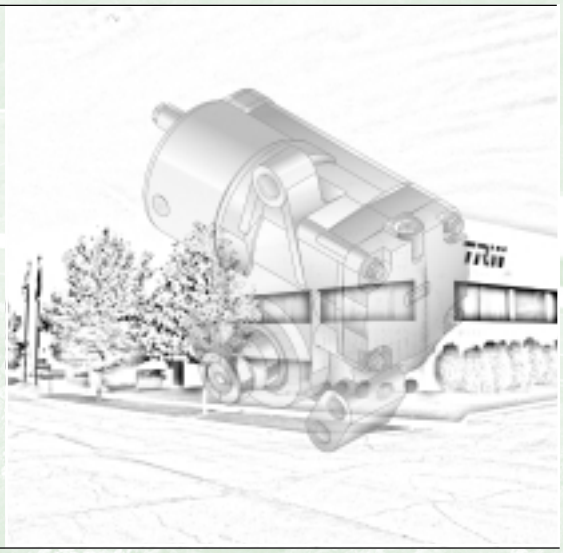
TRW Automotive

Commercial Steering Systems

RCS Rotary Cylinder Service Manual

RCS 40,55,65, 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 Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Commercial Steering Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the TRW Commercial Steering RCS Series Rotary Cylinders. Since this is a general Service Manual, the photographs and illustrations may not look exactly like the rotary cylinder 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 RCS rotary cylinder, 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 an RCS rotary cylinder 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 RCS rotary cylinder.**

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular RCS rotary cylinder to (a) inspect the rotary cylinder 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 RCS rotary cylinder and the vehicle steering system to ensure that the repair or service of the rotary cylinder has been properly performed and that the rotary cylinder and system will function properly.

Patents

TRW Commercial Steering Division RCS rotary cylinders are covered by several United States and foreign patents, either issued or pending.

Contents

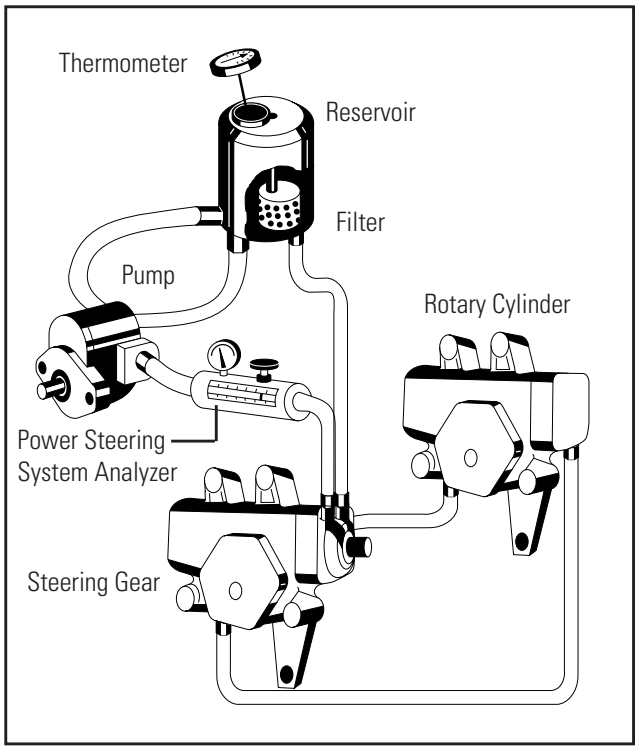
⚠ WARNING **All steering mechanisms are safety critical items. As such, it is imperative that the instructions in this booklet be followed to the letter. Failure to observe the procedures set forth in this pamphlet may result in a loss of steering.**

Section 1 General Information

Chart Your Way to Easy Steering Directory

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

Use Example: The driver of the vehicle you are working on complains of "Steering Wheel Kick". You have attempted to air bleed the system (using Chart Your Way to Easy Steering) test #12, but found that there still may be air trapped in your auxiliary rotary cylinder. Follow the chart below, which will direct you to the appropriate section of this Manual for proper air bleeding of the RCS unit.



