in seal bore and retaining ring groove.

**CAUTION** The input shaft seal must be square in the seal bore and installed to the correct depth.



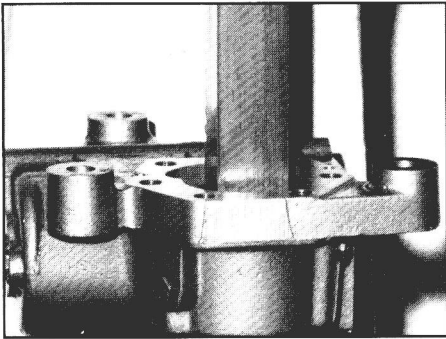
**Insert retaining ring**

- 30 Insert new retaining ring (3) into its groove in valve housing,

**Return to step 28, page 30.**

# Roller Bearing or Retaining Ring Replacement

Tools Required	Materials Required
Press J37071 (TAS55, 65) J37705 (TAS40) J38779 (TAS85) Screwdriver	Grease

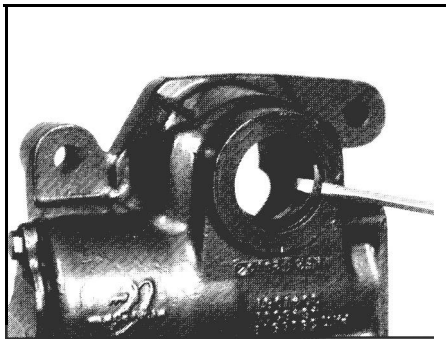


**Remove roller bearing if required**

J37705 (TAS40)  
 J37071 (TAS55, 65)  
 J38779 (TAS85)  
 Press

1. If roller bearing (37) in housing needs to be replaced, place the bearing removal end of the bearing and seal tool against the side cover end of the bearing and press it out of trunnion end of the bearing bore. Discard bearing.

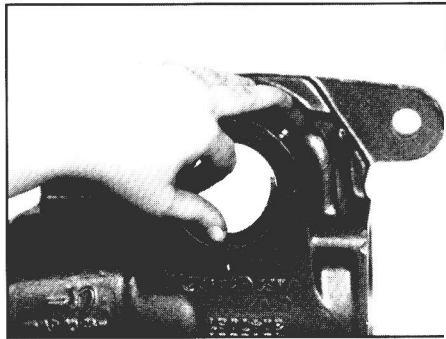
**CAUTION** The bearing must be pressed out from the side cover side to protect the seal counterbore. Be sure to use a bearing removal tool that will clear the retaining ring.



**Remove retaining ring**

Screwdriver

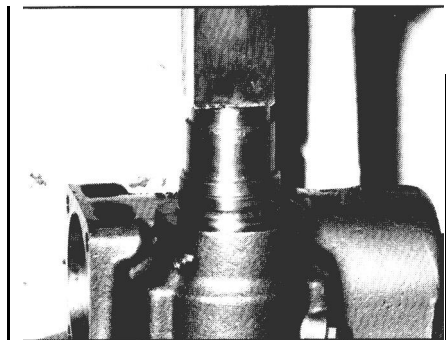
2. If the retaining ring (36) that is still in the housing bearing bore needs to be replaced, remove it through the trunnion end of the bearing bore to protect the pressure seal bore area from being damaged.



**Install retaining ring**

Grease

3. Insert retaining ring (36), if it was removed, into the housing bore from the trunnion end (to protect sealing area). Make sure it is seated in the retaining ring groove closest to side cover end of the bearing bore. Lubricate the bearing bore.



**Press in housing oiler bearing**

J37705 (TAS40)  
 J37071 (TAS55, 65)  
 J38779 (TAS85)  
 Press

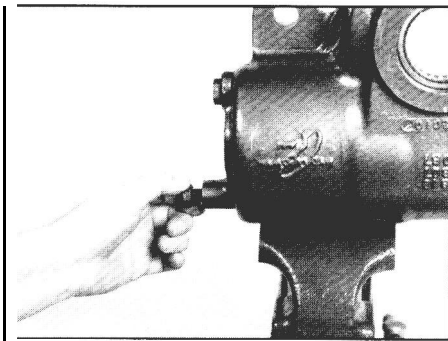
4. Press the roller bearing (37) into the housing from the trunnion end of bearing bore until it is seated against the retaining ring. Be sure the housing is square with the press base and the bearing is not cocked

**CAUTION** Use the bearing installation end of the tool. If the bearing removal end of the bearing & seal tool is used to press in bearing, the cage on the new bearing may be damaged.

Return to step 32, page 30.

# Replace Housing Ports, Plugs, Screws, Fittings

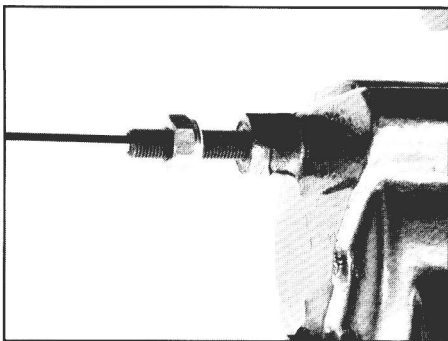
Tools Required	Materials Required
Allen wrench Torx sockets Sockets Lbf*in. Torque wrench Lbf*ft Torque wrench	



**Replace poppet fixed stop screw**

5/8" Socket or  
 E-14 Torx socket  
 lbf\*ft Torque  
 wrench

1. If damaged, remove and replace the poppet fixed stop screw (52 or 52A) and washer (53) if equipped, Replace with poppet fixed stop screw (52A), discard the washer, Torque to **48 lbf•ft (65 Nom)**,

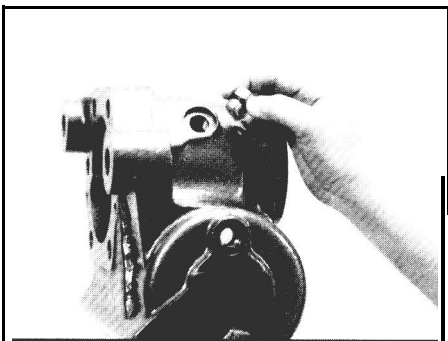


**Replace poppet adjusting screw**

7/32" Allen wrench  
 3/4" or 5/8"  
 closed-end  
 wrench  
 Lbf•ft Torque  
 wrench

2. If damaged, remove poppet adjusting screw (59) and sealing nut (60) without allowing the nut to change its position on the screw.

Assemble the new nut onto the new adjusting screw, matching its position to the nut and screw removed. Torque sealing nut to **35 lbf•ft (47 N-m)**,

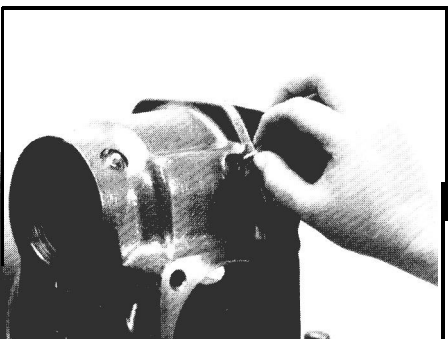


**Replace automatic bleed screw, and aux, port plugs**

E-1 4 Torx socket  
 Lbf=ft Torque  
 wrench

3. If damaged, remove and replace automatic bleed plug (51). Torque to **48 lbf•ft (65 Nom)**,

If damaged, remove and replace permanent auxilliary port plugs (54) and o-rings (55). Assemble new o-rings (55) on port plugs and torque to their respective ports In the housing or valve housing to **30 lbf•ft (41 N-m)**



**Replace manual bleed screw**

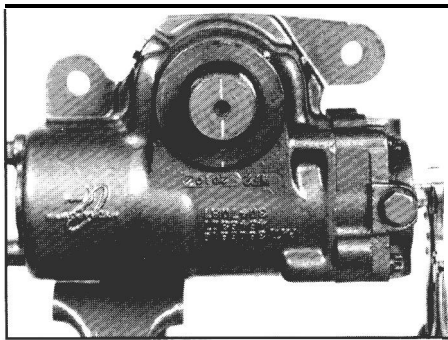
5/16" Hex socket  
 Lbf"ln. Torque  
 wrench

4. If damaged, remove and replace manual bleed screw (50). Torque to **30 lbf•in. (3,4 N•m)**.

**Return to inspection section, page 31.**

# Final Adjustments

Tools Required	Materials Required
Box-end wrench Lbf•ft Torque wrench Lbf•in. Torque wrench	Screwdriver Sockets



**Center steering gear**

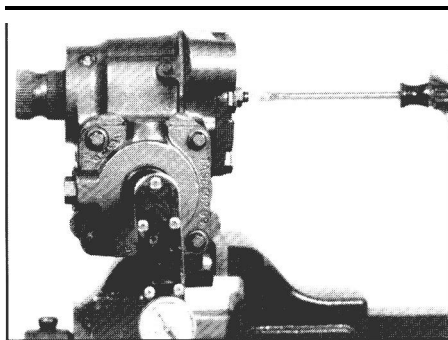
3/4" and 11/16"  
Socket or box  
end wrench

1. To center the steering gear, rotate input shaft, valve worm assembly (13 or 13A) until the timing mark on the end of the sector shaft (42) is in line with the timing mark on the end of housing trunion.

