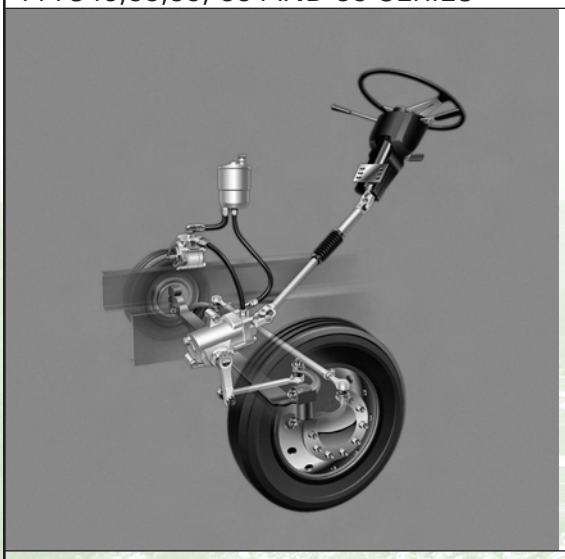
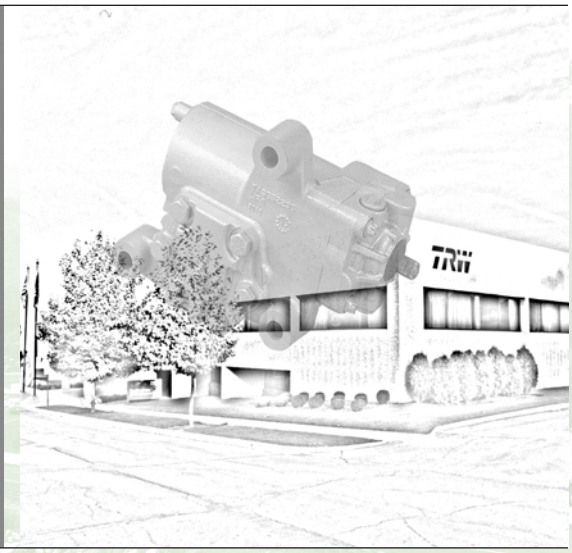
TRW Automotive

Commercial Steering Systems

TAS Steering Gear Service Manual

T A S40,55,65, 66 AND 85 SERIES





Hazard Warning Definitions

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

Disclaimer

This Service Manual has been prepared by TRW Commercial Steering Systems 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 Systems 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 a TAS 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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⚠ WARNING **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 manual may result in a loss of steering.**

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Introduction

This new TAS Service Manual replaces all previous editions of TRW's TAS40, 55, 65, 66 and 85 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 torque, force, pressure and flow notations that conform to international standards.
- Service Manual divided into sections for easier reference.
- 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.**

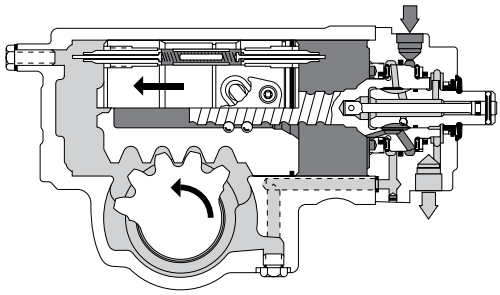
Item numbers on the exploded view correspond with item numbers used throughout the Service Manual.

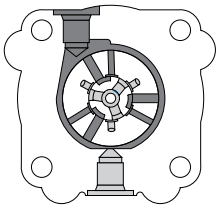
As you gain experience in servicing TAS steering gears, you may find that some information in this Service Manual could be clearer and more complete. If so, let us know about it. Don't try to second-guess the Service Manual; if you do not understand a procedure, contact our Technical Services Department at 765.423.5377 or 800.TRW.0899. Servicing TAS series steering gears should be safe and productive.

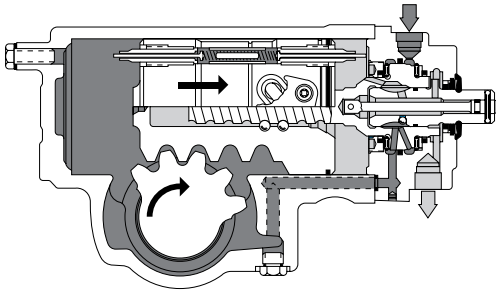
Oil Flow Illustration

Left Hand Lead

Right Hand Lead

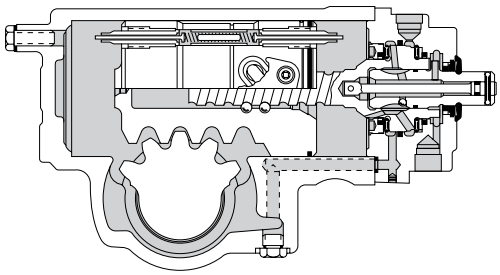


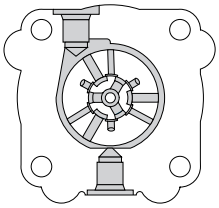


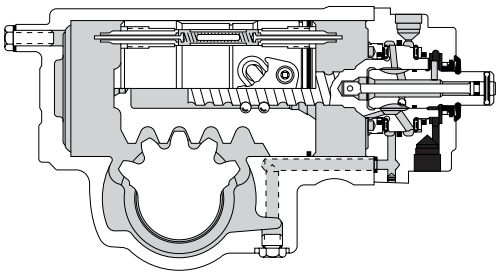


Right Hand Turn

Steering Wheel Input:
Clockwise Rotation

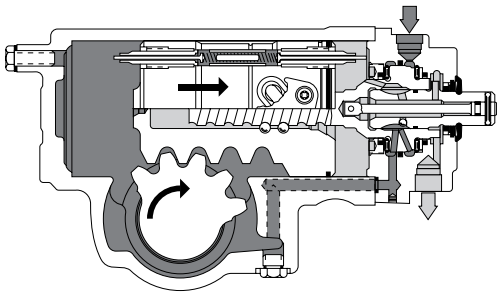


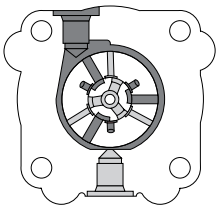


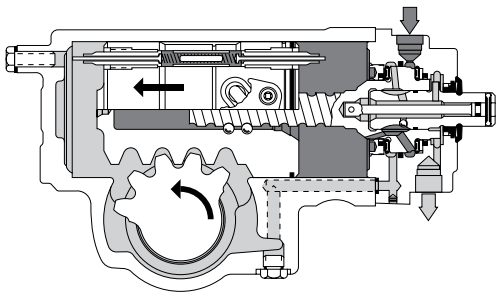


Straightline Running

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 another part of our fully integral hydraulic power steering gear family. Fully 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 TAS40, 55, 65 and 85 gears is 2,175 psi (150 bar). The maximum operating pressure for a TAS66 gear is 2,320 psi (160 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)
TAS66	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)
TAS66	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.

Maximum internal leakage for all TAS gears is 1 gal/min.

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

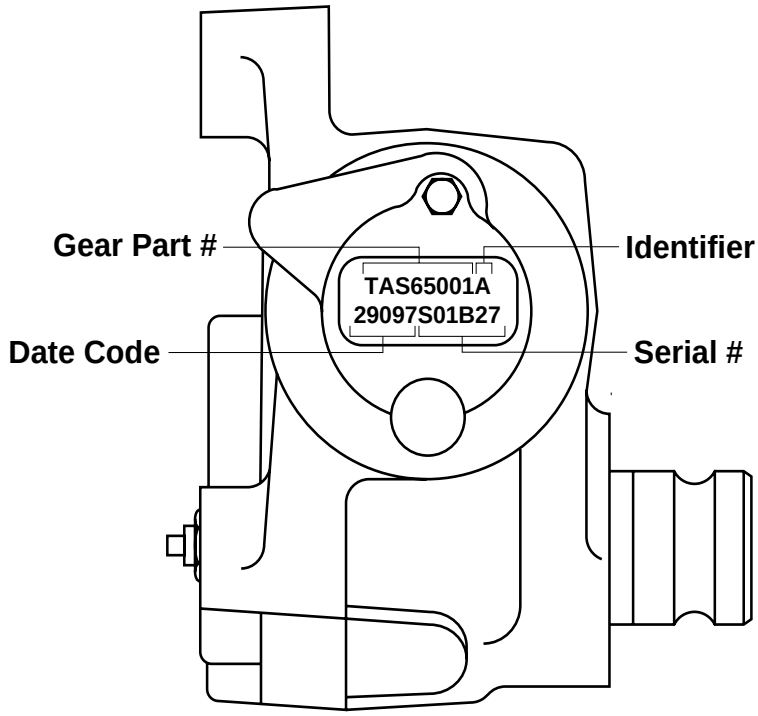
Some TAS gears, (with or without poppets), are supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering gear, but it does not reduce pressure as the steered wheels approach the axle stops.

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 procedures for Flushing and Air Bleeding the System are found in the Steering Maintenance Guideline packet (TRW Document #800). Replacement of damaged automatic bleed plugs, and manual bleed screws is described on page 52.

Specification Numbers



Gear Part #
The steering gear part number is stenciled on a machined surface opposite the input shaft of every TAS gear. *The number cast into the side of the housing IS NOT the part number.*

Gear Identifier
Letters stenciled after the part number indicate the following:

A - Q = Step Bore Hsg.
T - Z = High Flow Poppets
R = Reman (TRW)

Date Code
An example date code would be 29097; this means the gear was built on the 290th day of 1997.

Serial #
Newer gears include a serial number.

Torque Chart

Part Name	Item #	Torque Range Dry	Torque Range Lubricated
Auxiliary cylinder plug	8	25-35 lbf•ft (34-48 N•m)	
Ball return guide cap/strap bolts	29	14-22 lbf•ft (19-29 N•m)	
Bearing adjuster	21		11-15 lbf•ft (15-20 N•m)*
Locknut	22		101-122 lbf•ft (137-165 N•m)**
Manual bleed screw	n/s	40-50 lbf•in. (3.1-3.7 N•m)	
Plug, auto bleed	n/s	38-58 lbf•ft (52-79 N•m)	
Poppet sleeve assembly	23	16-20 lbf•ft (22-27 N•m)	
Poppet sealing nut, service	39	33-37 lbf•ft (45-50 N•m)	
Poppet fixed stop screw	38	38-42 lbf•ft (52-57 N•m)	
Poppet fixed stop screw	37	38-58 lbf•ft (52-79 N•m)	
Relief valve cap	5	25-35 lbf•ft (34-48 N•m)	
Sector shaft adjusting screw jam nut	46	40-45 lbf•ft (54-61 N•m)	
Side cover bolts (TAS40)	47		108-128 lbf•ft (147-174 N•m)
Side cover bolts (TAS55, 65, 66 & 85)	47		160-180 lbf•ft (217-244 N•m)
Valve hsg. bolts (TAS40, 55, & 65)	1		75-85 lbf•ft (102-115 N•m)
Valve hsg. bolts (TAS85)	1		108-128 lbf•ft (147-174 N•m)

n/s = Not Shown

Item numbers referenced are shown on the exploded views, pages 12, 14, and 16. (Please note that these exploded views are all identical.)

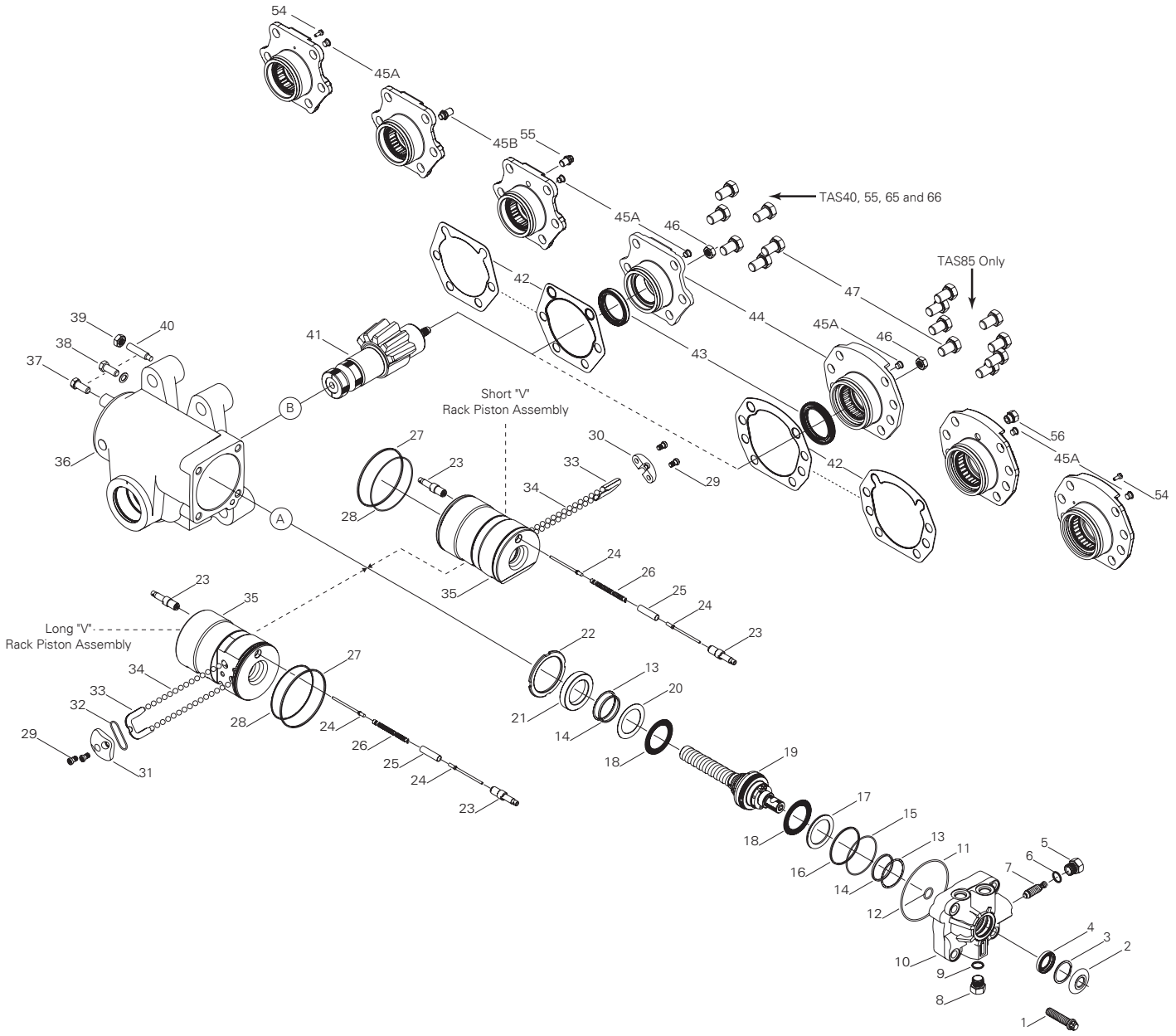
* After tightening to this torque value, the adjuster must be backed off ¼ to ½ of a turn as described in step 23 on page 47.