Failed Test	Problem	Solution	Section
Test 12	Air in hydraulic system	Bleed system	3
External Leakage	Porosity in housing, side cover or valve assy	Replace porous parts / reseal	4
	Output shaft seal	Reseal	4
	Side cover seal, vent plug, bolts, gaskets	Replace parts / reseal	4
	End cover sealing area	Remove nicks or replace / reseal	4
	Poppet screw or sealing nut	Replace with poppet adjusting screw kit / Reset poppets	3

Introduction

The three-column format used in this Service Manual will help make it easy for you to service a RCS rotary cylinder. 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 RCS rotary cylinders, you may find that some information in this Service Manual could be clearer and more complete. If so, let us know about it. Don't try to second-guess the Service Manual; if you do not understand a procedure, or are stuck, contact our Service Department at 765.423.5377 (USA only). Servicing RCS series rotary cylinders should be safe and productive.

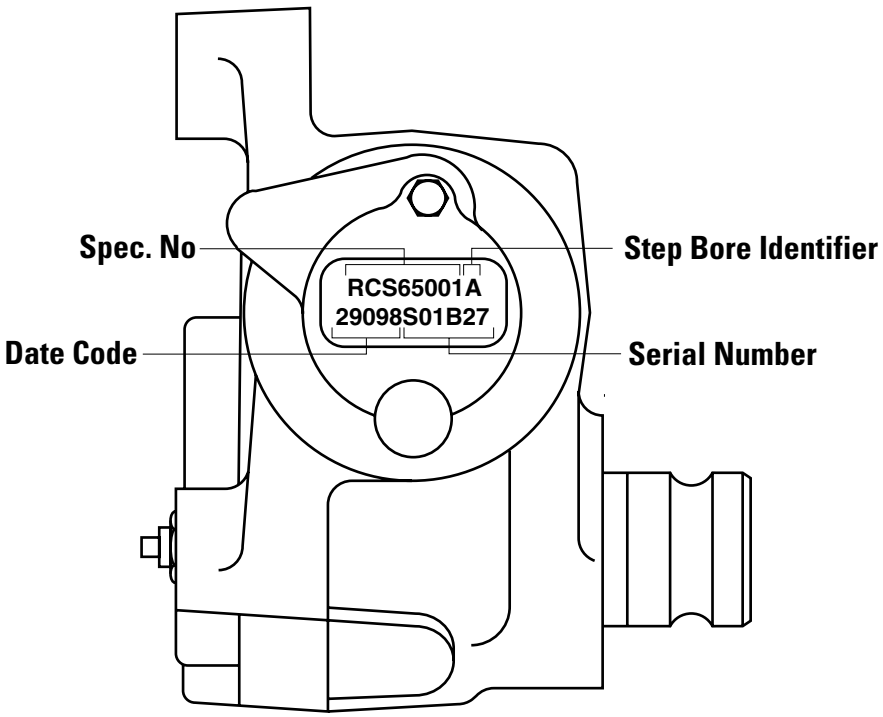
Approved Hydraulic Fluids

Automatic Transmission Fluid Dexron II
Automatic Transmission Fluid Type "E" or "F"
Chevron 10W-40
Chevron Custom 10W-40 Motor Oil
Chevron Torque 5 Fluid
Exxon Nuto H32 Hydraulic Fluid
Fleetrite PSF (Can #990625C2)
Ford Spec. M2C138CJ
Mack EO-K2 Engine Oil
Mobil ATF 210
Mobil Super 10W-40 Motor Oil
Premium Blue 2000 - SAE 15W-40
*Shell Rotella T30W
*Shell Rotella T SAE 30
Texaco 10W-40
Texaco TL-1833 Power Steering Fluid
Union 10W-40
Union 15W-40
Unocal Guardol 15W-40 Motor Oil

The steering system should be kept filled with one of the above fluids. Fluids marked with an asterisk (*) have not been approved for use with TRW's pump.

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

Specification Numbers



The cylinder specification number and date code are stamped on a machined surface under the poppet stop screw of every RCS cylinder. Newer cylinders include a serial number.

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

An "A" included at the end of the specification number indicates a step bore housing.