**CAUTION** Do not rotate the input shaft more than 1.5 revolutions from center position until the steering gear is installed, during poppet setting procedure. Doing so could make the automatic poppets inoperative, which would require disassembly of steering gear to reposition poppet seat and sleeve assemblies.

**NOTE** Initial poppet contact will occur at less than one input shaft rotation in one direction from steering gear center position, if new or reset poppet adjuster seat and sleeve assemblies are assembled in the unit

**NOTE** Worm preload adjustment was set when input shaft, valve and worm were assembled into valve housing.

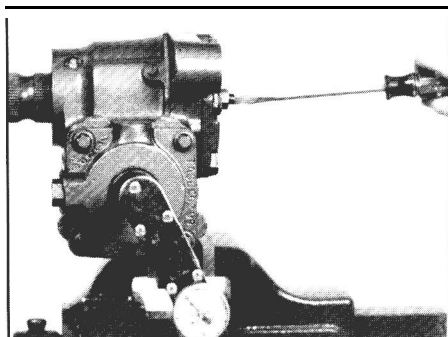


**Tighten adjusting screw**

Lbf•in. Torque  
wrench  
Screwdriver  
11/16" or 3/4"  
Socket

2. With adjusting screw jam nut (47) loose, turn sector shaft adjusting screw (43) clockwise to provide 45-50 lbf•in. (5-5.5 N•m) of torque required to rotate the input shaft, valve/worm assembly (13 or 13A) through one half turn (1 80°) each side of center.

**NOTE** This procedure will properly mesh and seat the rack piston and sector shaft teeth for final adjustments.

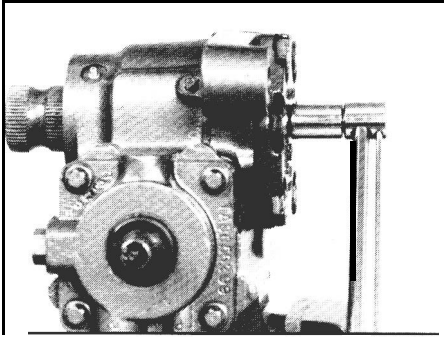


**Loosen adjusting screw and note torque**

Lbf•in. Torque  
wrench  
Screwdriver  
11/16" Socket

3. Turn sector shaft adjusting screw (43) counterclockwise one half turn and note maximum torque required to rotate the input shaft, valve/worm assembly through one half turn (1 80°) each side of center.





**Adjust adjusting screw**

$\frac{3}{4}$ " Socket  
11/16" Socket  
Lb•ft Torque wrench  
Lbf•in, Torque wrench

4. Adjust sector shaft adjusting screw (43) clockwise to increase maximum torque noted in step 3 by 7 lbf.in. (.8 Nom). Tighten jam nut (47) firmly against side cover while holding the adjusting screw in position. Final torque jam nut to 43 lbf•ft (58 N•m) and check input shaft, valve/worm assembly torque again. Readjust if input shaft torque exceeds 40 lbf•In (4.5 Nom).

## Section 5      Reinstallation

Reinstallation .....	55
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# Reinstallation

- Verify that axle stops are set to manufacturer's wheelcut or clearance specifications.
- Bolt gear to frame, torque to vehicle manufacturer's recommendation.
- Connect return line to reservoir in TAS return port.
- Connect hydraulic line from pump to pressure port in TAS unit.
- Connect steering column to input shaft, torque pinch bolt to vehicle manufacturer's recommendation.
- Install pitman arm on output shaft, with timing marks aligned. Torque bolt to vehicle manufacturer's recommendation,
- Connect drag link to pitman arm.

## Poppet Resetting

**IF** Poppets remain unchanged from when gear was removed from vehicle, and gear is being installed on the same vehicle with no change in axle stops or linkage.



After installation, check to make sure poppets relieve in both turns just before axle stop contact is made. If not, use resetting procedure on page 20,

**IF** Poppets were replaced with new components or reset during gear disassembly, and are ready for automatic positioning.



Use poppet setting procedure on page 11,

**IF** Poppets may have been moved during disassembly or reassembly procedures, or gear is being installed on a different vehicle.



Use poppet resetting procedure on page 20

# Maintenance Tips

Never high-pressure wash or steam clean a power steering gear while on or off the vehicle. Doing so could force contaminants inside the gear and cause it to malfunction.

Make sure vehicle wheel cut or clearances meet manufacturer's specifications, and make sure pitman arm timing marks are aligned properly to prevent internal bottoming of the steering gear.

Regularly check the fluid and the fluid level in the power steering reservoir.

Keep tires inflated to correct pressure

Never use a torch to remove pitman arm.

Investigate and immediately correct the cause of any play, rattle, or shimmy in any part of the steering system.

Make sure the steering column is aligned properly.

Encourage drivers to report any malfunctions or accidents that could have damaged steering components

Do not attempt to weld any broken steering component. Replace the component with original equipment only,

Do not cold straighten, hot straighten, or bend any steering system component.

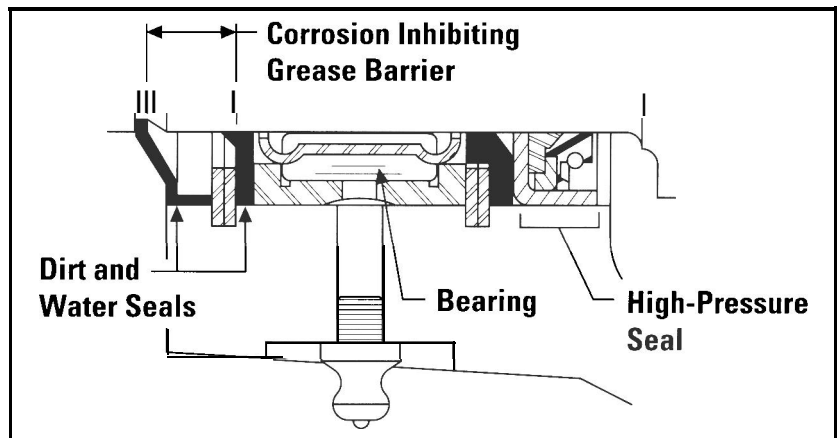
Always clean off around the reservoir filler cap before you remove it. Prevent dirt or other foreign matter from entering the hydraulic system.

Investigate and correct any external leaks, no matter how minor

Replace reservoir filters according to requirements.

If you feel the vehicle is developing excessively high hydraulic fluid temperatures, consult with your vehicle manufacturer for recommendations.

Maintain grease pack behind the output shaft dirt and water seal as a general maintenance procedure at least twice a year, in the Spring and Fall. Grease fitting is provided in housing trunnion, Use only NLGI grade 2 or 3 multipurpose chassis lube, and use only a hand operated grease gun on fitting. Add grease until it begins to extrude past the sector shaft dirt and water seal



# Glossary

## Aerated Fluid

Fluid with air bubbles

## Automatic Bleed Systems

Gears are mounted in such a way that trapped air can be forced out of the system “automatically” without loosening bleed screw. Follow procedure on page 13.

## Axial

In-out movement along an axis (imaginary straight line on which an object moves)

## Brinelling

Dents

## Date Code

Date the steering gear was built (Julian date)

## Discoloration

Change in color

## External Leakage

Fluid Leaking out of the system or steering gear

## Full Turn

Hub contacts axle stop

## Integral Power Steering

Steering gear has manual steering mechanism, hydraulic control valve, and hydraulic power cylinder all within gear housing

## Impact

The application of torques and forces to steering gear components during accidents or other similar events which exceed the hydraulic capacity of the steering gear

## Internal Leakage

Fluid leaking Inside the gear

## Lash

Free play

## Manual Bleed Systems

Gears are mounted in such a way that an air pocket could form in one end of the steering gear. The bleed screw is positioned so trapped air can be forced out when loosened. Follow procedure on page 13.

## OSHA

Occupational Safety and Health Administration

## Poppets

Unloading valves, reduce pressure in full turns.

## Relief Valve

Limits maximum supply pressure

## Return Line

Line that connects steering gear to reservoir to recirculate hydraulic fluid

## Rotary Control Valve

Controls flow in internal cavities

## Scoring

Scratch

## Shock Load

Shake or jar

## Spalling

Flaking or chipping

## Subassembly

An assembled unit that fits into a larger unit

## Supply Line

Line that connects pump to steering gear

## Twisted Serrations

Output shaft serrations damaged by impact overload. Serrations can be twisted at the area between the large diameter of the shaft and the end of the serrations.