** Torque value indicated is using recommended tools.

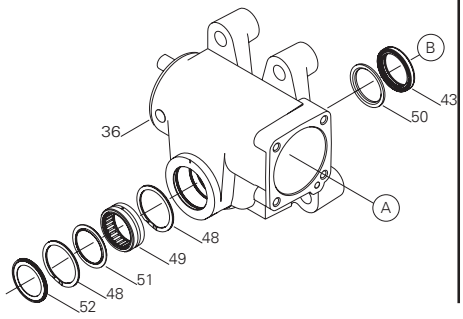
Special tools can be purchased through:

SPX Corporation
Kent-Moore Tool Group
28635 Mound Road
Warren, MI 48092
1-800-328-6657

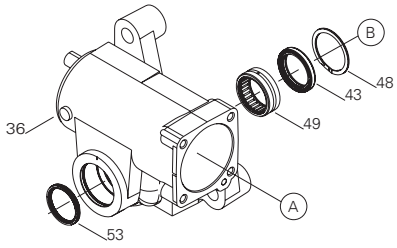
Exploded View



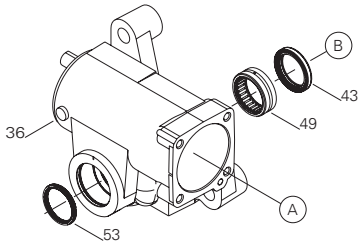
Standard



Step Bore w/ Retaining Ring



Step Bore w/ Hook Groove



Exploded View Part Descriptions

Kit	Item	Description
	1	Bolts, Valve Housing (4)
♣♦	2	Seal, Dirt and Water Seal
♣♦	3	Ring, Retaining
♣♦	4	Seal, Input Shaft
	5	Cap, Relief Valve
♣	6	O-ring, Relief Valve
	7	Valve, 2 Piece Relief
	8	Plug, Auxiliary Port
♣	9	O-ring, Auxiliary Port
	10	Housing, Valve
♣	11	Seal Ring, Valve Housing
♣	12	Seal Ring, Valve Housing
♣	13	O-ring
♣	14	Ring, Seal
♣	15	Ring, Seal
♣	16	O-ring, Valve Housing
	17	Washer (Thick), Thrust
	18	Bearing, Thrust (1 or 2)
	19	Input Shaft / Worm Valve Assy.
	20	Washer (Thin), Thrust
	21	Adjuster, Bearing
♣	22	Locknut, Adjuster
♠	23	Poppet Seat and Sleeve Assy. (2)
♠	24	Poppet (2)
♠	25	Push Tube
♠	26	Poppet Spring
♣	27	Ring, Rack Piston Teflon Seal
♣	28	O-ring, Rack Piston (Back up)
♣	29	Screws, Torx (2)
♣	30	Strap, Ball Return Guide
	31	Cap, Ball Return Guide
♣	32	Seal, Cap
	33	Guide Halves, Ball Return
	34	Balls, Steel
	35	Piston, Rack
	36	Housing
	37	Bolt, Alt. Fixed Stop
	38	Bolt and Washer, Fixed Stop
∇	39	Jam Nut, Poppet Sealing
∇	40	Screw, Poppet Adjusting
	41	Shaft, Sector
♣♥	42	Gasket, Side Cover
♣♥	43	Seal, Output (2)
	44	Cover Assembly, Side
♣	45A	Vent Plug, Side Cover
♣	45B	Vent Plug, Side Cover
	46	Jam Nut, Side Cover
	47	Bolts, Side Cover (6 or 8)
♥	48	Ring, Retaining
	49	Bearing, Roller
	50	Washer, Spacer
♣♥	51	Seal, Dirt
♣♥	52	Seal, Dirt and Water
♣♥	53	Seal, Dirt and Water
	54	Bleed Screw, Manual
	55	Bleed Screw, Auto
	56	Plug, Auxiliary Port (Side Cover)

Symbol indicates which kit item is included in.

♣	=	Complete Seal Kit
♦	=	Input Shaft Seal Kit
♥	=	Output Shaft Seal Kit
♠	=	Poppet Kit
∇	=	Poppet Adjusting Screw Kit

Service Parts List

Item	Description	Standard	SB / Retaining Ring	SB / Hook Groove
1	Bolts, Valve Housing (4)	020251	020251	020251
	Bolts, Valve Housing (4) TAS85	020272	020272	020272
2	Seal, Dirt and Water Seal	Available in Kit	Available in Kit	Available in Kit
3	Ring, Retaining	Available in Kit	Available in Kit	Available in Kit
4	Seal, Input Shaft	Available in Kit	Available in Kit	Available in Kit
6	O-ring, Relief Valve	Available in Kit	Available in Kit	Available in Kit
8	Plug, Auxiliary Port	Available in Kit	Available in Kit	Available in Kit
9	O-ring, Auxiliary Port	Available in Kit	Available in Kit	Available in Kit
11	Seal Ring, Valve Housing	Available in Kit	Available in Kit	Available in Kit
12	Seal Ring, Valve Housing	Available in Kit	Available in Kit	Available in Kit
13	O-ring	Available in Kit	Available in Kit	Available in Kit
14	Ring, Seal	Available in Kit	Available in Kit	Available in Kit
15	Ring, Seal	Available in Kit	Available in Kit	Available in Kit
16	O-ring, Valve Housing	Available in Kit	Available in Kit	Available in Kit
17	Washer (Thick), Thrust	400143	400143	400143
18	Bearing, Thrust (1 or 2)	070027	070027	070027
20	Washer (Thin), Thrust	400144	400144	400144
21	Adjuster, Bearing	400149	400149	400149
22	Locknut, Adjuster	Not Serviceable	Not Serviceable	Not Serviceable
23	Seat and Sleeve Assy. Poppet	Available in Kit	Available in Kit	Available in Kit
24	Poppet (2)	Available in Kit	Available in Kit	Available in Kit
25	Tube, Push	Available in Kit	Available in Kit	Available in Kit
26	Spring, Poppet	Available in Kit	Available in Kit	Available in Kit
27	Ring, Rack Piston Teflon Seal	Available in Kit	Available in Kit	Available in Kit
28	O-ring, Rack Piston (Back up)	Available in Kit	Available in Kit	Available in Kit
29	Screw, Torx (2)	Available in Kit	Available in Kit	Available in Kit
30	Strap, Ball Return Guide	400167	400167	400167
31	Cap, Ball Return Guide	Available in Kit	Available in Kit	Available in Kit
32	Seal, Cap	Available in Kit	Available in Kit	Available in Kit
34	Balls, Steel	213684-X1	213684-X1	213684-X1
39	Jam Nut, Poppet Sealing	Available in Kit	Available in Kit	Available in Kit
40	Screw, Poppet Adjusting	Available in Kit	Available in Kit	Available in Kit
42	Gasket, Side Cover	Available in Kit	Available in Kit	Available in Kit
43	Seal, Output (2)	Available in Kit	Available in Kit	Available in Kit
48	Ring, Retaining	Available in Kit	Available in Kit	Available in Kit
50	Washer, Spacer	Available in Kit	Available in Kit	Available in Kit
51	Seal, Dirt	Available in Kit	Available in Kit	Available in Kit
52	Seal, Dirt and Water	Available in Kit	See Item 53	See Item 53
53	Seal, Dirt and Water	See Item 52	Available in Kit	Available in Kit
54	Screw, Manual Bleed (Housing Location Not Shown)	213705	213705	213705
55	Screw, Auto Bleed (Housing Location Not Shown)	021397	021397	021397
56	Plug, Auxiliary Port (Side Cover Location)	415437-A1	415437-A1	415437-A1

Parts Vary by Specification*

Item	Description
5	Cap, Relief Valve
7	Valve, 2 Piece Relief
10	Housing, Valve
19	Worm Valve Assembly, Input Shaft
33	Guide Halves, Ball Return
35	Piston, Rack
36	Housing
41	Shaft, Sector
44	Cover Assembly, Side
47	Bolts, Side Cover (6 or 8)
49	Bearing, Roller

*Contact TRW Technical Service for part numbers

Service Kits (General)

Gear Model	Description	Kit Part Number
TAS40	Complete Seal Kit	TAS400004
TAS55	Complete Seal Kit	TAS550004
TAS65 & TAS66	Complete Seal Kit	TAS650012
TAS85	Complete Seal Kit	TAS850005
All TAS	Input Shaft Seal Kit	TAS000001
TAS40	Output Shaft Seal Kit	TAS400005
TAS55, TAS65, TAS66	Output Shaft Seal Kit	TAS000002
TAS85	Output Shaft Seal Kit	TAS850007
TAS40, TAS55, TAS65, TAS66	Poppet Kit	TAS000003
TAS85	Poppet Kit	TAS850006
All TAS	Poppet Adjusting Screw/Nut Kit	021407X1
All TAS	Relief Valve Cap and O-ring	411061A1
All TAS	Auxiliary Port Plug and O-ring	415437A1

Service Kits (Gear Specific)

Gear Part Number	Description	Kit Part Number
TAS65127A TAS65129A TAS65155A TAS65156A TAS65172A	Complete Seal Kit	TAS650014
TAS65094T TAS65095T TAS65126T TAS65142T TAS65198T TAS65200T TAS65202T TAS65213T TAS65214T TAS65215T TAS66006T	Poppet Kit	TAS000004
TAS40019A TAS40030A TAS40044A TAS65006A TAS65013A TAS65033A TAS65035A TAS65076A TAS65133A TAS66005A TAS65033A TAS85055A TAS85064A TAS85067A	Poppet Adjusting Screw/Nut Kit	021318X1

Section 2 Installation

Initial Installation 18
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Maintenance Tips..... 19
Output Shaft Grease Pack Diagrams..... 20

Initial 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:** A fixed stop screw installed in the housing, or a poppet adjusting screw installed so that it duplicates the fixed stop screw length.

⚠ CAUTION **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.**

Full turn in one direction

1. With the engine at idle and the vehicle unloaded, turn the 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.

NOTE If you encounter excess rim pull effort, allow the 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.

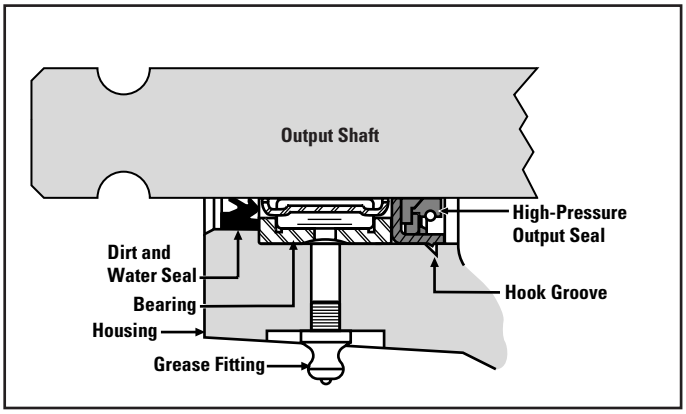
Replace reservoir filters according to requirements.

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

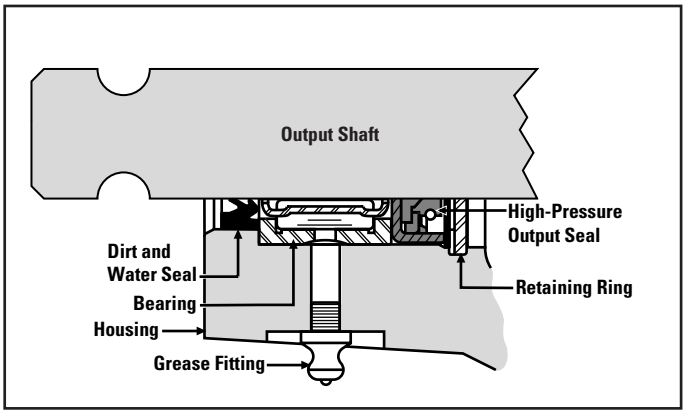
Maintain grease pack behind the output shaft dirt and water seal as a general maintenance procedure at least twice a year, in the Spring and Fall. Grease fitting is provided in housing trunnion. Use only NLGI grade 2 or 3 multipurpose chassis lube, and use only a hand operated grease gun on fitting. Add grease until it begins to extrude past the sector shaft dirt and water seal. See Page 16 for illustrations of typical TAS Output Shaft Assemblies.