Torque Chart

Part Name	Item #	Torque Range Dry	Torque Range Lubricated
Ball return guide cap bolts (alt)	31	14-22 lbf•ft (19-29 N•m)	
Manual bleed screw	50	27-33 lbf•in. (3.1-3.7 N•m)	
Plug, auto bleed	51	38-58 lbf•ft (52-79 N•m)	
Poppet sleeve assembly	22	16-20 lbf•ft (22-27 N•m)	
Poppet sealing nut, service	60	33-37 lbf•ft (45-50 N•m)	
Poppet fixed stop screw	52	38-42 lbf•ft (52-57 N•m)	
Poppet fixed stop screw	52A	38-58 lbf•ft (52-79 N•m)	
Sector shaft adjusting screw jam nut	47	40-45 lbf•ft (54-61 N•m)	
Side cover bolts (RCS40)	48		108-128 lbf•ft (147-174 N•m)
Side cover bolts (RCS55, 65, 85)	48		160-180 lbf•ft (217-244 N•m)
End cover bolts (RCS40, 55, 65)	1		75-85 lbf•ft (102-115 N•m)
End cover bolts (RCS85)	1		108-128 lbf•ft (147-174 N•m)

Item numbers referenced are shown on the exploded views, pages 8 and 10.

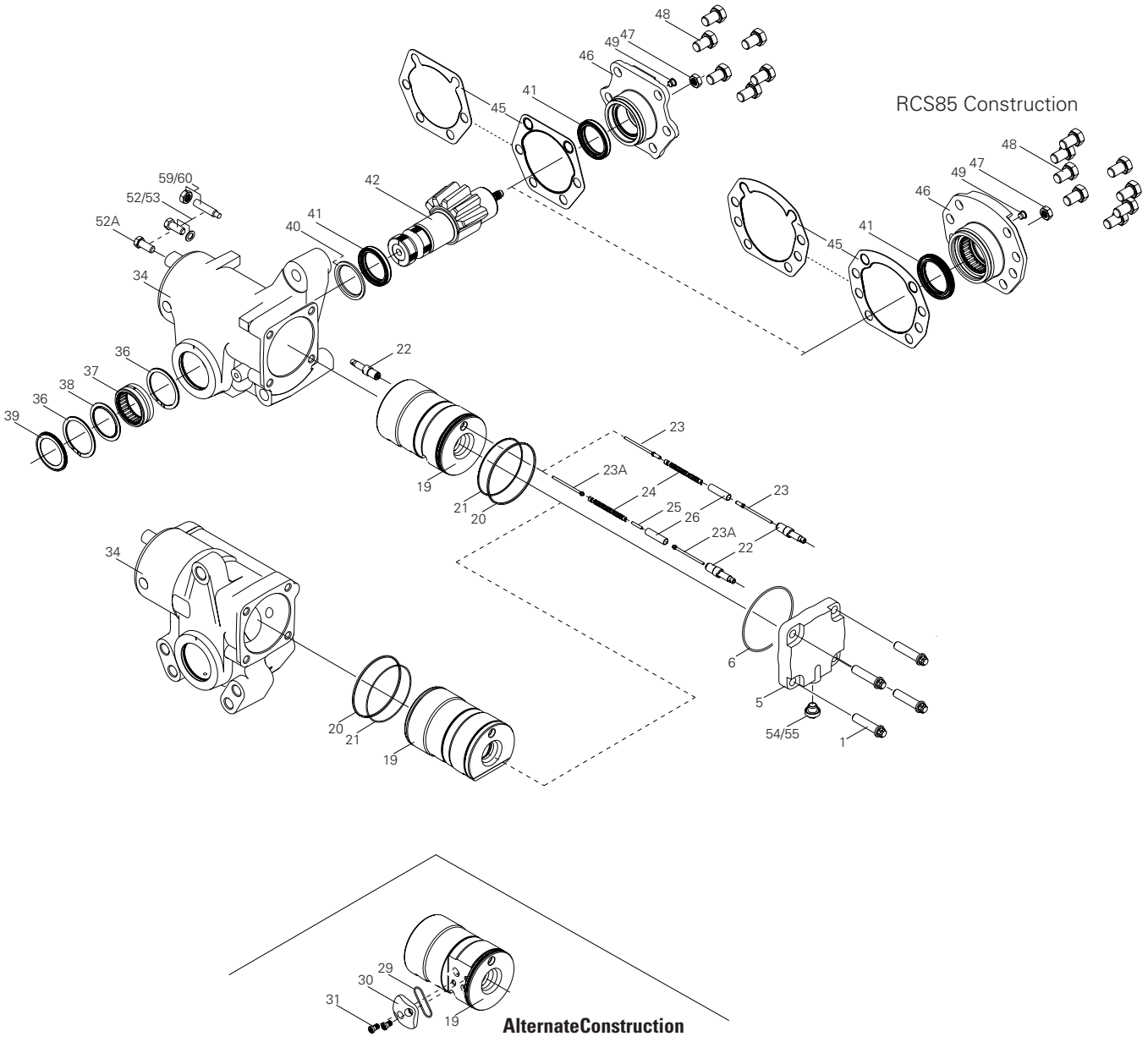
Special tools can be purchased through:

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

OR

SPX Australia Pty. Ltd.
7 Expo Court
Mount Waverley 3149
Phone: (03) 9544-6222
Fax: (03) 9544-5222

RCS Series Exploded View -- Standard



Item	Description
1	Bolts (4-End Cover)
5	End cover
*6	Seal Ring (End Cover)
19	Rack Piston
*20	Teflon Seal Ring
*21	O-ring (Back up; Rack Piston)
22	Poppet Seat and Sleeve Assy. (2)
23	Poppet (2)
24	Poppet Spring
25	Spacer Rod
26	Push Tube
29	Seal (Alt)
30	Ball Return Guide (Alt)
31	Torx Screws (2-Alt)
34	Housing
35	Grease Fitting (not shown)
36	Retaining Ring (2)
37	Roller Bearing
*38	Dirt Seal
*39	Dirt and Water Seal (Trunnion)
40	Washer (Spacer)
*41	Seal (2-Output)
42	Sector Shaft
43	Adjusting Screw (Sector Shaft)
44	Retainer (Adjusting Screw)
*45	Gasket (Side Cover)
46	Side Cover Assembly
47	Jam Nut
48	Special Bolts (6 or 8-Side Cover)
*49	Vent Plug (Side Cover)
50	Bleed Screw (Manual)(not shown)
51	Plug (Auto Bleed)(not shown)
52	Fixed Stop Screw (Poppet)
52A	Fixed Stop Screw (Poppet-Alt)
53	Washer (Stop Screw)
54	Port Plug (2)
*55	O-ring (2- Port Plug)
59	Service Poppet Adjusting Screw
60	Service Sealing Jam Nut

*These items are included in complete seal kits along with 406038 lubricant and a service bulletin.

Service Parts List - Standard

Common Parts

Item	Description	Part Number
1	Bolts (4-Valve Housing)	020251
29	Seal (Alt)	478042
30	Ball Return Guide (Alt)	400161
31	Torx Screws (2-Alt)	020228
35	Grease Fitting	037032
43	Adjusting Screw (Sector Shaft)	021200
44	Retainer (Adjusting Screw)	062005
47	Jam Nut	025150
49	Vent Plug (Side Cover)	036201
50	Bleed Screw (Manual)	213705
51	Plug (Auto Bleed)	021397
52A	Fixed stop screw	021426
54	Auxiliary Port Plug (2)	415437-A1
55	O-ring (2-Aux. Port Plug)	032229
59	Service Poppet Adjusting Screw	021407
60	Service Sealing Jam Nut	025119

Kits

Items	Description	Part Number
54 & 55	Port Plug & O-ring	415437-A1
59 & 60	Adj. Screw & Jam Nut	021407-X1