# TAS Steering Gear Service Manual



WRITE OR CALL FOR INFORMATION AND ADDED DETAILS  
CONCERNING YOUR INSTALLATION AND APPLICATIONS.

PHONE 3174235377

FAX: 317.429.1868

WRITE TRW Commercial Steering Division

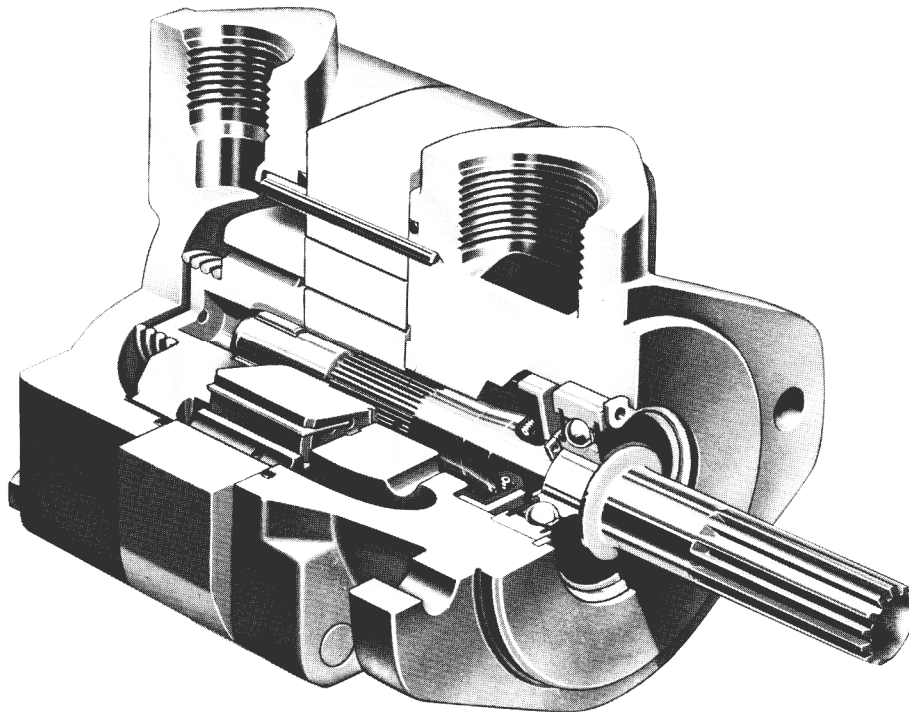
P O Box 60  
800 Heath Street  
Lafayette, IN 47902

Price: \$4,50



# Vane Pump

V10, V20, V10F, V10P,  
V20F and V20P Series





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Section I - INTRODUCTION

A. PURPOSE OF MANUAL

This manual has been prepared to assist the users of Vickers balanced vane type hydraulic single pumps in properly installing, maintaining and repairing their units. In the sections which follow, the single pumps are described in detail, their theory of operation is discussed and instructions are given for their proper installation, maintenance and overhaul.

The general series of models covered are V10, V20, V10F, V10P, V20F, and V20P. The information given applies to the latest design configurations listed in Table 1. Earlier designs are covered only insofar as they are similar to the present equipment.

B. GENERAL INFORMATION

1. Related Publications - Service parts information and installation dimensions are not contained in this manual. The parts catalogs and installation drawings listed in Table 1 are available from any Vickers

Application Engineering office, or from:

Vickers, Incorporated  
1401 Crooks Road  
Troy, MI 48084

2. Model Codes - There are many variations within each basic model series, which are covered by variables in the model code. Table 2 is a complete breakdown of the code covering these units. Service inquiries should always include the complete unit model number, which is stamped on the pump cover.

TABLE 1.  
PARTS CATALOGS AND INSTALLATION DRAWINGS

MODEL SERIES	PARTS DRAWING	INSTALLATION DRAWING
V10	M-2005-S	MB-53
V10F		
V10P		
V20	M-2004-S	MB-53
V20F		
V20P		
HYDRAULIC RECOMMENDATIONS	INDUSTRIAL APPLICATIONS I-286-S	MOBILE APPLICATIONS M-2950-S

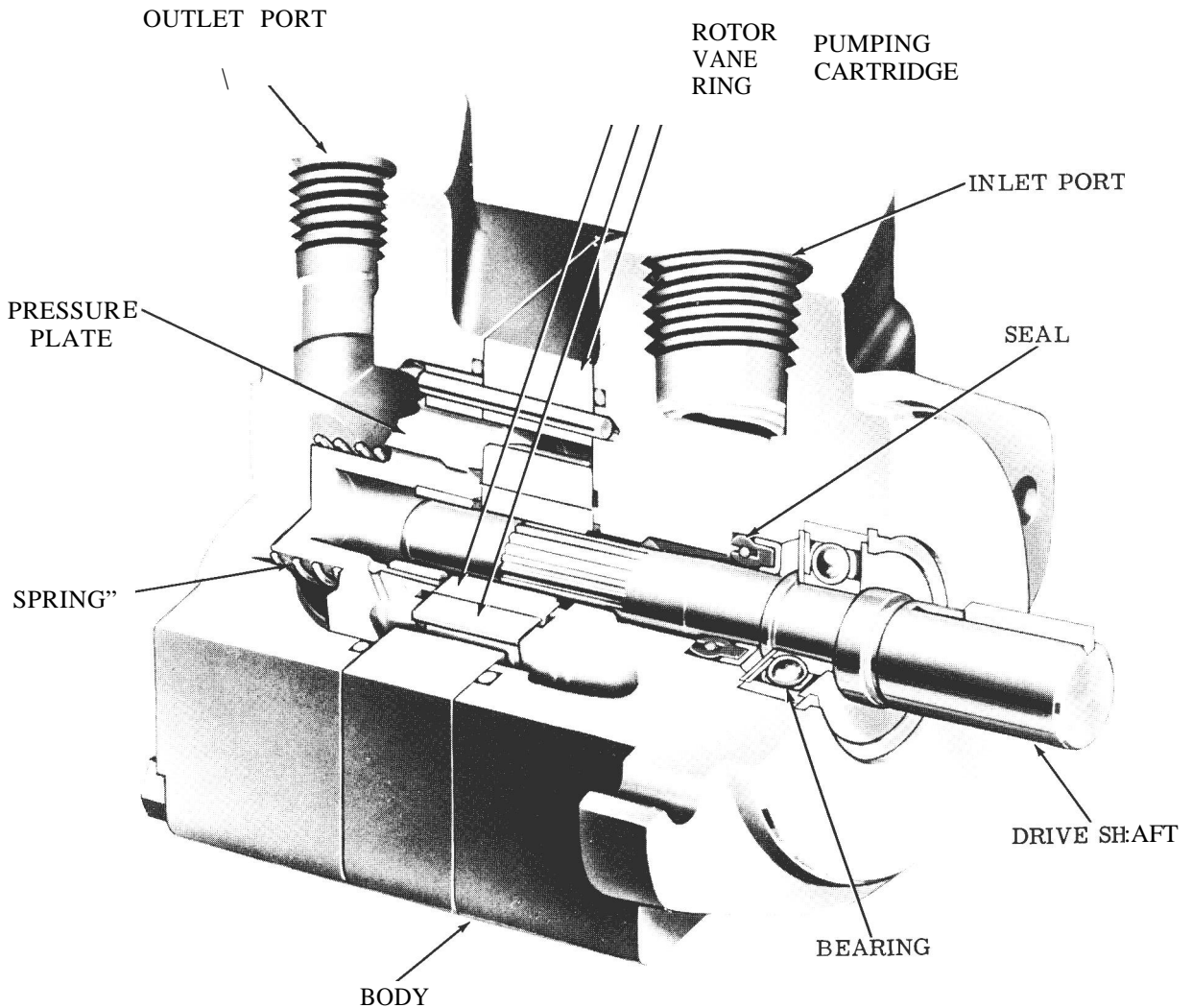


Figure 1

# MODEL CODE BREAKDOWN

VANE PUMP  
SERIES  
10 OR 20

F - FLOW CONTROL COVER  
P - PRIORITY VALVE COVER  
OMITTED - STD. COVER

MOUNTING  
1-2 BOLT FLANGE (SAE "A" SIZE)  
2-FOOT BRACKET AT 12 O'CLOCK  
(VIEWED FROM THE SHAFT END)  
23-FOOT BRACKET AT 3 O'CLOCK  
26-FOOT BRACKET AT 60' CLOCK  
29-FOOT BRACKET AT 90' CLOCK

INLET PORT		
CODE	MODEL	SIZE
E	V20	1. 5" Dia. -2 BOLT FLG.
F		1. 156" Dia. -2 BOLT FLG.
H	V10	1" O.D. TUBE CONN.
K		1. 3125"-12 UN2B THD.
P		1" N. P. T. F.
R	V20	1. 25" N. P. T. F.
S	V10	1. 3125"-12 STR. THD.
	V20	1. 625"-12 UN2B THD.
T	V10	1. 1875"-12 STR. THD.