Output Shaft Grease Pack Diagrams

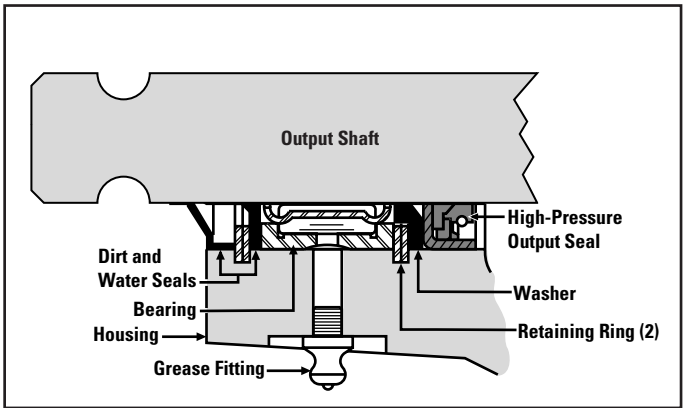
Step Bore with Hook Groove Gear



Step Bore Gear



Standard Gear



Section 3 Gear Disassembly, Inspection, and Assembly

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Assembly Preparation 33

Assembly Procedures 33

Internal Component Repair Procedures

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- Valve Housing/Worm Screw 43
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- Roller Bearing - Step Bore Gears 51

Port Plugs, Screws and Grease Fitting Replacement 52

Final Adjustments 53

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 Procedures

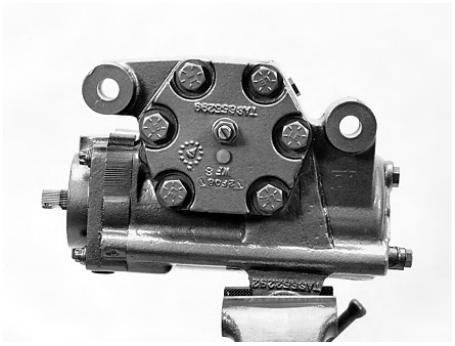
Tools Required

Allen wrenches
Pocket knife
Ratchet
Rolling head pry bar
Rubber mallet
Screwdriver
Sockets:
- •Standard
- •Torx

Vise

Materials Required

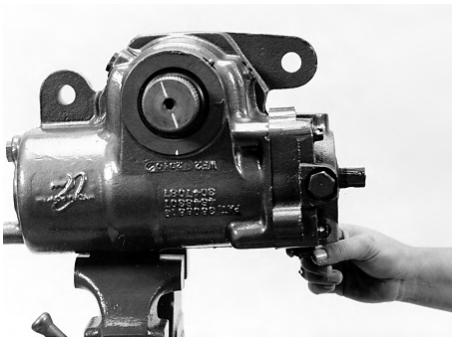
Emery cloth
Masking tape



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.

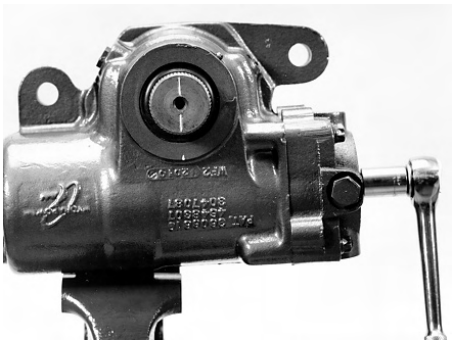
⚠ CAUTION **Do not clamp against body of housing. If mounting boss or flange is not accessible, fabricate and attach a mounting plate to the housing mounting bosses.**



Unplug ports

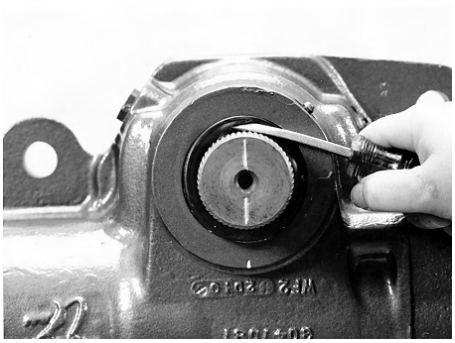
Appropriate size socket or open-end wrench

2. Prepare for fluid drainage and unplug hydraulic ports.



Position sector shaft

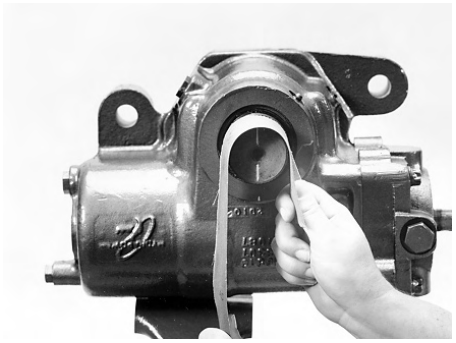
3. Rotate the input shaft until the timing mark on the end of the sector shaft is in line with the timing mark on the end of the housing. This will position the sector shaft for removal.



Remove dirt & water seal

Small screwdriver

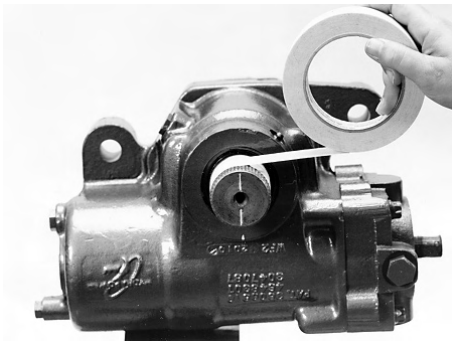
4. **Standard gears only** - Remove and discard dirt & water seal (52) from the housing trunnion.



Clean sector shaft

Fine grade emery cloth

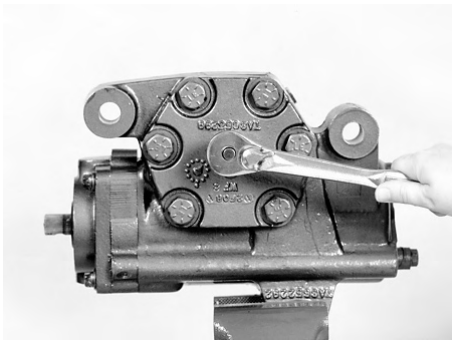
5. Remove any paint or corrosion from the exposed area of the sector shaft (41).



Tape sector shaft

Masking tape

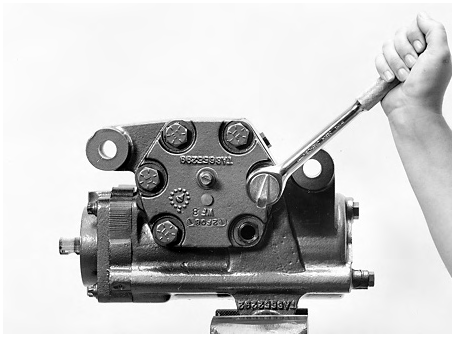
6. Tape the serrations and bolt groove of the sector shaft with one layer of masking tape. The tape should not extend onto the sector shaft bearing diameter.



Remove jam nut

¾" Socket

7. Remove the sector shaft adjusting screw jam nut (46).



Remove side cover bolts

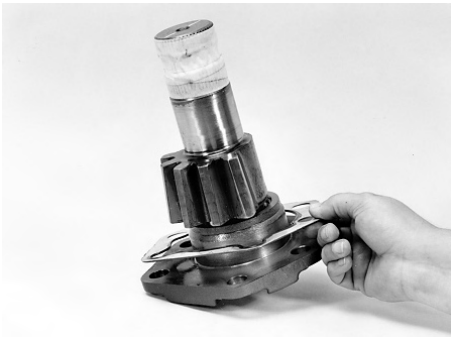
15⁄16" Socket or
13⁄16" Socket

8. Be prepared for more fluid drainage and remove the six or eight bolts (47) from the side cover (44).

Remove side cover

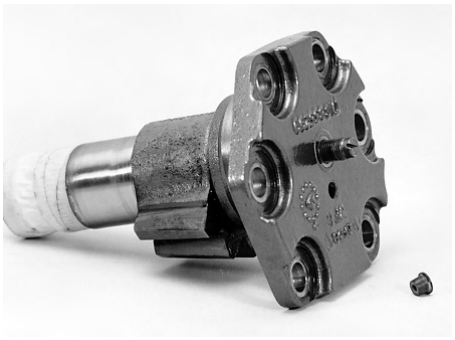
Soft mallet

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.



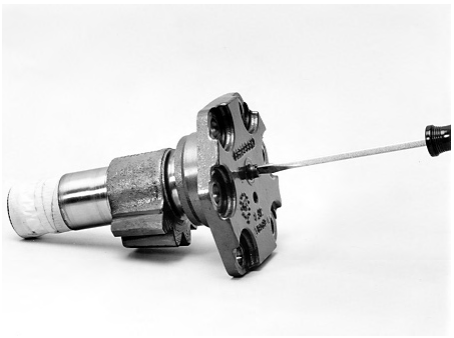
Discard gasket

10. Remove and discard the side cover gasket (42).



Remove vent plug

11. Remove and discard the vent plug (45).



Remove sector shaft from cover

Screwdriver

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

Remove side cover seal

⅜" Drive socket
Rolling head pry bar

13.

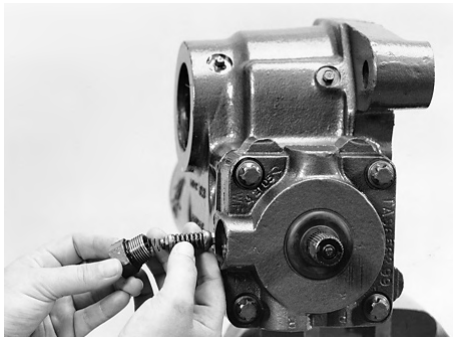
⚠ CAUTION **Be careful not to damage the bore & bushing/bearing when removing the seal.**

NOTE **TAS40, TAS55 and some TAS65 gears are equipped with a bushing. TAS66, TAS85 and some TAS65 gears are equipped with a bearing.**

Clamp the side cover in a vise. Place a standard ⅝" or 11⁄16" - ⅜ drive socket in the center of the side cover. Pry the seal (43) out with a rolling head pry bar, using the socket for support. Discard the seal and remove the socket.

Inspect adjusting screw and retainer

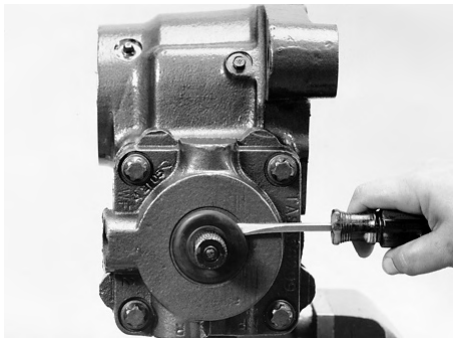
14. Inspect the sector shaft assembly for damaged adjusting screw threads. The retainer must be securely staked in place. The adjusting screw must rotate by hand with no perceptible end play (lash).



Remove relief valve components

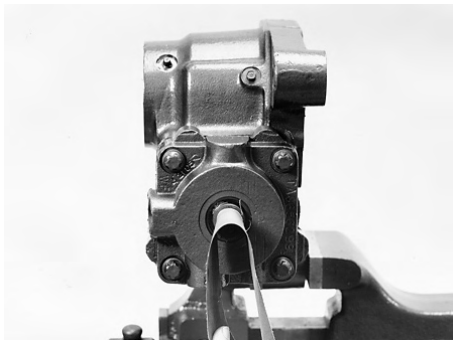
7/8" Socket

15. If equipped, remove relief valve cap (5), o-ring (6) and two-piece relief valve (7) from the valve housing. Discard the o-ring.



Remove dirt & water seal

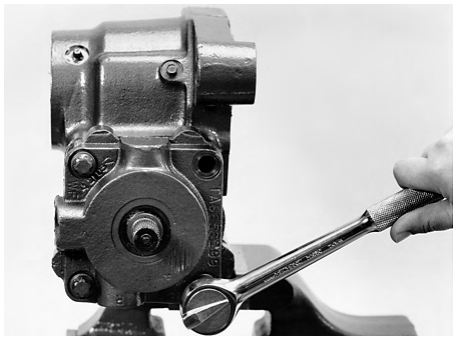
16. Remove and discard the dirt & water seal (2) from the input shaft (19). Save this seal for comparison with the new seal.



Clean input shaft

Fine grade emery cloth

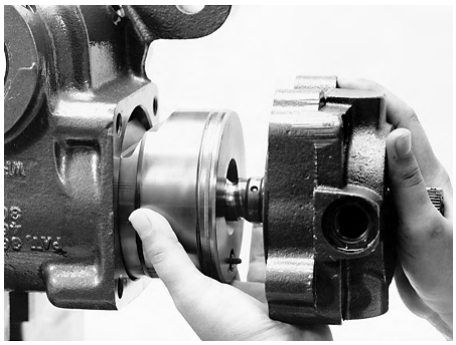
17. Clean any paint or corrosion from the exposed area of the input shaft.