Parts Vary by Specification*

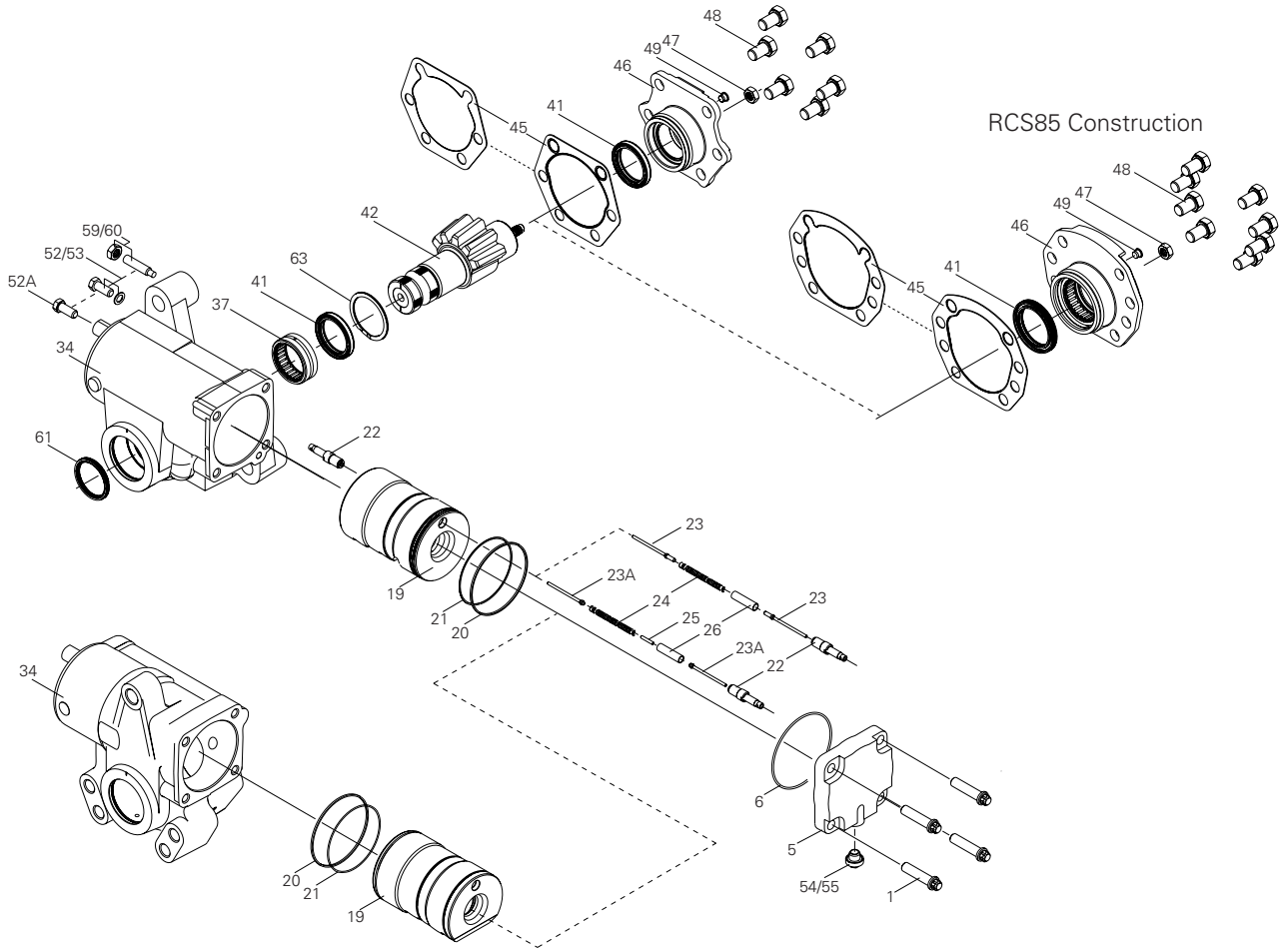
Item	Description
5	End cover
19	Rack Piston
34	Housing
42	Sector Shaft
46	Side Cover Assembly