RING CAPACITY-1200 RPM- 100PSI  
(V10) (V20)

1 -1 USGPM	6 -6 USGPM
2 -2 USGPM	7 -7 USGPM
3 -3 USGPM	8 -8 USGPM
4 -4 USGPM	9 -9 USGPM
5 -5 USGPM	11 -11 USGPM
6 -6 USGPM	12 -12 USGPM
7 -7 USGPM	13 -13 USGPM

FOR LEFT HAND ROTATION  
VIEWED FROM SHAFT END

SPECIAL FEATURE SUFFIX

DESIGN & MODIFICATION  
V10-10 V20(F)-11  
V10(F)-20 V20P-11/12

FLOW RATE THROUGH  
ORIFICE IN COVER

2-2 GPM  
3-3 GPM (V10F ONLY)  
4-4 GPM  
5-5 GPM (V10F ONLY)  
6-6 GPM  
7-7 GPM (V10F ONLY)  
8-8 GPM (V20F ONLY)

PRESSURE PORT POSITIONS  
VIEW FROM COVER END  
A-OPPOSITE INLET  
CONNECTION.

B -90° COUNTERCLOCKWISE  
FROM INLET CONNECTION  
C-INTJNE WITH INLET  
D- 90 °CLOCKWISE FROM INLET  
CONNECTION

SHAFTS

1 -STR. KEYED  
3 -THD.  
4-THD.  
6-STR. STUB-KEYED  
11 -SPLINE -9 TOOTH  
12 -SPLINE -13 TOOTH  
15-SPLINE -13 TOOTH  
27 -TANG  
34-THD.  
38-SPLINE -11 TOOTH

## OUTLET PORT CONNECTIONS

MODEL	STANDARD COVER	FLOW CONTROL COVER PRESSURE	PRIORITY VALVE COVER TANK	PRIORITY VALVE COVER		
				PRIMARY OUTLET	SECONDARY OUTLET	TANK
K	—	—	—	9/16-18 ST. THD. (V10P)	3/4-16 ST. THD. (V10P)	9/16-18 ST. THD. (V10P)
P	1/2 IN. NPT THD. (V10 ONLY)	3/4-16 ST. THD.	1/2 IN. NPT THD.	—	—	—
	3/4 IN. NPT THD. (V20 ONLY)	V10F AND V20F	V10F AND V20F	—	—	—
S	3/4-16 ST. THD.	—	—	—	—	—
	1 1/16-12 ST. THD. (V20 ONLY)	3/4-16 ST. THD. (V20F)	1/16-12 ST. THD. (V20F)	—	—	—
T	—	3/4-16 ST. THD. (V10F)	3/4-16 ST. THD. (V10F)	3/4-16 ST. THD. (V20P)	7/8-14 ST. THD. (V20P)	3/4-16 ST. THD. (V20P)

## Section II - DESCRIPTION

### A. GENERAL

Pumps in this series are used to develop hydraulic fluid flow for the operation of Mobile and Industrial equipment. The positive displacement pumping cartridges are the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

### B. ASSEMBLY AND CONSTRUCTION

The V10 series pump illustrated in the cut-a-way of Figure 1 is representative of all single pumps in this series. The unit consists principally of a ported body, a ported cover and a pumping cartridge. Components of the pumping cartridge are an elliptical cam ring, a slotted rotor splined to fit the drive shaft and twelve vanes fitted to the rotor slots.

The pumping cartridge cam ring is sandwiched between the body and cover. A ball bearing and bushing located in the body and pressure plate respectively support each end of the drive shaft and center the rotor within the cam ring. As the drive shaft is driven by the prime mover, the rotor and vanes generate flow by carrying fluid around the elliptical cam ring contour. Fluid enters the cartridge through the inlet port in the body and is discharged through the pressure plate into the outlet port of the cover.

### C. FLOW CONTROL AND RELIEF VALVE

V10 and V20 pumps are available with an integral Flow Control and Relief Valve in the pump cover. This limits the fluid flow in the system to a maximum pre-scribed rate and prevents excessive pressure build-up. Fluid not required in the system is recirculated to tank.

### D. PRIORITY VALVE

V10 and V20 pumps are also available with a priority valve located in the pump cover. The priority valve maintains nearly a constant flow to a primary circuit and diverts the remaining flow to a secondary circuit. Flow going to the secondary circuit is determined by pump delivery. The primary circuit is protected by an integral relief valve but an external relief valve must be provided for the secondary circuit.

### E . APPLICATION

Pump ratings in GPM as shown in the model coding are at 1200 RPM and 100 PSI. For ratings at other speeds, methods of installation and other application information, Vickers Application Engineering personnel should be consulted.

## Section III - PRINCIPLES of OPERATION

### A. PUMPING CARTRIDGE

As mentioned in Section 11, fluid flow is developed by the pumping cartridge. The action of the cartridge is illustrated in Figure 2. The rotor is driven within the cam ring by the driveshaft, which is coupled to a power source. As the rotor turns, centrifugal force causes the vanes to follow the elliptical inner surface of the cam ring.

Radial movement of the vanes and turning of the rotor cause the chamber volume between the vanes to increase as the vanes pass the inlet sections of the cam ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers. (Fluid outside the inlet is at atmospheric pressure or higher. )

This fluid is trapped between the vanes and carried

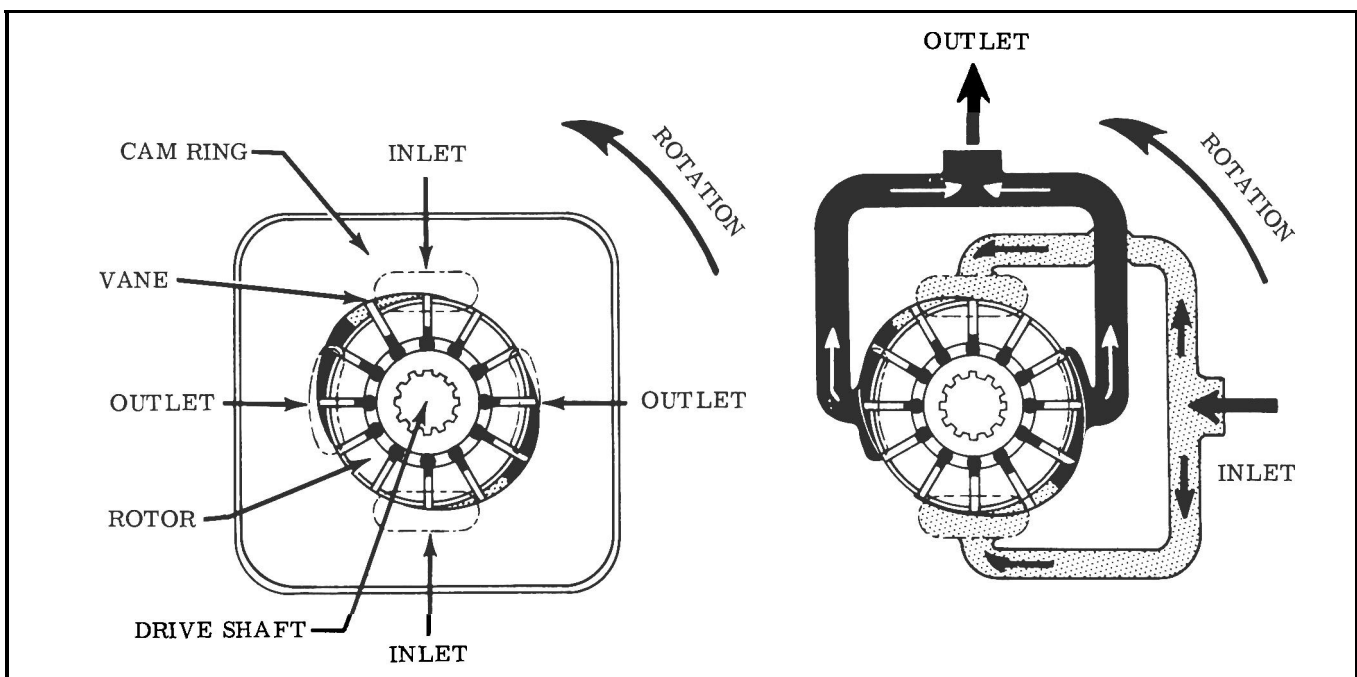


Figure 2

past the large diameter or dwell section of the cam ring. As the outlet section is approached, the cam ring diameter decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the cam ring during normal operation.