Remove valve housing bolts

Torx socket E-16 or E-18

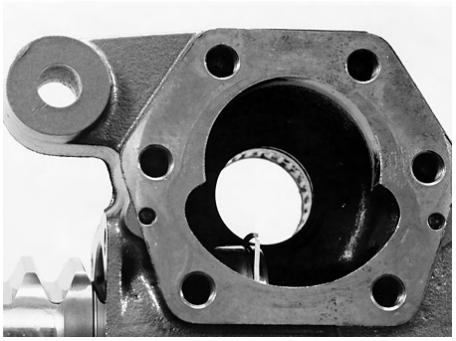
18. Remove the four torx head valve housing bolts (1).



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.

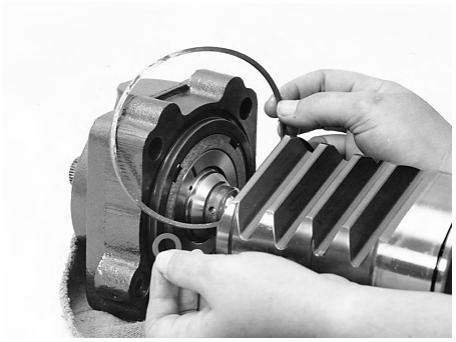
⚠ CAUTION **The set position of poppet seat and sleeve assemblies (23) must not be disturbed if the poppets are not going to be replaced or reset during disassembly.**



Pocket knife

19A.

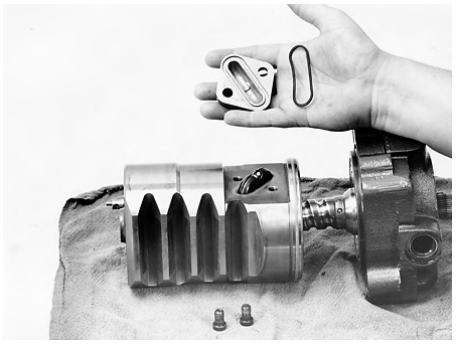
NOTE If your gear is short "V" construction, the rack piston seal is on the end of the rack piston farthest from the input shaft. Remove the seal before removing the valve housing assembly to prevent the Teflon rack piston seal ring (27) from "hanging up" when it exits the housing. Expose the seal through 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 (11 & 12).

⚠ 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.**

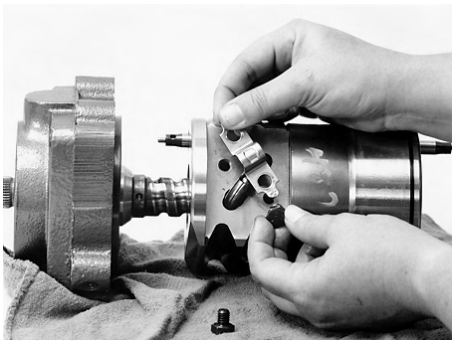


Remove ball return guide cap/strap

5⁄32" Allen wrench or T-30 Torx wrench

21. Remove and discard the two special sealing screws (29). Remove the ball return cap (31) and seal (32), or strap (30), discard the seal.

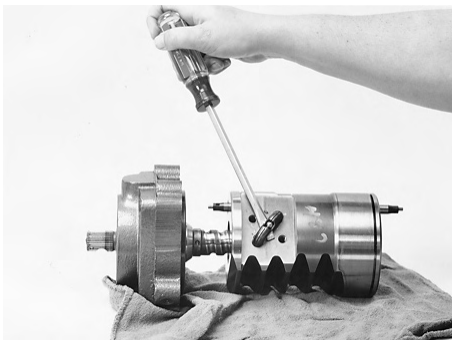
OR



Remove ball return guide clip

1/2" Socket

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

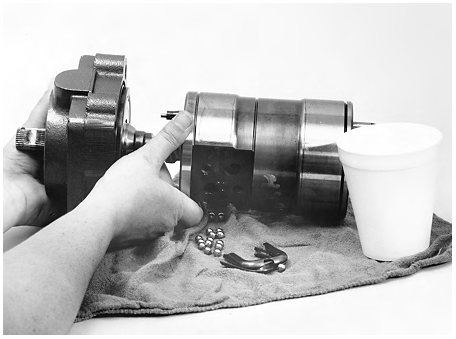


Remove ball return guides

Screwdriver

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 (33) by carefully inserting a screwdriver between the rack piston and guides.

NOTE Left hand ball return guide halves are copper or zinc chromate plated for identification and right hand guides are not plated. **RETAIN THE GUIDES FOR REASSEMBLY**.



Remove steel balls

23. Remove the steel balls (34) from the rack piston (35) 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 entire set must be replaced. Number of steel balls installed by model is: TAS40-29, TAS55-31 (30 if date code is 33789 or earlier), TAS65-32, TAS66-32, TAS85-34.**

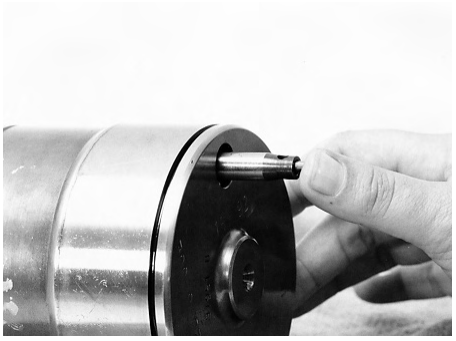
Separate rack piston from worm subassembly

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

Remove seal ring and o-ring

Pocket knife

25. Cut and remove the Teflon seal ring (27) and o-ring (28) from the rack piston if not removed during disassembly step 19A.



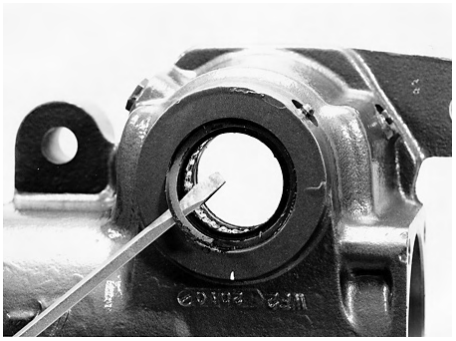
Inspect poppet assemblies

26. Push poppet stems (24), they should spring back. Push poppet seat (23), 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 the **Poppets** section on page 41. Otherwise, proceed to step 27.

> **NOTE** TRW recommends the poppet seat and sleeve assemblies (23) not be removed unless replacement of poppet components is required.

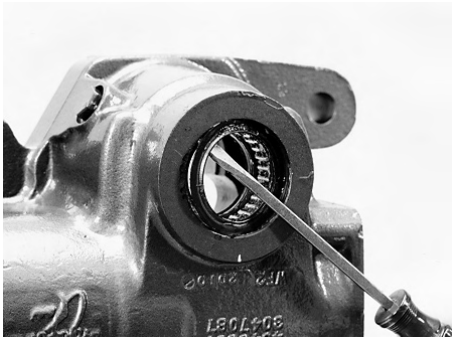
Inspect valve housing and worm screw

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** procedures on page 43. If not, proceed to step 28.



Remove retaining ring (if equipped)

28. **Standard gears only** - Remove the retaining ring (48) that is closest to the output end of the housing trunnion.



Remove dirt seal

Screwdriver

29. **Standard gears** - Remove and discard dirt seal (51).

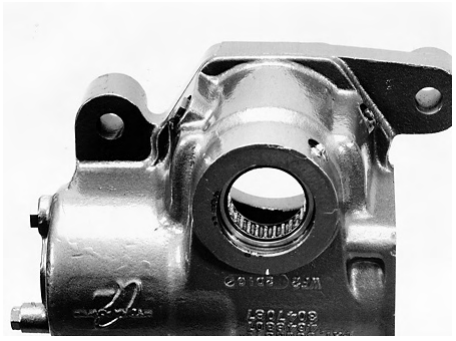
Step Bore gears - Remove and discard the dirt and water seal (53).

Remove pressure seal (and spacer washer if equipped)

Screwdriver

30. **Standard gears** - Insert a screwdriver into the housing bearing bore from the trunnion end, and carefully push the seal (43) and spacer washer (50) out of the other end of the bearing bore ***without damaging the sealing area of the bore***. Discard the seal.

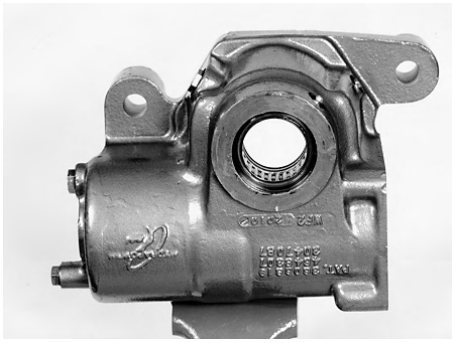
Step Bore gears - Remove the retaining ring (48), if applicable, through the side cover opening. Then insert a screwdriver through the trunnion opening, and carefully push the seal (43) out ***without damaging the sealing area of the bore***. Discard the seal.



Inspect roller bearing

31. **Standard gears** - Inspect roller bearing (49) in the housing for brinelling or spalling. Inspect retaining ring for damage. If replacement of either part is required, go to **Roller Bearing - Standard Gears** on page 50. If not, proceed to step 32.

Step Bore gears - Inspect the roller bearing (49) for brinelling or spalling. If replacement is required, go to **Roller Bearing - Step Bore** on page 51. If not, proceed to step 32.



Inspect housing screws, and plugs

32. Inspect the following for damage:

- Poppet fixed stop screw and washer (38) if equipped.
- Poppet adjusting screw (39) and sealing nut (40)
- Auto-bleed plug
- Manual bleed screw
- Auxiliary port plugs (8) and o-rings (9)

If any are damaged, go to **Replace Housing Ports, Plugs, Screws, Fittings** on page 52. If not, proceed to the Inspection Section on page 31.

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.**

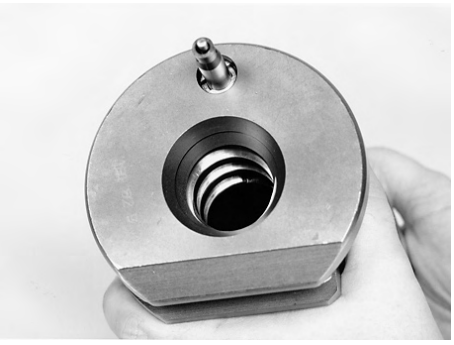
⚠ WARNING **Any of the following conditions present in the steering gear indicates impact damage.**

Condition	Area
Brinelling	**• Ball track grooves of rack piston** **• Ball track grooves of worm screw** **• Bearing area of sector shaft** **• Thrust washers and bearings in valve housing**
Cracks or Breaks	**• Bearing area of sector shaft** **• Sector shaft teeth** **• Rack piston teeth** **• Housing** **• Thrust washers and bearings in valve housing** **• Worm screw**
Twisted serrations	**• Output shaft serrations**

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 teeth

1. Inspect the rack piston (35) teeth for cracks or obvious damage. If teeth are damaged, replace the rack piston, sector shaft (41) and set of balls (34).

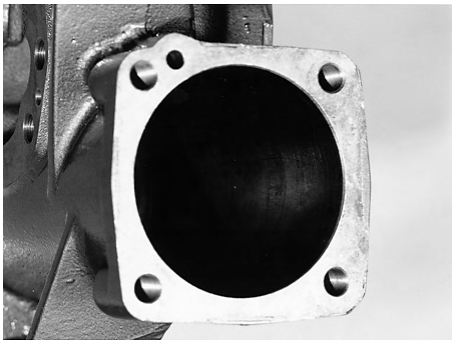


Inspect rack piston and worm ball track grooves

2. Inspect the rack piston 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.

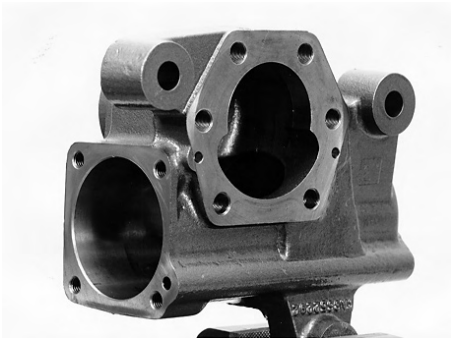
Inspect input shaft, valve/worm assembly sealing areas

3. Inspect the sealing area of input shaft (19) and valve housing (10) for nicks, and damage. Inspect for discoloration from excessive 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.



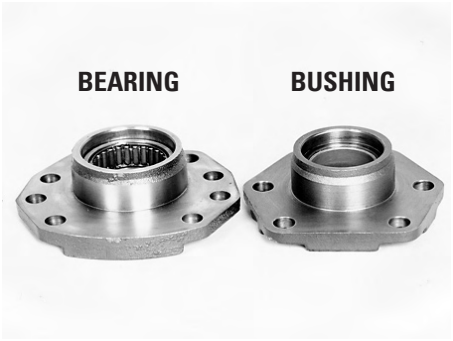
Inspect housing cylinder bore

4. Inspect the housing (36) cylinder bore. Some scoring marks are normal. If there was internal leakage greater than 1 GPM, make sure there are no damaged seals before replacing the housing.



Inspect housing faces

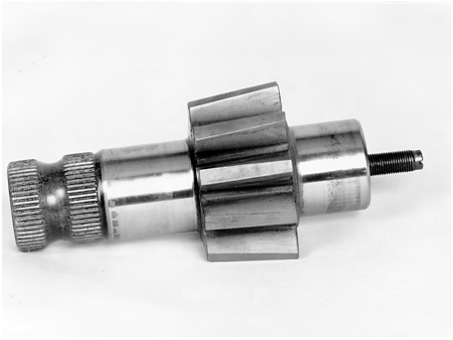
5. Inspect the housing faces for nicks that would prevent proper sealing. Replace the gear housing if these nicks are present and cannot be easily removed with a fine-tooth flat file without changing the dimensional characteristics.