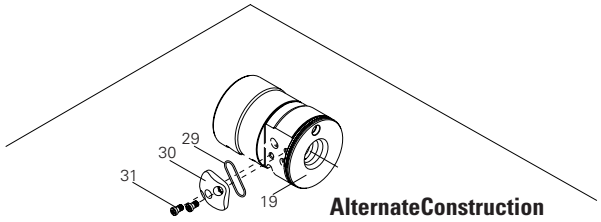
*Contact Service/Sales for part numbers

Parts Vary by Gear Size

Item	Description	RCS40	RCS55	RCS65	RCS85
6	Seal Ring (End Cover)	032829	032829	032616	032834
20	Teflon Seal Ring	032828	032830	032590	032547
21	O-ring (Back up; Rack Piston)	032827	032831	032615	032556
22	Poppet Seat and Sleeve Assy. (2)	409118-A2	409118-A2	409118-A2	409118-A6
23	Poppet (2-old design)	040210	040210	040210	040217
23A	Poppet (2-new design)	040248	040248	040248	040249
24	Poppet Spring	401662	401662	401662	401684
25	Spacer Rod	040209	040209	040209	040218
26	Push Tube	080154	080154	080154	080158
36	Retaining Ring (2)	401674	401650	401650	401685
37	Roller Bearing	070028	071025	071020	072003
38	Dirt Seal	478052	478041	478041	478057
39	Dirt and Water Seal (Trunnion)	478053	478045	478045	478059
40	Washer (Spacer)	028527	028519	028519	028534
41	Seal (2-Output)	478051	478040	478040	478084
45	Gasket (Side Cover)	HFB529000	HFB649000	HFB649000	TAS859000
48	Special Bolts (6 or 8-Side Cover)	021277	021434	021434	021434

RCS Series Exploded View -- Step Bore





AlternateConstruction

Item	Description				
1	Bolts (4-End Cover)	31	Torx Screws (2-Alt)	*49	Vent Plug (Side Cover)
5	End Cover	34	Housing	50	Bleed Screw (Manual) (not shown)
*6	Seal Ring (End Cover)	35	Grease Fitting (not shown)	51	Plug (Auto Bleed) (not shown)
19	Rack Piston	37	Roller Bearing	52	Fixed Stop Screw (Poppet)
*20	Teflon Seal Ring	*41	Seal (2-Output)	52A	Fixed Stop Screw (Poppet-Alt)
*21	O-ring (Back up; Rack Piston)	42	Sector Shaft	53	Washer (Stop Screw)
22	Poppet Seat and Sleeve Assy. (2)	43	Adjusting Screw (Sector Shaft)	54	Port Plug (2)
23	Poppet (2)	44	Retainer (Adjusting Screw)	*55	O-ring (2- Port Plug)
24	Poppet Spring	*45	Gasket (Side Cover)	59	Service Poppet Adjusting Screw
26	Push Tube	46	Side Cover Assembly	60	Service Sealing Jam Nut
29	Seal (Alt)	47	Jam Nut	*61	Dirt & Water Seal (Trunnion)
30	Ball Return Guide (Alt)	48	Special Bolts (6 or 8-Side Cover)	*63	Retaining Ring

*These items are included in complete seal kits along with 406038 lubricant and a service bulletin.

Service Parts List - Step Bore

Common Parts

Item	Description	Part Number
1	Bolts (4-Valve Housing)	020251
29	Seal (Alt)	478042
30	Ball Return Guide (Alt)	400161
31	Torx Screws (2-Alt)	020228
35	Grease Fitting	037032
43	Adjusting Screw (Sector Shaft)	021200
44	Retainer (Adjusting Screw)	062005
47	Jam Nut	G9419666
49	Vent Plug (Side Cover)	036201
50	Bleed Screw (Manual)	213705
51	Plug (Auto Bleed)	021397
52A	Fixed stop screw	021426
54	Auxiliary Port Plug (2)	G9410358
55	O-ring (2-Aux. Port Plug)	032229
59	Service Poppet Adjusting Screw	021407
60	Service Sealing Jam Nut	025119

Kits

Items	Description	Part Number
54 & 55	Port Plug & O-ring	415437-A1
59 & 60	Adj. Screw & Jam Nut	021407-X1

Parts Vary by Specification*

Item	Description
5	End Cover
19	Rack Piston
34	Housing
42	Sector Shaft
46	Side Cover Assembly