### B. HYDRAULIC BALANCE

The pump cam ring is shaped so that the two pumping chambers are formed diametrically opposed. Thus, hydraulic forces which would impose side loads on the shaft are cancelled.

### C. PRESSURE PLATE

The pressure plate seals the pumping chamber as shown in Figure 3. A light spring holds the plate against the cartridge until pressure builds up in the system. System pressure is effective against the area at the back of the plate, which is larger than the area exposed to the pumping cartridge. Thus, an unbalanced force holds the plate against the cartridge, sealing the cartridge and providing the proper running clearance for the rotor and vanes.

### D. FLOW CONTROL AND RELIEF VALVE

1. Maximum flow to the operating circuit and maximum system pressure are determined by the integral flow control and relief valve in a special outlet cover used on some Vv10 and V20 pumps. This feature is illustrated pictorially in Figure 4. An orifice in the cover limits maximum flow. A pilot-operated type relief valve shifts to divert excess fluid delivery to tank, thus limiting the system pressure to a predetermined maximum.

2. Figure 4A shows the condition when the total pump delivery can be passed through the orifice.

This condition usually occurs only at low drive speeds. The large spring chamber is connected to the pressure port through an orifice. Pressure plus spring load in this chamber slightly exceeds pressure at the

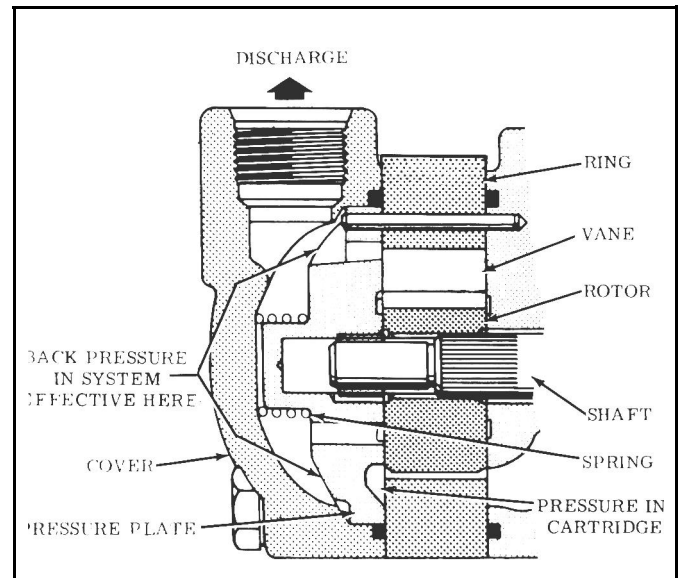


Figure 3

other end of the relief valve spool and the spool remains closed. Pump delivery is blocked from the tank port by the spool land.

3. When pump delivery is more than the flow rate determined by the orifice plug, pressure builds up across the orifice and forces the spool open against the light spring. Excess fluid is throttled past the spool to the tank port as shown in Figure 4B.

4. If pressure in the system builds up to the relief valve setting (Figure 4C), the pilot poppet is forced off its seat. Fluid in the large spring chamber flows through the spool and out to tank. This flow through the small sensing orifice, causes a pressure drop and prevents pressure in the large spring area from increasing beyond the relief valve setting. As pressure against the right end of the spool starts to exceed the relief valve setting, the pressure differential forces the spool to the left, against the light spring, porting the full pump flow to tank.

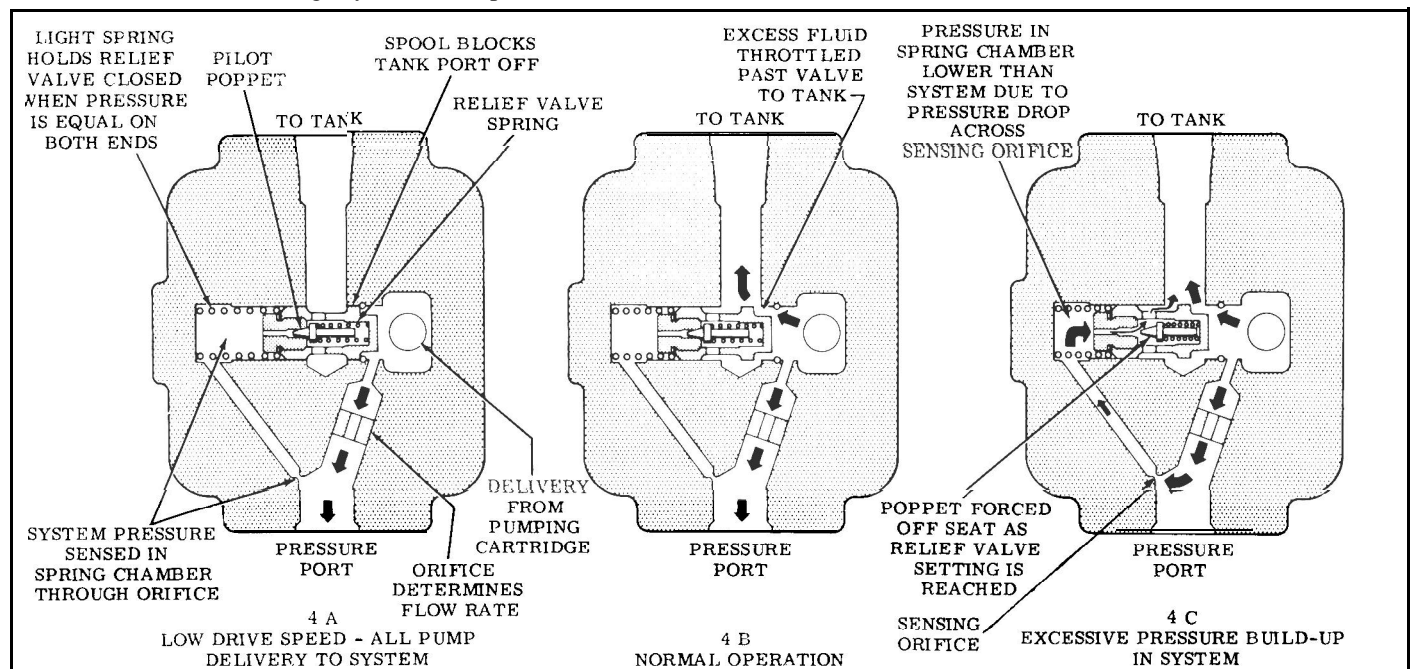


Figure 4

## E. PRIORITY VALVE OPERATION

Referring to the V20P Cover Schematic, Figure 5, pressure is sensed in cavities "A", "B" and "C". Primary flow into cavity "A" is restricted by the controlled flow orifice "O". Secondary flow will be zero until the pump flow rate through orifice "O" develops a pressure differential across the control spool.

When pump delivery is increased, pressure builds up in cavities "B" and "C" because of the resistance to flow through orifice "O". This causes the spool to shift toward cavity "A" against the spring. The amount of spool shift is proportional to the pressure differential between cavities "A" and "C".

Flow from the primary port is held to an almost constant volume, as determined by orifice "O", and the metering action of the control spool at area "D". Flow to the secondary port varies with pump delivery. Metering area "E" diverts excess flow to the secondary port.

This single spool design cannot give precisely controlled flow to the primary circuit because of the effects of varying conditions of flows and pressures. For example: If the primary circuit is operating at 1000 PSI and the secondary at 100 PSI, the spool must be metering at "E". However, if primary pressure is 100 PSI and secondary is 1000 PSI, the spool must

be metering at "D". As the two systems approach the same pressure, the probability of flow fluctuation increases because the spool may shift between these two metering points.

### CAUTION

The pump has a built-in relief valve in the primary circuit. However, an external relief valve must be provided for the secondary circuit to protect the pump.

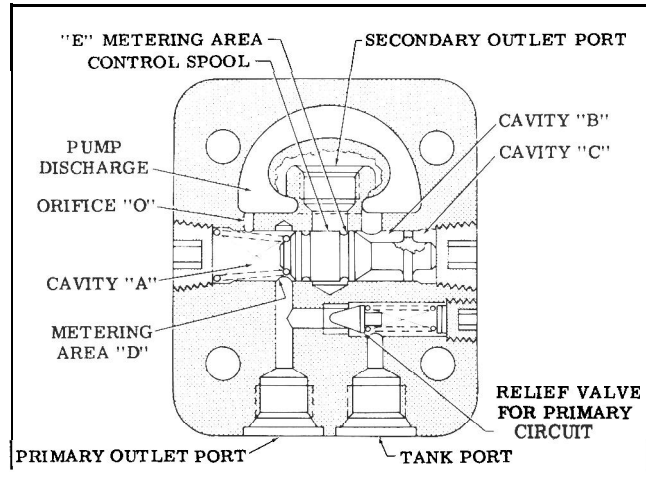


Figure 5

## Section IV INSTALLATION and OPERATING INSTRUCTIONS

### A. INSTALLATION DRAWINGS

The installation drawings listed in Table 1 show the correct installation dimensions and port locations.