Inspect side cover bushing/bearing

6. **Bushing Cover:** Inspect side cover bushing/bearing 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/bearing assembly.

Bearing Cover: Inspect roller bearing in side cover assembly (44) for brinelling or spalling. If either condition exists, replace the side cover assembly.



Inspect sector shaft assembly

7. Inspect the sector shaft (41) 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.

NOTE	A service sector shaft will come assembled with the adjusting screw and retainer.

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 Systems has complete seal kits available. These kits can be purchased through most OEM parts distributors. Contact your local dealer for availability.

Assembly Procedures

Tools Required

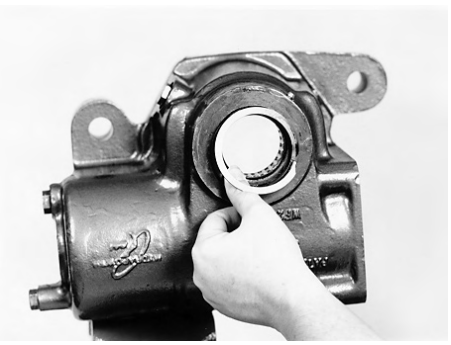
Allen wrenches	Ratchet	J37705 (TAS40)
Ft•lb Torque wrench	Screwdriver	J37071 (TAS55/65/66)
Hammer	Sockets	J38779 (TAS85)
Press	Torx sockets	
Punch	Vise	

Materials Required

TAS40-66	Grease
½"-20 x 7" All Thread	Exxon Polyrex* EP2 (P/N 045422)
TAS85	Seal kit: TAS400004
9/16"-14 x 7" All Thread	TAS550004
ATF oil	TAS650012
Masking tape	TAS850005

Install dirt seal

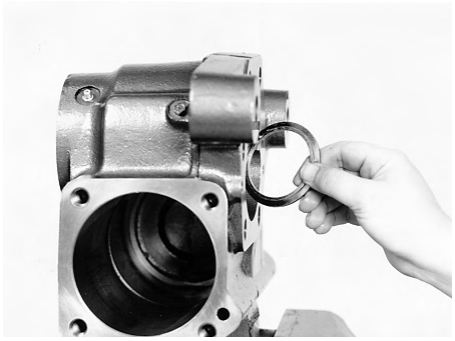
1. **Standard gears** - Install new dirt seal (51) into the trunnion end of the housing sector shaft bore and against the bearing, with the seal lip out.



Install retaining ring

2. **Standard gears only** - Install the outside retaining ring (48), seating it firmly in the housing retaining ring groove.

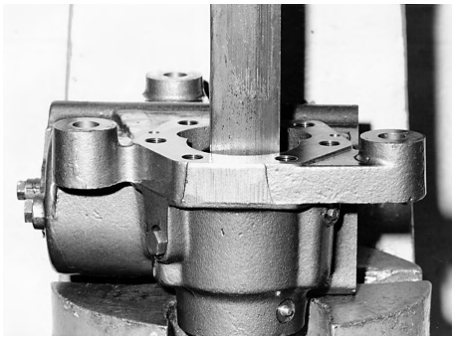
*Trademark of Exxon Oil Corp.



Install washer

3. **Standard gears only** - Install washer (50) into the side cover side of the housing seal bore with the small diameter piloted into the retaining ring.

NOTE If you are working with a housing with an unmachined trunnion face, you may need to square the housing to the press with shims for step 4.

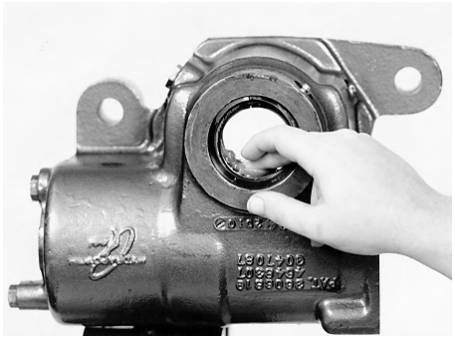


Press seal into housing

J37705 (TAS40)
J37071 or J37071-A
(TAS55, 65, 66)
J38779 (TAS85)
Press

4. **All gears** - Assemble new seal (43) onto bearing and seal tool (short end) 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 firmly.

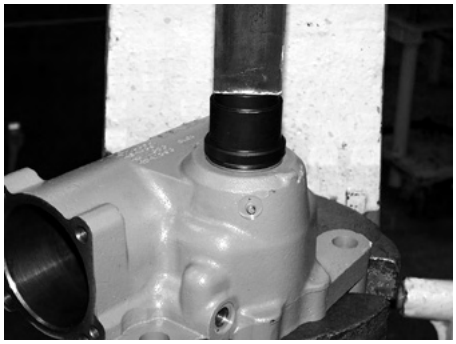
Step Bore gears with Retaining Ring only - Install the inside retaining ring (48) from the side cover opening. Seat the ring firmly in the retaining ring groove.



Grease the bearing and seal area

Grease

5. **Standard gears** - Liberally pack the area between dirt seal (51) and pressure seal (43) including roller bearing with clean, high temperature industrial grease, Exxon Polyrex* EP2.



Install dirt & water seal

J37705 (TAS40)
J37071 or J37071-A
(TAS55, 65, 66)
J38779 (TAS85)
Press

6. **Step Bore gears** - Install the dirt & water seal (53) with the bearing and seal tool (long end), making sure it is not cocked. Press the seal only until it seats against the bearing. DON'T PUSH IT IN FARTHER.

Liberally pack the roller bearing and new seals with clean, high temperature industrial grease, Exxon Polyrex* EP2.

Assemble seal rings

7. Lightly oil new seal rings (11 & 12) and assemble in valve housing mounting face groove.

TAS40, 55, 65, 66: Oil new seal ring (11) and assemble in valve housing mounting face groove.

TAS85: Oil new seal ring (11) and assemble in valve housing pilot groove.

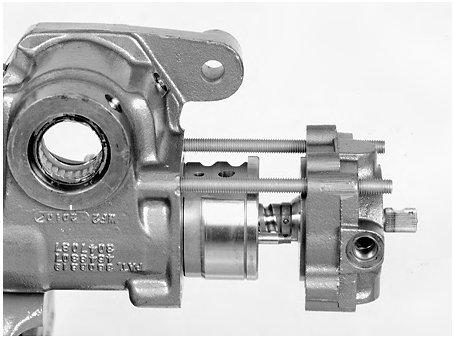
*Trademark of Exxon Oil Corp.

Install rack piston o-ring and seal ring

8. Install a new backup o-ring (28) and then a new Teflon seal ring (27) on rack piston (35). Do not over-stretch these rings as you install them. Do not allow the Teflon seal ring to be twisted.

Position rack piston in housing

9. Apply clean oil to housing cylinder bore. Place the rack piston in the housing piston bore with ball return guide holes facing up.



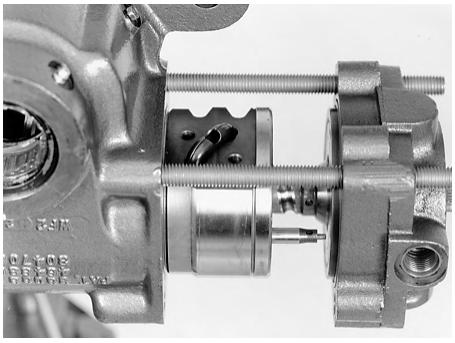
Insert worm and valve assembly into rack piston

All Thread
TAS40-66
½"-20 x 7"
TAS85
9/16"-14 x 7"

10. Insert the worm screw into the rack piston close to maximum depth, without the valve housing making contact with the poppet stem.

    Insert two All threads through valve housing bolt holes and tighten into housing to support the worm screw. (Note the size of all threads required for the gear being serviced.)

    Line up rack piston ball guide holes with the worm ball track grooves by rotating the input shaft.



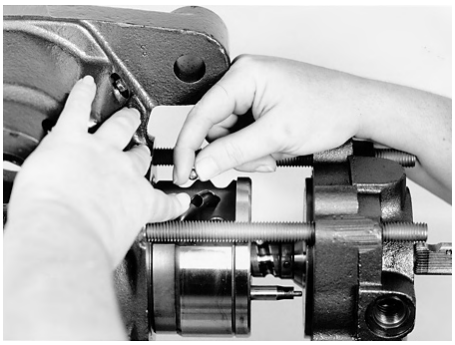
Assemble ball return guide halves

11. Assemble the ball return guide halves (33) 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 (35) or a new input shaft, valve, worm subassembly (19) is being assembled, the balls (34) 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 **Use the correct quantity of service balls: TAS40-29, TAS55-31, TAS65-32, TAS66-32 TAS85-34, when using the service ball kit.**



Assemble balls

12. **Hold the ball return guides (33) 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.**

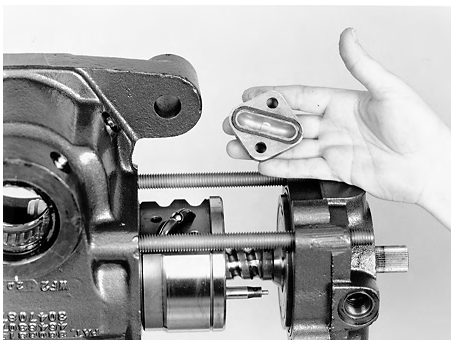
⚠ WARNING **The correct number of balls are required for proper gear operation. Count the balls and insert each carefully as in step 11.**

	TAS40	TAS55	TAS65	TAS66	TAS85
Original	29	30/31*	32	32	34
Service	29	31	32	32	34

***TAS55 gears built prior to 33889 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.**

⚠ CAUTION **Remove any fluid present in the two screw holes. Fluid in these holes could cause improper clamp load when torquing the cap or strap screws.**

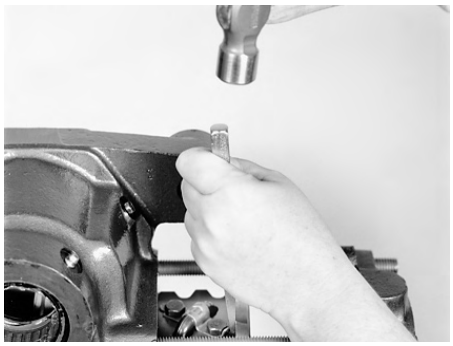


Assemble ball return guide cap

Allen wrench or T-30 Torx socket
Ft•lb Torque wrench
Grease

13. Place a new ball return guide cap seal (32) in the seal groove of the cap (31). Make sure the seal makes full contact with the rack piston surface. Install two new Allen or Torx head screws (29) and torque each screw alternately until a final torque of 18 ft•lb (24.5 N•m) is achieved.

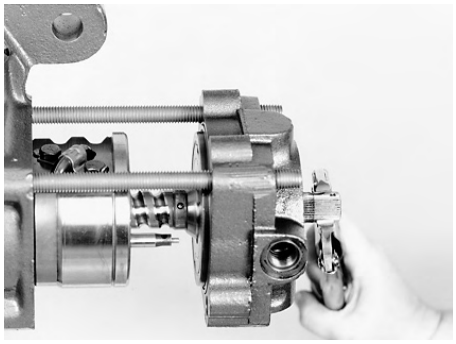
⚠ CAUTION **Ball cap seal is greased to hold seal in groove while assembling. Be sure not to trap the seal outside of the groove during reassembly.**



Assemble ball return guide strap

Allen wrench or T-30 Torx socket
Ft•lb Torque wrench
Grease

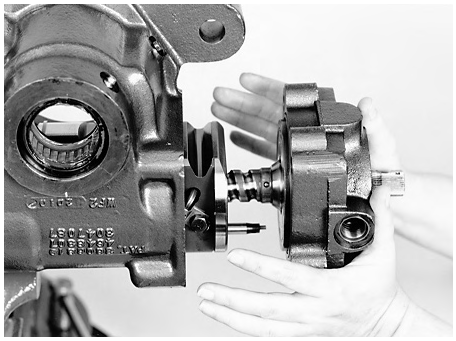
14. If your gear was equipped with the ball return guide strap (30), or if it was equipped with the clip, install the new ball return guide strap. Position it on the rack piston, install two new Allen or Torx head screws (29) and torque each screw alternately until a final torque of 18 ft•lb (24.5 N•m) is achieved.



Rotate input shaft to check for proper installation of balls

15. 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.**



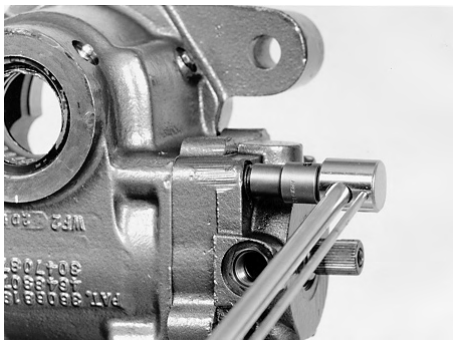
Install rack piston, worm, valve assembly

Oil

16. Apply clean oil to Teflon seal ring (27) on rack piston. Make sure there is a space of ⅜ - ½" (10.0-13.0 mm) between valve housing (10) 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 (27) 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.**

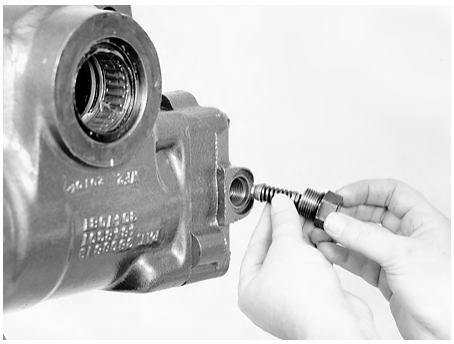
⚠ CAUTION **The poppet seat and sleeve assemblies (23) must not bottom against the internal poppet stops in the steering gear until the gear is installed on the vehicle and the poppet adjustment procedures are performed.**



Install valve housing bolts

E-16 Torx socket (TAS40, 55, 65, 66)
E-18 Torx socket (TAS85)
Ft•lb Torque wrench

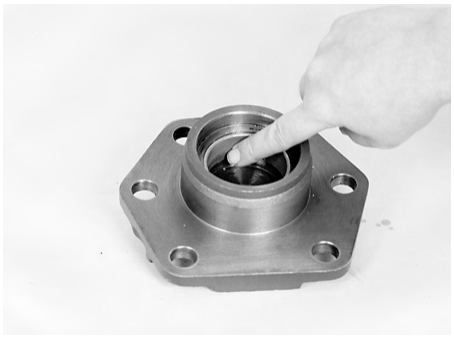
17. Lubricate and install the four valve housing bolts (1) into the housing. Torque the **TAS40, 55, 65 and 66 bolts alternately to 80 ft•lb** (108.5 N•m). Torque **TAS85 bolts to 118 ft•lb** (160 N•m).



Install relief valve parts

⅞" Socket
Ft•lb Torque wrench

18. If the gear is equipped with a relief valve, assemble a new o-ring (6) on relief valve cap (5). Assemble the small end of tapered spring onto the pin on the relief valve cartridge and insert the assembly (7), (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 ft•lb** (41 N•m).

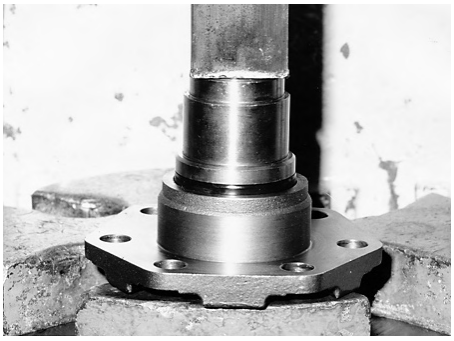


Lubricate side cover bushing/ bearing

19. **Bushing Side Cover:** Lightly oil bushing (if applicable). **Do not grease.**

Bearing Side Cover: Apply a generous amount of Exxon Polyrex* EP2 (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.**



Press seal in side cover

J37705 (TAS40)
J37071 or J37071-A (TAS55, 65, 66)
J38779 (TAS85)
Press

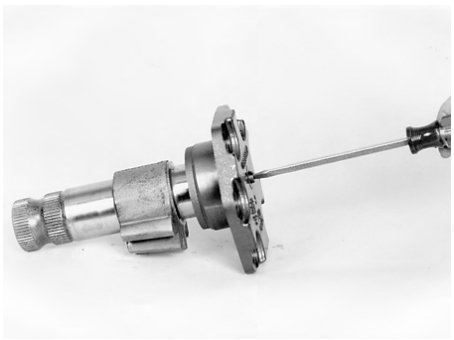
20. Grease and assemble new seal (43) onto installation tool so the side with the garter spring is against the shoulder of the tool. Pilot the tool into the side cover (44) with a force of 100-800 lb (445-3560 N) until it is seated against the bearing or bushing.

⚠ CAUTION **Make sure the OD of the seal, and the ID of the bore are free from grease and dust, for proper engagement of the seal.**

Lubricate sector shaft

21. **Bushing Side Cover:** Lightly oil short bearing area of sector shaft. **Do not grease.**

Bearing Side Cover: Apply a generous amount of Exxon Polyrex* EP2 to the short bearing area of the sector shaft.



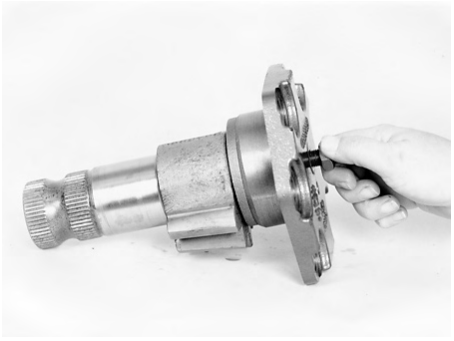
Install sector shaft into side cover

Screwdriver

22. Insert the sector shaft (41) into the side cover subassembly (44), and screw the sector shaft adjusting screw 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.

*Trademark of Exxon Oil Corp.



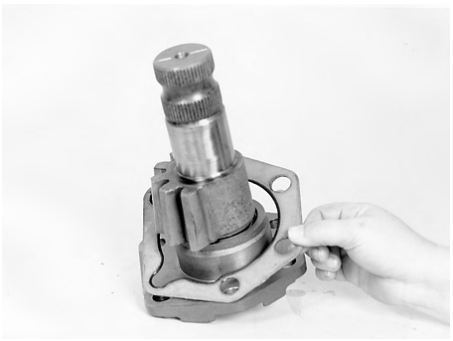
Install jam nut

23. Install the sector shaft adjusting screw jam nut (46) onto the sector shaft adjusting screw a few threads. Final adjustment will be made later.

Assemble vent plug

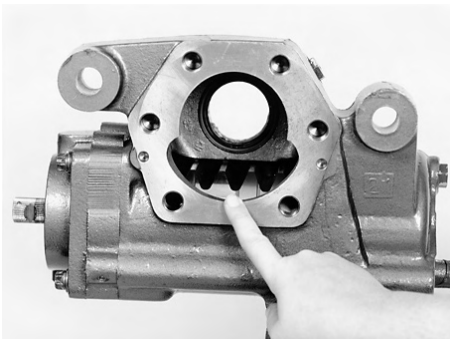
24. Press the new vent plug (45) into the hole provided in the side cover until the plug is fully seated.

⚠ 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.**



Install side cover gasket

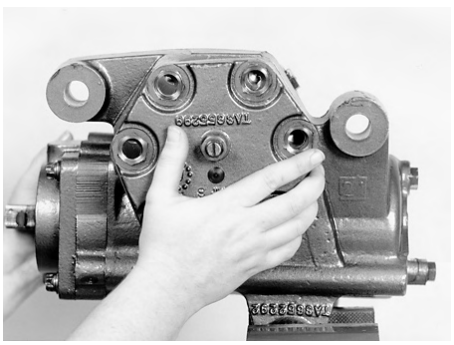
25. Apply clean grease to the new side cover gasket (42) to hold it in place and assemble it onto the side cover (44).



Center rack piston

26. 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.**

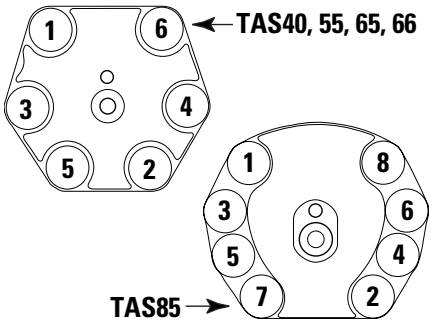


Install sector shaft and side cover into housing

Masking tape

27. 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 (43) in housing, causing the seal to leak.**



Install side cover bolts

13/16" Socket (TAS40)
15/16" Socket (TAS55, 65, 66 85)
Ft•lb Torque wrench

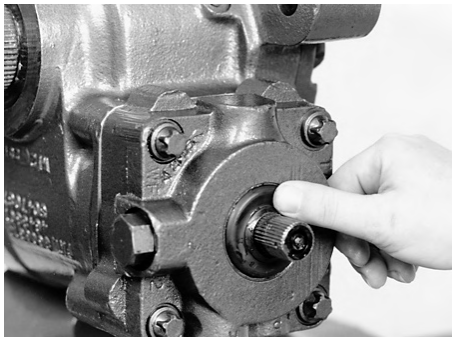
28. Install TAS40, 55, 65 and 66 bolts in positions 3 and 4 first, by hand. For TAS85, Install in positions 3 and 6 first, by hand. Install the remaining side cover bolts (47) into the side cover and torque them in the sequence shown. If bolts must be replaced, use bolts of the same design, type and length as those you removed. Do not use a substitute.

Lubricate side cover bolts and torque TAS40 bolts to **118 ft•lb** (160 N•m), TAS55, 65, 66 and 85 bolts to **170 ft•lb** (230 N•m).

Remove tape

29. **Standard gears** - Remove tape from sector shaft and pack the end of the housing trunnion area at the sector shaft with clean, high temperature industrial grease, Exxon Polyrex* EP2. Apply more of the grease to the inside of the new trunnion dirt seal (52) and assemble it over the sector shaft and into the trunnion bore.

Step Bore gears - remove tape from the sector shaft.



Install dirt & water seal

Grease

30. Pack the end of the valve housing bore around the input shaft with clean, high temperature industrial grease, Exxon Polyrex* EP2. Apply more of the grease to the inside of a new dirt and water seal (2) and install it over the input shaft. Seat the seal in the groove behind the serrations and against the valve housing.

This step may have already been completed if you disassembled the valve housing and worm screw for repair.

Proceed to **Final Adjustments** on page 53.

*Trademark of Exxon Oil Corp.

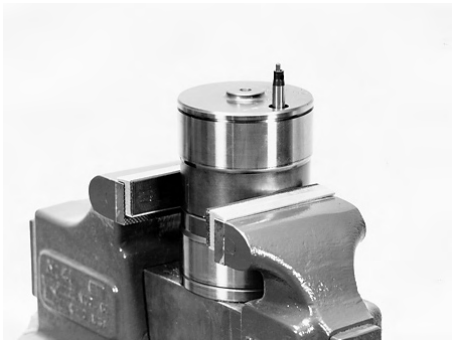
Poppets

Tools Required

2 lb Sledge
Ft•lb Torque wrench
J36452-A
Press
3/8" x 6" drill rod
Ratchet
Soft-jawed vise

Materials Required

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 (35) in a soft-jawed vise.

Loosen poppet adjuster seat

J36452-A
2 lb Sledge

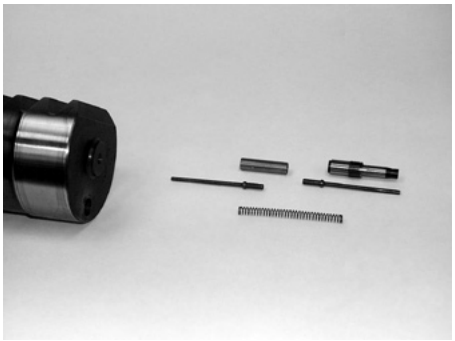
2. Slide special tool #J36452-A over the seat of poppet adjuster seat and sleeve assembly (23) and engage tool in the slots in the threaded sleeve. Hit the end of the tool firmly four or five times with a 2 lb sledge hammer to loosen Loctite.

⚠ CAUTION **Poppet adjuster seat and sleeve assemblies (23) are retained by Loctite applied to the threads which makes the assemblies difficult to remove.**

Remove poppet adjuster seat

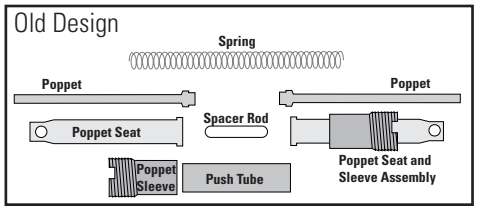
J36452-A

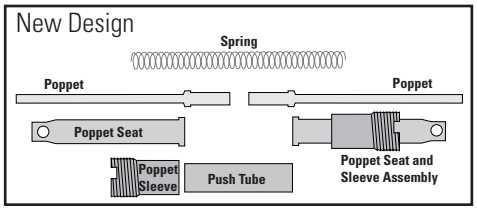
3. With a ratchet applied to the tool, turn one adjuster seat and sleeve assembly out of the rack piston. If the ratchet does not turn easily, strike the adjuster removal tool again with a hammer. If the engaging tangs won't stay in place while torquing, it might be necessary to hold in place with an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



Remove poppet components

4. Remove the two poppets (24), spring (26), and push tube (25). Some older gears may also have a spacer rod (See Illustration) to be removed.

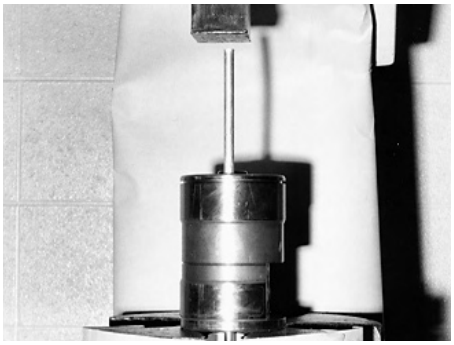




Remove other seat & sleeve if necessary

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

NOTE 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.



Reset remaining poppet seat and sleeve assembly

Press
⅜" x 6" Drill rod

6. If one poppet seat and sleeve assembly was left in rack piston, it can be reset for automatic poppet adjustment by inserting a ⅜" (9.52 mm) dia. 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.

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 (23). Allow to dry for ten minutes; then carefully apply Loctite® RC680 to same threads.