### B. DRIVE CONNECTIONS

#### CAUTION

Pump shafts are designed to be installed in couplings, pulleys, etc., with a slip fit or very light tap. Pounding can injure the bearings. Shaft tolerances are shown on the pump installation drawings. (See Table 1.)

1. Direct Mounting - A pilot on the pump mounting flange (Figure 6) assures correct mounting and shaft alignment. Make sure the pilot is firmly seated in the accessory pad of the power source. Care should

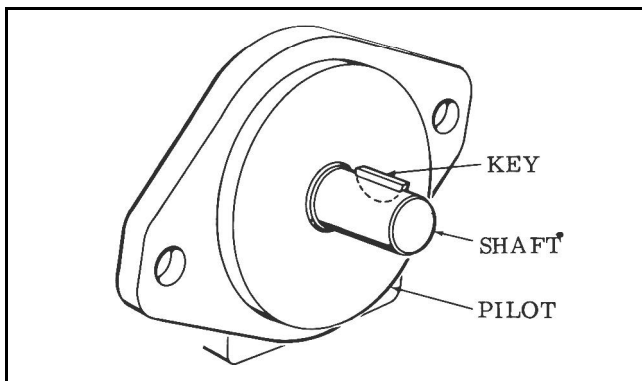


Figure 6

be exercised in tightening the mounting screws to prevent misalignment.

If gaskets are used, they should be installed carefully and should lay flat. Shaft keys and couplings must be properly seated to avoid slipping and possible shearing.

2. Indirect Drive - Chain, spur gear or v-belt pulley drives may also be used with these pumps. Flat belt drives are not recommended because of the possibility of slipping.

To prevent excessive side loads on pump bearings, it is important to check for correct alignment and guard against excessive belt or chain tension.

For best results on indirect drive applications, use the largest permissible pulley diameter at the pump and position it close as possible to the pump mounting face. For specific indirect drive application data, contact your Vickers Application Engineer.

### C. SHAFT ROTATION

Pumps are normally assembled for right-hand (clockwise) rotation as viewed from the shaft end. A pump made for left-hand rotation is identified by an "L" in the model code (See Table 2).

#### NOTE

These pumps must be driven in the direction of the arrows cast on the pump ring. If it is desired to change the direction of drive rotation, it is necessary to reverse the ring. (See Section VI-B -D and Figure 10.)



## CAUTION

Never drive a pump in the wrong direction of rotation. Seizure may result, necessitating expensive repairs.

### D. PIPING AND TUBING

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sand blasting, wire brushing and pickling.

#### NOTE

For instructions on pickling refer to instruction sheet 1221-S.

2. To minimize flow resistance and the possibility of leakage, only as many fittings and connections as are necessary for proper installation should be used.

3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow. Tubing must not be bent too sharply. The recommended radius for bends is three times the inside diameter of the tube.

### E. HYDRAULIC FLUID RECOMMENDATIONS

#### GENERAL DATA

Oil in a hydraulic system performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components with particular emphasis on hydraulic pumps. Any oil selected for use with pumps is acceptable for use with valves or motors.

Data sheets for oil selection are available from Vickers, Inc. Technical Publications, Troy, MI. 48084.

For Industrial Applications order data sheet I-286 -S. For Mobile Applications order M-2950-S.

The oil recommendations noted in the data sheets are based on our experience in industry as a hydraulic component manufacturer.

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your Vickers representative.

#### CLEANLINESS

Thorough precautions should always be observed to insure the hydraulic system is clean:

A. Clean (flush) entire new system to remove paint, metal chips, welding shot, etc.

B. Filter each change of oil to prevent introduction of contaminants into the system.

C. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

D. Provide continuous protection of system from entry of airborne contamination, by sealing the system and/or by proper filtration of the air.

E. During usage, proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over emphasized.

F. Thorough precautions should be taken, by proper system and reservoir design, to insure that aeration of the oil will be kept to a minimum.

#### SOUND LEVEL

Noise is only indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining optimum reduction of system sound levels.

Some of the major factors affecting the fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start-up temperatures can cause pump noises due to cavitation.

2. Running with a moderately high viscosity fluid will impede the release of entrained air. The fluid will not be completely purged of such air in the time it remains in the reservoir before recycling through the system.

3. Aerated fluid can be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings, or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

4. Contaminated fluids can cause excessive wear of internal pump parts which may result in increased sound levels.

### F. OVERLOAD PROTECTION

A relief valve must be installed in the system, unless it is an integral part of the pump. The relief valve limits pressure in the system to a prescribed maximum and protects the components from excessive pressure. The setting of the relief valve depends on the work requirements of the system components.

### G. PORT POSITIONS

The pump cover can be assembled in four positions with respect to the body. A letter in the model

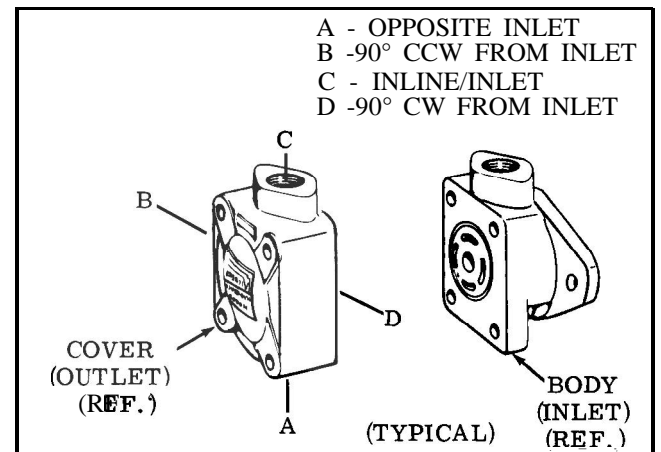


Figure 7

code (Table 2) identifies the cover position as shown in Figure 7.

Disassembly and assembly procedures are in Section VI -B and D.

#### H. START -UP

With a minimum drive speed of 600 RPM, a pump

should prime almost immediately, if provision is made to initially purge the air from the system. Failure to prime within a reasonable length of time may result in damage due to lack of lubrication. Inlet lines must be tight and free from air leaks. However, it may be necessary to crack a fitting on the outlet side of the pump to purge entrapped air.

### Section V SERVICE , INSPECTION AND MAINTENANCE

#### A. SERVICE TOOLS

No special tools are required to service these pumps.

#### B. INSPECTION

Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly.

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the system, resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants.

If the fluid becomes contaminated the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

#### C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to replenish the system, it should always be poured through a fine wire screen (200 mesh or finer).

It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

#### D. ADJUSTMENTS

No periodic adjustments are required other than to maintain proper shaft alignment with the driving medium.

#### E. LUBRICATION

Internal lubrication is provided by the fluid in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

#### F. REPLACEMENT PARTS

Reliable operation throughout the specified operating range is assured only if genuine Vickers parts are used. Sophisticated design processes and material are used in the manufacture of our parts. Substitutions may result in early failure. Part numbers are shown in the parts catalog listed in Table 1.

#### G. TROUBLE -SHOOTING

Table 6 lists the common difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

It should always be remembered that many apparent pump failures are actually the failures of other parts of the system. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

### Section VI - OVERHAUL

#### WARNING

Before breaking a circuit connection, make certain that power is off and system pressure has been released. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure.

#### A. GENERAL

Plug all removed units and cap all lines to prevent the entry of dirt into the system. During disassembly, pay particular attention to identification of the parts, especially the cartridges, for correct assembly.

Pump bearings are pressed in the bodies or on the shafts and should not be removed unless defective. Figure 8 is an exploded view which shows the proper relationship of the parts for disassembly and assembly. Refer to Figure 1 and Figure 8 for the correct assembled relationship of the parts.