⚠ CAUTION **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.**

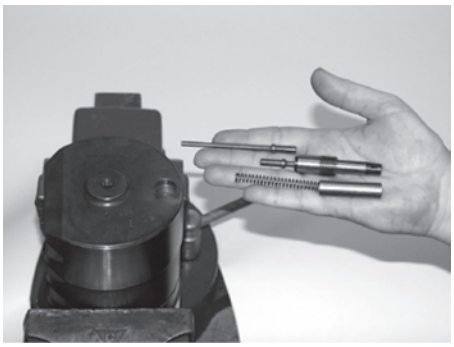
Install one poppet seat and sleeve assembly

Soft-jawed vise

8. **⚠ WARNING** **Wear eye protection while assembling poppets, as spring loaded poppets could eject and cause eye injury.**

Place rack piston in a soft-jawed vise and turn one new poppet adjuster seat and sleeve assembly, (slotted end out) into the poppet hole in one end of rack piston.

⚠ WARNING **Do not use the spacer with the new poppet design. You must only install the spacer with the old poppet design.**

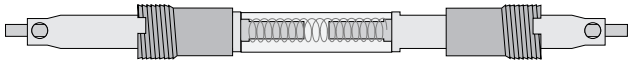


Install remaining poppet components

J36452-A
Ft•lb Torque wrench

9. From the other end of the poppet hole in the rack piston, install: one poppet (24), poppet spring (26), push tube (25), other poppet (24), and the other new poppet adjuster seat and sleeve assembly (23). The new components will stack up as shown below.

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

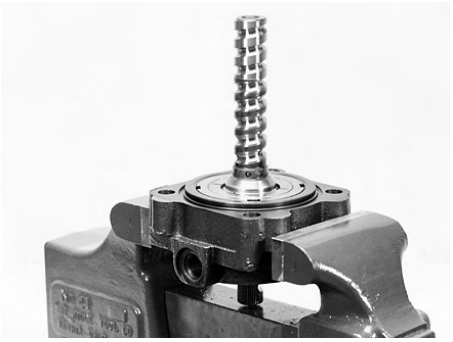


Valve Housing/Worm Screw

Tools Required

Hammer
Ft•lb Torque wrench
In•lb Torque wrench
Punch, center
Punch, roll pin
J37464
J37070
J37073
Screwdriver
Small probe or pick
Sockets
12-point sockets

Materials Required



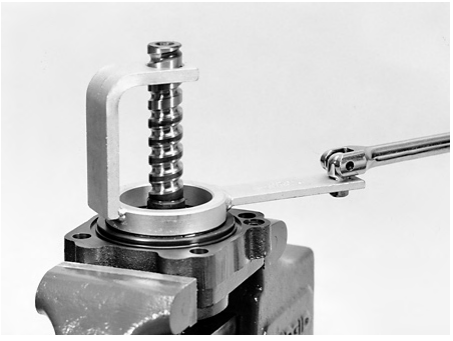
Place valve housing and valve assembly in vise

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 (10) where it was upset into the adjuster locknut (22) slot. Also unstake adjuster nut from adjuster (21).



Remove bearing adjuster locknut

J37464

3. Turn bearing adjuster locknut (22) out of the valve housing.

Remove bearing adjuster

J37070

4. Turn bearing adjuster (21) out of the valve housing.

Remove seal ring and o-ring

Small probe or pick

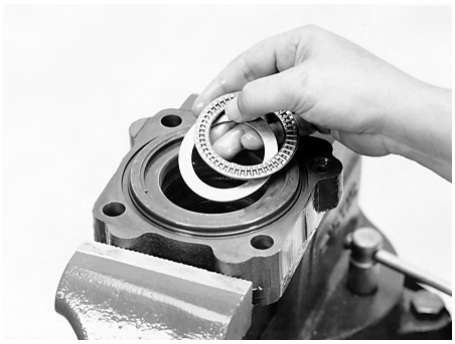
5. Remove and discard seal ring (13) and o-ring (14) from bearing adjuster.

Remove input shaft

6. Remove the input shaft, valve/worm assembly (19) from the valve housing.

Remove thin washer and bearing

7. Remove thin thrust washer (20) and thrust bearing (18) from worm shaft.



Remove thick washer and bearing

8. Remove thick thrust washer (17) and thrust bearing (18) 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.**

Remove seal rings and o-rings

Small probe or pick

9. Remove and discard seal rings and o-rings (11, 12, 13, 14, 15, 16) from valve housing (10).

Remove retaining ring

Screwdriver

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

Remove seal

1⅛" Socket
Hammer

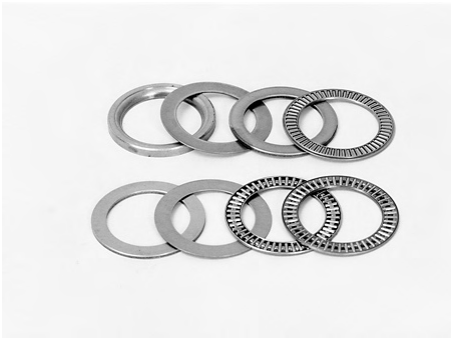
11. **⚠ CAUTION** **Exercise special care when removing seal (4) to prevent damaging the valve housing seal bore.**

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.

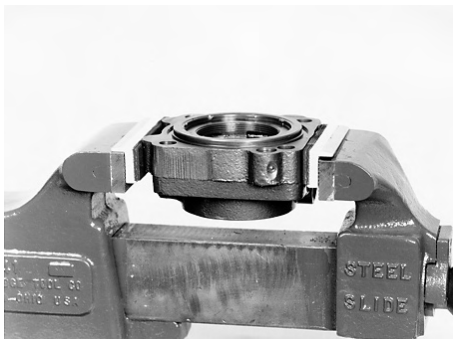
Inspect input shaft, valve worm assembly sealing areas

12. Inspect the sealing areas of input shaft and valve (19) 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 (18) rollers for any deterioration. Inspect thrust washers (17 & 20) for brinelling, spalling, or cracks. Replace any part with these conditions.



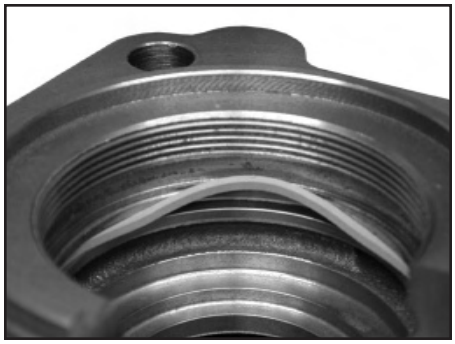
Place valve housing in vise

14. Place valve housing firmly in a vise so the input shaft, valve/worm assembly 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

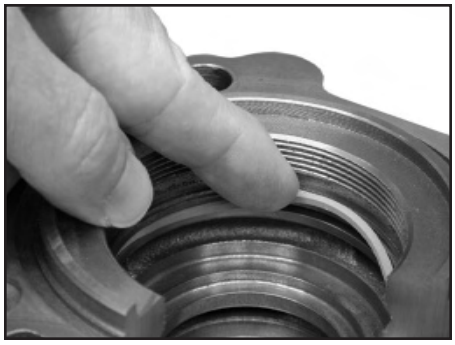
15. Oil and assemble a new o-ring (13) into its counter bore in valve housing.



Assemble other o-ring and seal ring

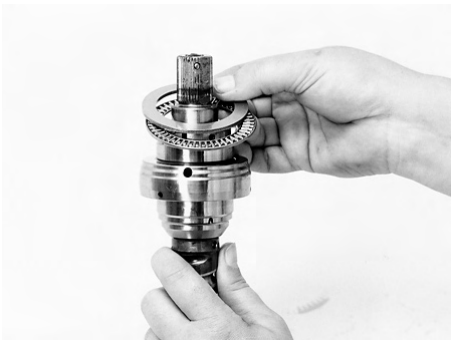
16. First, install o-ring (16) into valve housing groove. Then insert seal ring (15) into groove as shown, being careful not to "butterfly" the seal towards the inner diameter of the housing bore.

⚠ CAUTION **Be sure not to "butterfly" this seal ring during installation. This will deform the part and cause it to be damaged during the installation process.**



17. Gently pull the seal in towards the inner diameter of the housing bore while working the seal down to seat it into the valve housing groove.

    The seal ring, when installed correctly, will be seated fully into the housing groove with only a slight protrusion into the valve housing inner diameter.



Install roller thrust bearing and washer

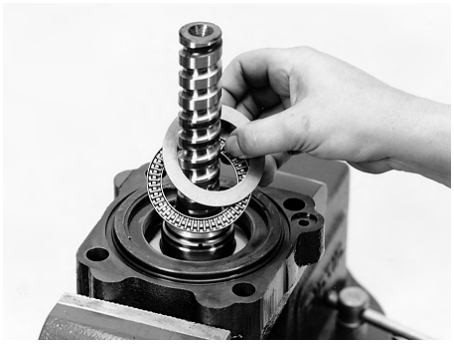
18. Install roller thrust bearing (18) and then the thick washer (17) (square side out) onto input shaft end of input shaft, valve, worm subassembly, seating them against the input shaft thrust face.

Install seal ring

19. Lightly oil and assemble new seal ring (14) onto input shaft and against the thick thrust washer (17) to hold the bearing components in place.

Assemble input shaft, valve worm & bearing assembly

20. Dip the input end of the input shaft, valve, worm assembly (19) into oil up to the worm lead. Assemble the input shaft end of the assembly into the valve housing (10) until it is firmly seated.



Assemble bearing and thrust washer

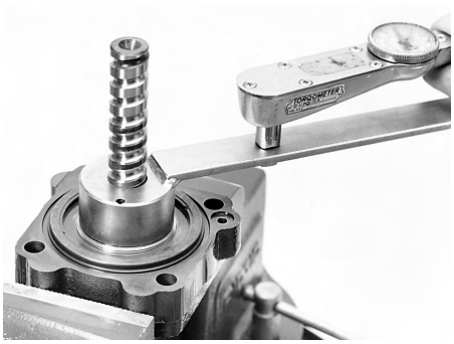
21. Apply oil and assemble the other thrust bearing (18) then the thin thrust washer (20) over the ball groove end of worm, and seat them against the shoulder of input shaft, valve, worm assembly.

Assemble seals in bearing adjuster

22. Lightly oil a new o-ring (13) and assemble into the seal groove in bearing adjuster (21). Oil and work a new seal ring (14) into the same groove and smooth it out.

NOTE

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.



Assemble bearing adjuster

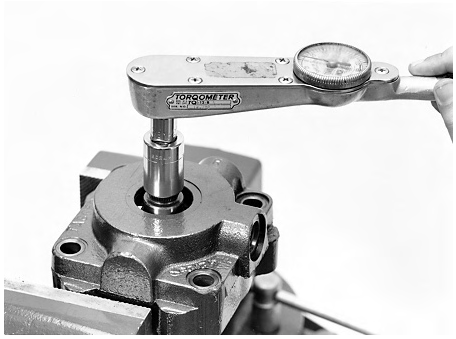
J37070
Ft•lb Torque wrench

23. Lightly oil and assemble bearing adjuster (21) over worm and into valve housing. Torque adjuster to **13 ft•lb** (18 N•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

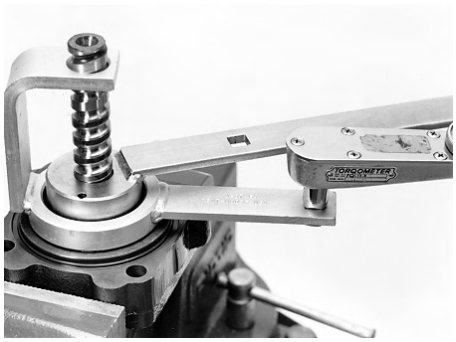
24. Lightly oil and assemble new locknut (22) onto bearing adjuster (21) with radius (slightly rounded) side down. Tighten slightly to keep the bearing adjuster in place.



Adjust to required input torque

¾" or 11⁄16" 12-point socket
In•lb Torque wrench

25. 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 in•lb** (.5-1.0 N•m) over that which was previously noted.



Torque locknut

J37070
J37464
Ft•lb Torque wrench

26. 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 ft•lb** (152 N•m).

NOTE The bearing adjuster, locknut and valve housing flange should be flush. If not, the seal ring (14) or o-ring (13) may be out of position; which will result in axial lash.

Check input shaft torque

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

Stake valve housing and locknut

Center punch
Hammer
13⁄16" Socket
Ft•lb Torque wrench

28. Stake valve housing into the clockwise most corner of two opposing slots in locknut (22). Stake the locknut into the adjuster (21) in two places (180° 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 in•lb** (.5-1.0 N•m) **greater** than the torque noted in step 25. Torque value must **not exceed 22 in•lb** (2.5 N•m). Unstake and readjust if necessary.

Reposition subassembly in vise

29. 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

30. Apply clean grease (Exxon Polyrex* EP2) 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.

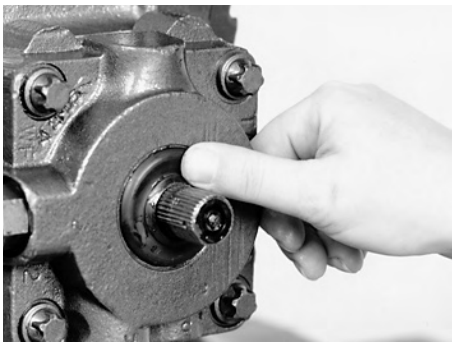
    Place seal installer tool, small diameter end first, over the input shaft and against the seal. Tap the seal installer tool until the tool shoulder is squarely against the valve housing. This will correctly position the seal in the housing bore just beyond the retaining ring groove.