#### B. DISASSEMBLY

1. Disassembly of Basic Pump-See Figure 8. If a foot bracket is used, remove before dismantling the pump. Clamp the pump body in a vise (not too

TABLE 6 - TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING FLUID	DRIVEN IN THE WRONG DIRECTION OF ROTATION	The drive direction must be changed immediately to prevent seizure. Figure 10 shows the correct ring position for each direction of rotation.
	COUPLING OR SHAFT SHEARED OR DISENGAGED	Disassemble the pump and check the shaft and cartridge for damage. (See Section VI. ) Replace the necessary parts.
	FLUID INTAKE PIPE IN RESERVOIR RESTRICTED	Check all strainers and filters for dirt and sludge. Clean if necessary.
	FLUID VISCOSITY TOO HEAVY TO PICK UP PRIME	Completely drain the system. Add new filtered fluid of the proper viscosity .
	AIR LEAKS AT THE INTAKE. PUMP NOT PRIMING	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump.
	RELIEF VALVE STUCK OPEN. (MODELS WITH INTEGRAL RELIEF VALVE ONLY)	Disassemble the pump and wash the valve in clean solvent. Return the valve to its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the lands or attempt to polish the bore. Wash all parts and reassemble the pump.
	VANE (S) STUCK IN THE ROTOR SLOT(S)	Disassemble the pump. Check for dirt or metal chips. Clean the parts thoroughly and replace any damaged pieces. If necessary flush the system and refill it with clean fluid.
INSUFFICIENT PRESSURE BUILD-UP	SYSTEM RELIEF VALVE SET TOO LOW	Use a pressure gage to correctly adjust the relief valve.
	COMPLETE LOSS OF FLOW FROM PUMP.	-A valve is stuck open permitting free flow to tank. -Broken inlet or pressure line. -Actuator bypassing the full flow. (Motor valve plate lift)
PUMP MAKING NOISE	PUMP INTAKE PARTIALLY BLOCKED	Service the intake strainers. Check the fluid condition and, if necessary, drain and flush the system. Refill with clean fluid.
	AIR LEAKS AT THE INTAKE OR SHAFT SEAL. ( OIL IN RESERVOIR WOULD PROBABLY BE FOAMY)	Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening.
	PUMP DRIVE SPEED TOO SLOW OR TOO FAST	Operate the pump at the recommended speed.
	COUPLING MISALIGNMENT	Check if the shaft seal bearing or other parts have been damaged. Replace any damaged parts. Realign the coupled shafts.

tightly), cover end up, and remove the four cover screws. Note the position of the cover port with respect to the body port before lifting off the cover and "O" ring. (See paragraph 2 for disassembly of flow control covers and paragraph 3 for disassembly of the priority valve covers).

Remove the pressure plate and spring. Note the position of the ring for correct reassembly. Lift off the ring and remove the locating pins. Separate the vanes from the rotor and remove the rotor from the shaft.

Turn the pump body over then remove the shaft key and the snap ring which retains the bearing. Tap with a soft hammer on the splined end of the shaft to force the shaft out of the body. Remove the small snap ring, located on the shaft, behind the bearing. Support the bearing inner race and press the shaft out of the bearing. Pull the shaft seal out of the body with a suitable hooked tool.

#### CAUTION

Do not disassemble the relief valve S/A removed in the following step. The unit is factory set and could malfunction if disassembled.

2. Disassembly of Flow Control and Relief Valve Covers - See Figure 8. Remove the plug (and "O" ring latest design V10 models) from the snap ring side of the cover. Then remove the plug (and "O" ring latest design V10 models), that releases the spring and relief valve S/A. Insert a suitable tool from the snap ring end of the bore. Slide the relief valve S/A from the cover. Remove the snap ring with care - DO NOT scratch the bore.

3. Disassembly of the Priority Valve Cover - See Figure 8. Remove the plug (and "O" ring latest design V10/V20 models) and spring from one end of the priority valve bore, and the plug (and "O" ring latest design V10/V20 models) from the other end of the bore. Insert a suitable tool into the snap ring end of the bore (Snap ring used with pipe thread plugs only) and slide the priority valve spool from the cover. If the snap ring exists, remove it from the cover. Disassemble the relief valve by removing the plug spring poppet and shims. On later designs, a spring guide is used. See Figure 8. DO NOT remove the seat unless inspection of the poppet contact area reveals a problem in the seat area. If removal of the seat is required, thread the seat with a suitable tap approximately 3/8 inch into the seat. Thread a long bolt into the seat and pull the bolt and seat from the bore with a small gear puller.

#### C. INSPECTION AND REPAIR

**CLEANING.** All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement more stringent than usual. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful in cleaning spools, orifices, and cover passages.

1. Discard the used shaft seal and all "O" rings. Wash the metal parts in a solvent, blow them dry with filtered compressed air and place them on a clean surface for inspection.

2. Check the wearing surfaces of the body, pressure plate, ring and rotor for scoring and excessive

wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.

3. Inspect the vanes for burrs, wear and excessive play in the rotor slots. Replace the vanes and rotor if the slots are worn.

4. Check the bearings for wear and looseness. Rotate the bearings while applying pressure to check for pitted or cracked races.

5. Inspect the oil seal mating surface on the shaft for scoring or wear. If marks on the shaft cannot be removed by light polishing, replace the shaft.

6. Flow Control Cover: Check the relief valve sub-assembly for free movement in the cover bore. Remove burrs from the valve by polishing, but DO NOT round off the corners of the lands. Do not attempt to rework the valve bore. If the bore is damaged, replace the cover.

7. Priority Valve Cover: Inspect the priority valve spool and bore for burrs. Remove burrs from the spool by light polishing with crocus or # 500 grit paper. DO NOT round off sharp corners of the lands. Inspect the cover bore for scratches, wear and/or a pitted surface. DO NOT attempt to rework the bore. If the bore is damaged, replace the cover. The priority valve spool must fit and move within the bore without evidence of bind. Rotate the spool through 360° while inspecting for bind. Inspect the snap ring for damage. (V20 units only). If worn or bent, replace with a new snap ring. If the snap ring is bent, inspect the snap ring groove in the cover for sufficient depth and rounded edges of the snap ring groove. If the groove is defective, replace the cover.

**Integral Relief Valve:** Inspect the spring. The spring ends must be parallel to prevent cocking of the poppet. The poppet requires a close inspection in the seat contact area. A slight wear pattern should exist around the poppet at the area of seat contact. If the wear pattern is broken, a possible leakage path exists between the poppet and seat. Inspect the seat for possible erosion or other defects. Refer to the seat removal procedure if the seat is defective. (paragraph VI. B. 3)

#### D. ASSEMBLY

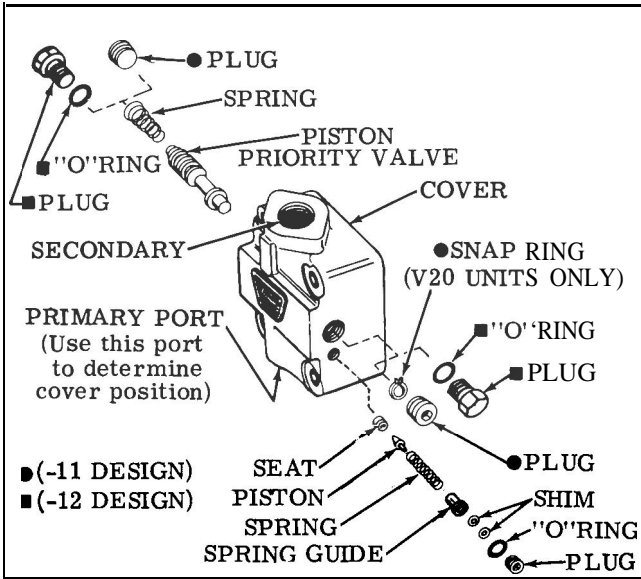
Coat all parts with hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold "O" rings in place during assembly.

#### IMPORTANT

During handling and shipping of the precision machined cartridge parts, it is possible to raise burrs on the sharp edges. All sharp edges on the parts of a new cartridge kit should be stoned prior to installation.

1. Assembly of Flow Control Cover - See Figure 8. Assemble the snap ring in place within the bore, (early design only) seat firmly in the groove. Insert the valve in the bore, small land first. Then install the spring and both plugs. Use new "O" rings if straight thread plugs are used.

2. Assembly of priority valve cover- See Figure 8. If the relief valve seat was removed, a new seat must be pressed into the body. Lubricate and insert the new seat chamfered end first into the cover open -



**NOTE: Priority Cover Information:**

V10-10 early models and V20-11 models use pipe threaded plugs.

V10-10 current design and V20-12 models use straight threaded plugs and "O" ring seals.

**Flow Control Cover Information**

V10-20 early models and V20-11 models use pipe threaded plugs.

V10-20 current design uses straight threaded plugs with "O" rings. The V20 -11 is the current design and still uses pipe threaded plugs.

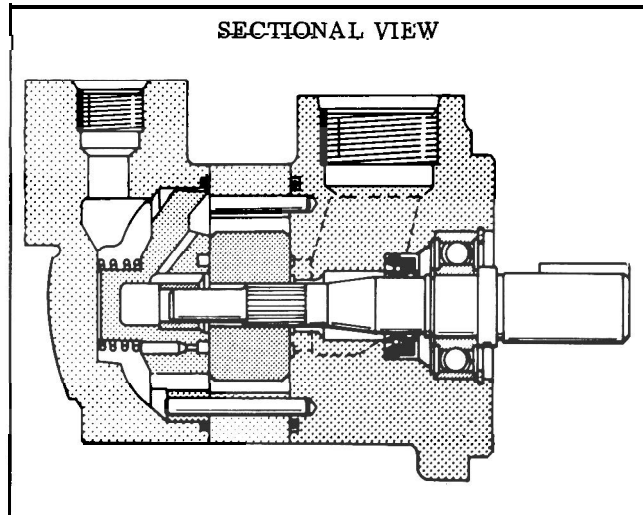
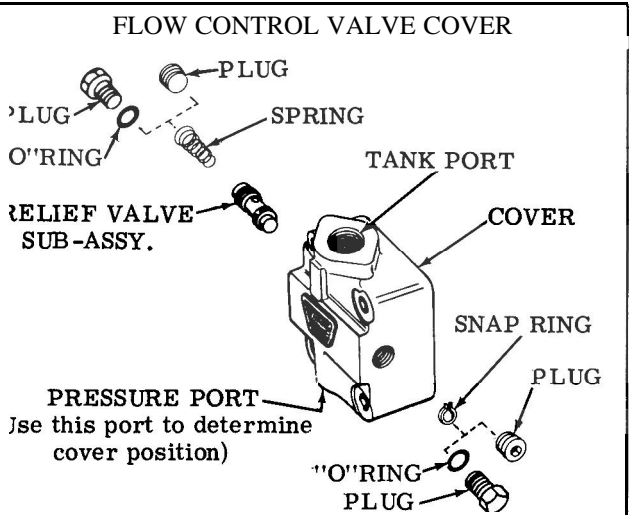
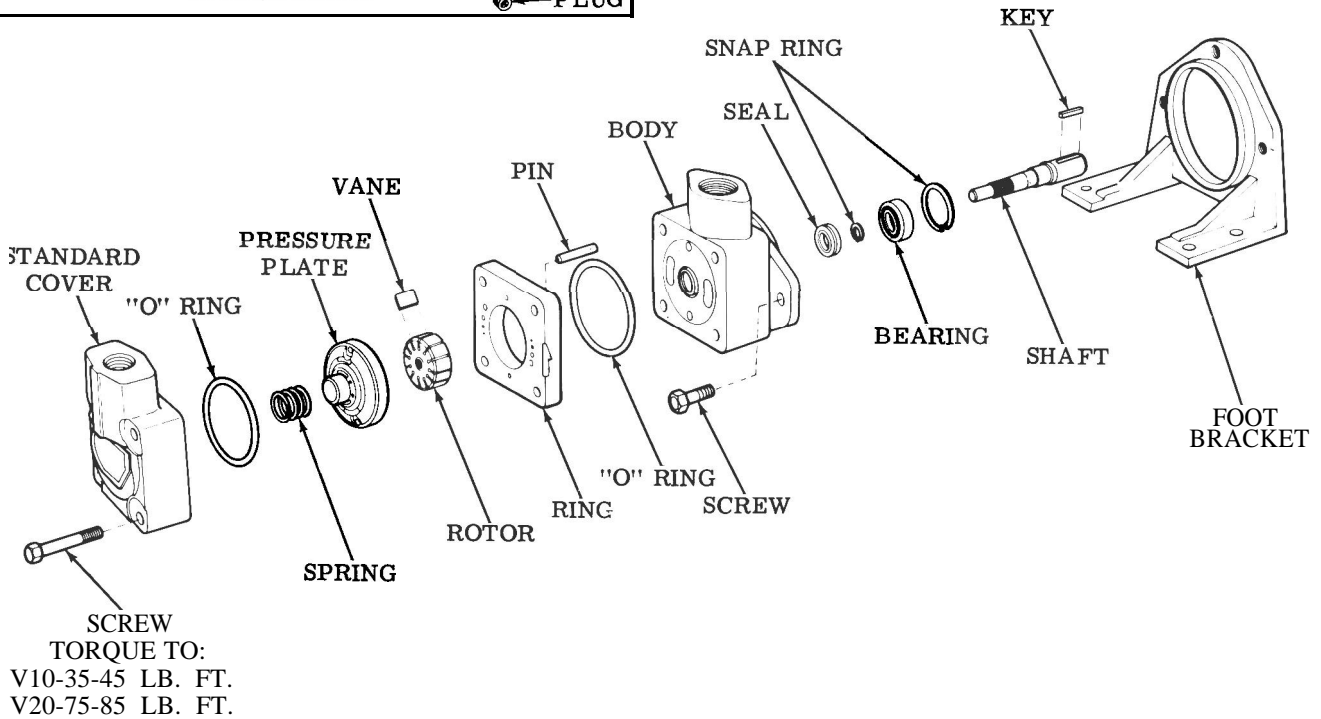


Figure 8

ing. Align square and press into place. Use a short length of brass rod as a pressing tool, to prevent seat damage. Clean the relief valve bore to remove chips and filings. Insert the poppet into the bore, align square and lightly tap the stem of the poppet to mate the poppet and seat. Install the spring, shims, and plug into the cover. (later design uses a spring guide and straight thread plug with "O'rings) Be sure to check the pressure setting of the relief valve against the model code. If the setting is out of tolerance, readjust by removing or adding shims. (Removing shims reduces pressure while adding shims increases pressure. )

Priority Valve - Install the snap ring within the priority valve cover bore, (early V20 series only) ;make sure the snap ring is seated within its groove. Insert the priority valve spool, small land first, into the bore. Install plugs at each end of the bore and secure. Refer to Figure 8 for spool orientation.

3. Assembly of Pump - See Figure 8. Begin assembly by pressing the shaft into the front bearing while supporting the bearing inner race. Install the small snap ring on the shaft.

**NOTE**

Before assembling the shaft seal, determine the cor-

rect position of the sealing lip. (See Figure 9. ) Seals are assembled with the garter spring toward the pump - ing cartridge. Press the seal firmly in place and lubricate the lip with petroleum jelly or other grease compatible with the system fluid. Slide the drive shaft into the body until the bearing is seated. Tap lightly on the end of the shaft if necessary. Install the snap ring.

Install new "O' rings in the body and cover. Insert the ring locating pins in the body and assemble the ring so that the arrow on the perimeter points in the direction of rotation. Check the assembly against Figure 10. Install the rotor on the shaft and insert the vanes in the rotor slots. Be certain the radius edges of the vanes are toward the cam ring.

Place the pressure plate on the locating pins and flat against the ring. Place the spring over the pressure plate, and then install the cover with the outlet port in the correct position. Tighten the cover screws to the torque shown in Figure 8. Rotate the shaft by hand to insure that there is no internal binding. Install the shaft key.

If a foot mounting is used, assemble the pump to its foot mounting. If a gasket is used, be certain it is flat to avoid misalignment of the shaft.

**Section VII - TESTING**

If a test stand is available, the pump should be tested at the recommended speeds and pressures shown on the installation drawing. (See Table 1).

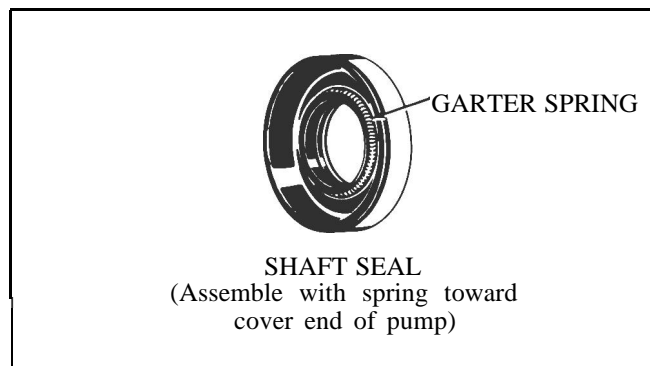


Figure 9

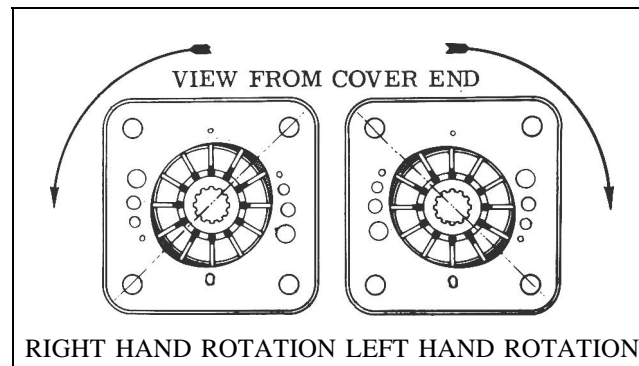


Figure 10





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# Chart Your Way to Easy Steering

## Steering System Troubleshooting Guide

### Notice

This guide and the accompanying videotapes were prepared for the purpose of providing general advice concerning the diagnosis and correction of commercial vehicle steering related problems. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-Yourselfers". These materials should be used in conjunction with service manuals provided by vehicle and component manufacturers. Diagnosis and correction of commercial vehicle steering related problems should only be handled by properly trained, professional mechanics who have the proper equipment, tools, instructions and know-how to perform the work properly and safely.