    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

31. Insert new retaining ring (3) into its groove in valve housing (10).



Install dirt & water seal

Grease

32. Pack the end of the valve housing bore around the input shaft with clean, high temperature industrial grease, Exxon Polyrex* EP2. Apply more of the grease to the inside of a new dirt and water seal (2) and install it over the input shaft. Seat the seal in the groove behind the serrations and against the valve housing.

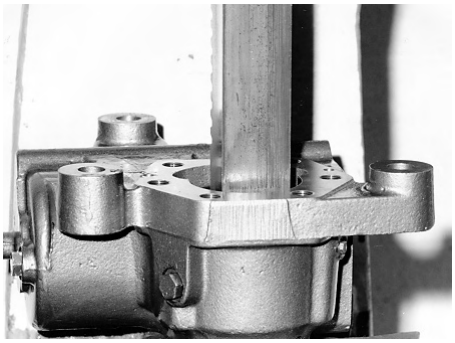
*Trademark of Exxon Oil Corp.

Roller Bearing/Retaining Ring - Standard

Tools Required

J37705 (TAS40)
J37071 (TAS55, 65, 66)
or
J37071-A (TAS55, 65, 66)
J38779 (TAS85)
Press
Screwdriver

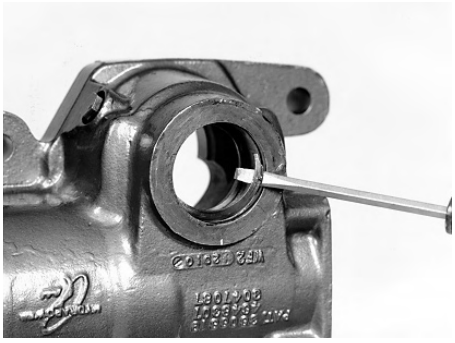
Materials Required



Remove roller bearing if required

J37705
J37071
or J37071-A
J38779
Press

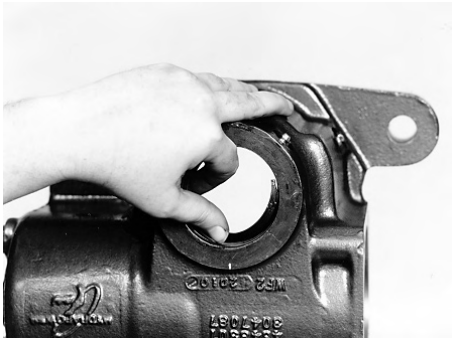
1. **Standard Gears only:** If roller bearing (49) in housing needs to be replaced, place the bearing removal end (long end) of the bearing and seal tool against the side cover end of the bearing and press it out of trunnion end of the bearing bore. Discard bearing.



Remove retaining ring

Screwdriver

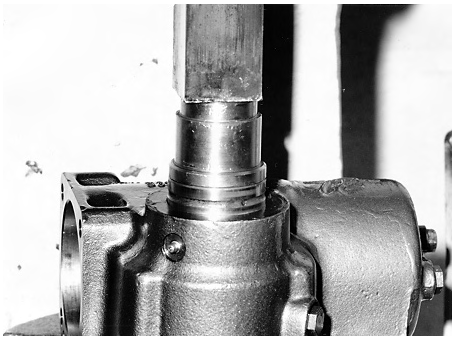
2. **Standard Gears only:** If the retaining ring (48) that is still in the housing bearing bore needs to be replaced, remove it through the trunnion end of the bearing bore to protect the pressure seal bore area from being damaged.



Install retaining ring

Grease

3. **Standard Gears only:** Insert retaining ring, 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 roller bearing

J37705
J37071 or
J37071-A
J38779
Press

4. **Standard Gears only:** Press the roller bearing into the housing from the trunnion end of bearing bore until it is seated against the retaining ring. **DO NOT PUSH IT IN FARTHER.** Be sure the housing is square with the press base and the bearing is not cocked.

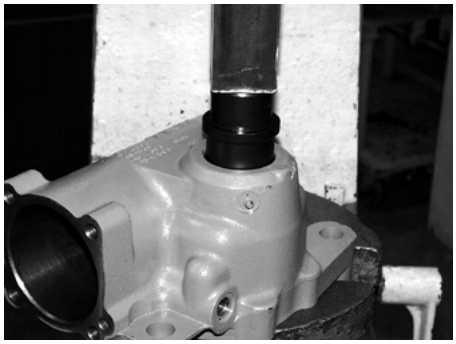
⚠ CAUTION **Use the bearing installation end of the tool (short end). If the bearing removal end of the bearing & seal tool is used to press in bearing, the cage on the new bearing may be damaged.**

Roller Bearing - Step Bore

Tools Required

Press
J37071-A (TAS65 Step Bore gear)

Materials Required



Remove roller bearing if required

J37071-A
Press

1. If roller bearing (49) in housing needs to be replaced, place the bearing removal end (long end) of the bearing and seal tool against the trunnion end of the bearing and press it out of the side cover end of the bearing bore. Discard bearing.

Press in housing roller bearing

J37071-A
Press

2. Press the roller bearing into the housing from the side cover end of the bearing bore until it is seated against the step bore. Be sure the housing is square with the press base and the bearing is not cocked.

⚠ CAUTION **Use the bearing <u>installation end</u> of the tool (short end). If the bearing <u>removal end</u> of the bearing & seal tool is used to press in bearing, the cage on the new bearing may be damaged.**

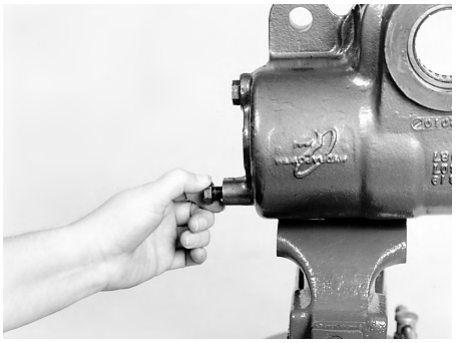
NOTE If the unmachined trunnion face is not square, use shims to square it before pressing in the bearing.

Replace Housing Ports, Plugs, Screws, Fittings

Tools Required

Allen wrench
Torx sockets
Sockets
In•lb Torque wrench
Ft•lb Torque wrench

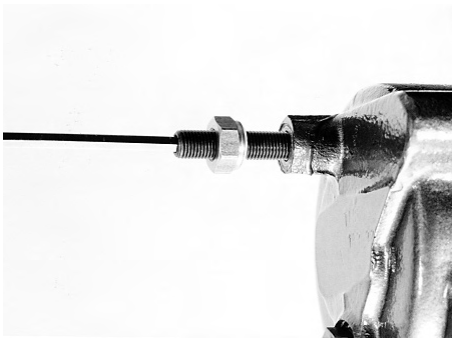
Materials Required



Replace poppet fixed stop screw

5/8" Socket or
E-14 Torx socket
Ft•lb Torque wrench

1. If damaged, remove and replace the poppet fixed stop screw and washer (38) if equipped. Replace with poppet fixed stop screw (37), discard the washer. Torque to **48 ft•lb** (65 N•m).

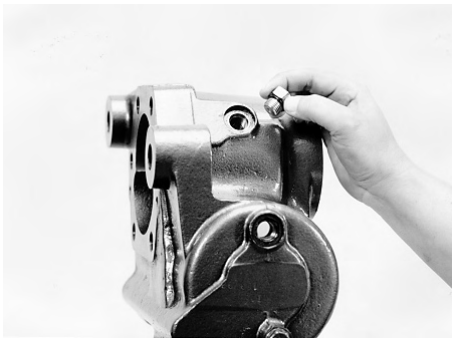


Replace poppet adjusting screw

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

2. If damaged, remove poppet adjusting screw (39) and sealing nut (40) 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 ft•lb** (47 N•m).

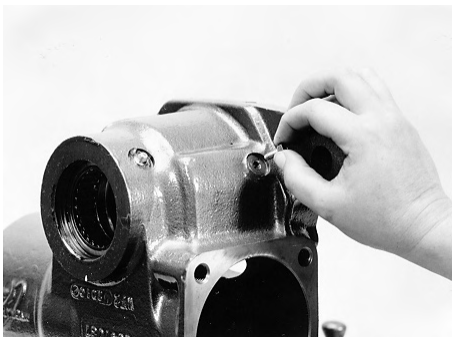


Replace automatic bleed screw, and aux. port plugs

E-14 Torx socket
Ft•lb Torque wrench

3. If damaged, remove and replace automatic bleed plug. Torque to **48 ft•lb** (65 N•m).

   If damaged, remove and replace permanent auxiliary 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 ft•lb** (41 N•m).



Replace manual bleed screw

5/16" Hex socket
In•lb Torque wrench

4. If damaged, remove and replace manual bleed screw. Torque to **45 in•lb** (3.4 N•m).

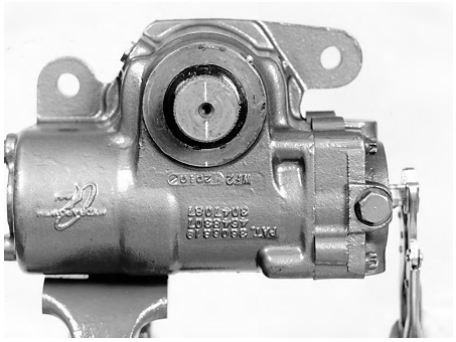
NOTE Some gears may be equipped with manual or auto bleed screws and/or auxiliary port plugs in the side cover. See page 12 exploded view for illustration.

Final Adjustments

Tools Required

Box-end wrench
In•lb Torque wrench
Ft•lb Torque wrench
Screwdriver
Sockets

Materials Required



Center steering gear

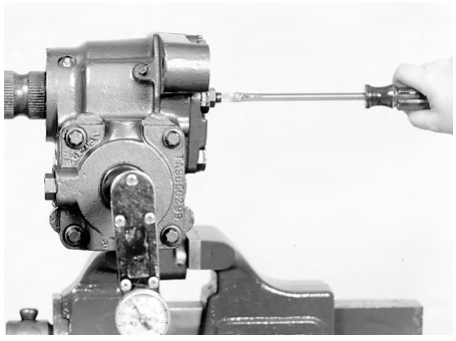
¾" and 11⁄16" Socket or box end wrench

1. To center the steering gear, rotate input shaft, valve worm assembly (19) until the timing mark on the end of the sector shaft (41) is in line with the timing mark on the end of housing trunnion.

⚠ 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.

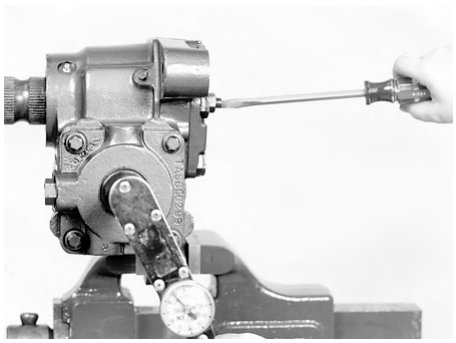


Tighten adjusting screw

Lbf•in. Torque wrench
Screwdriver
11⁄16" or ¾" Socket

2 With adjusting screw jam nut (46) loose, turn sector shaft adjusting screw clockwise to provide **45-50 in•lb** (5-5.5 N•m) of torque required to rotate the input shaft, valve/worm assembly through one half turn (180°) each side of center.

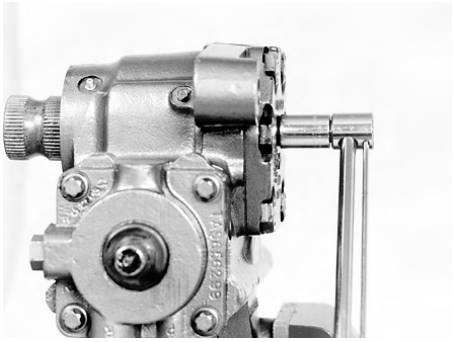
NOTE This procedure will properly mesh and seat the rack piston and sector shaft teeth for final adjustments.



Loosen adjusting screw and note torque

In•lb Torque wrench
Screwdriver
11⁄16" Socket

3. Turn sector shaft adjusting screw counterclockwise one half turn and **note maximum torque** required to rotate the input shaft, valve/worm assembly through one half turn (180°) each side of center.



Adjust adjusting screw

¾" Socket
11/16" Socket
Ft•lb Torque wrench
In•lb Torque wrench

4. Adjust sector shaft adjusting screw clockwise to increase maximum torque noted in step 3 by **7 in•lb** (.8 N•m). Tighten jam nut (46) firmly against side cover while holding the adjusting screw in position. Finally, torque the jam nut to **43 ft•lb** (58 N•m) and check input shaft, valve/worm assembly torque again. Readjust if input shaft torque exceeds **40 in•lb** (4.5 N•m).

Section 4 Reinstallation

Reinstallation Procedure 57

Poppet Resetting Procedure 57

Reinstallation Procedure

- 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 Procedure

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, Refer to Poppets found inside the TRW Steering Maintenance Guidelines packet (Document #TRW800).
IF Poppets were replaced with new components or reset during gear disassembly, and are ready for automatic positioning. →	Use poppet setting procedure on page 20.
IF Poppets may have been moved during disassembly or reassembly procedures, or gear is being installed on a different vehicle. →	Refer to Poppets found inside the TRW Steering Maintenance Guidelines packet (Document #TRW800).

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.

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