*Contact Service/Sales for part numbers

Parts Vary by Gear Size

Item	Description	TAS40	TAS55	TAS65	TAS85
6	Seal Ring (End Cover)	032829	032829	032616	032834
20	Teflon Seal Ring	032828	032830	032590	032547
21	O-ring (Back up; Rack Piston)	032827	032831	032615	032556
22	Poppet Seat and Sleeve Assy. (2)	409118-A2	409118-A2	409118-A2	409118-A6
23	Poppet (2-old design)	040210	040210	040210	040217
23A	Poppet (2-new design)	040248	040248	040248	040249
24	Poppet Spring	401662	401662	401662	401684
26	Push Tube	080154	080154	080154	080158
37	Roller Bearing	070028	071025	071020	072003
41	Seal (2-Output)	478051	478040	478040	478084
45	Gasket (Side Cover)	HFB529000	HFB649000	HFB649000	TAS859000
48	Special Bolts (6 or 8-Side Cover)	021277	G223734	G223734	G223734
61	Dirt & Water Seal (Trunnion)	K301963	478095	478095	478096
63	Retaining Ring	401674	401650	401650	401685

Section 2 Initial Installation

Initial RCS Installation

- Bolt cylinder to frame, torque to vehicle manufacturer's recommendation.
- Connect the auxiliary ports from the main gear to the apropriate RCS ports.
- 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 cylinder received from TRW or your vehicle manufacturer's aftermarket system, **or** a used cylinder on which poppet seats have been replaced or reset during 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 or rotary cylinder 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 and rotary cylinder.

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.

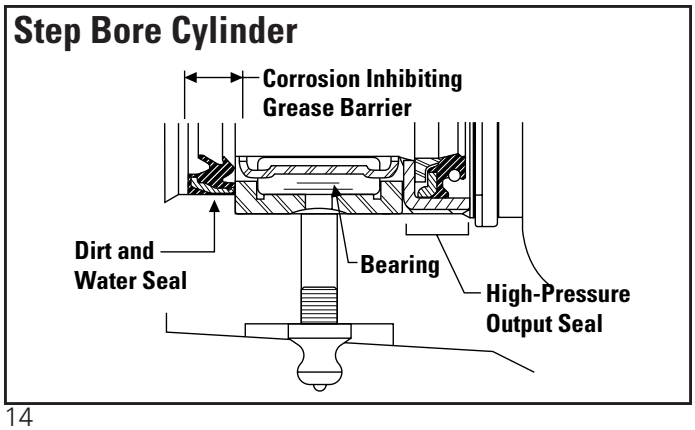
Always **clean off around the reservoir filler cap** before you remove it. Prevent dirt or other foreign matter from entering the hydraulic system.

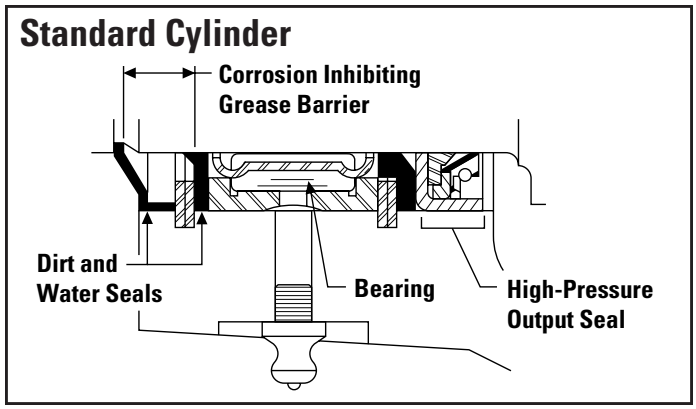
Investigate and correct any external leaks, no matter how minor.

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 sector 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 1 or 2 multipurpose chassis lube, and use only a hand operated grease gun on fitting. Add grease until it begins to extrude past the sector shaft dirt and water seal.





Section 3 On-Vehicle Service

Filling and Air Bleeding the System

Tools Required	Materials Required
5/16" Socket Lbf•in. Torque wrench	Hydraulic fluid

⚠ CAUTION

- **Make sure poppets are set correctly before beginning this procedure.**
- **Find and correct the source of air entry into the system before attempting these procedures. (Air can naturally enter the system when components are being removed or installed.)**
- **Do not allow the fluid level to drop significantly or run out of the reservoir during the entire procedure. This may induce air into the system.**

Auto or Natural Bleed Systems

Used for single TAS or HFB gears with no manual bleed screw, and dual systems when neither the gear nor the rotary cylinder has a manual bleed screw: TAS, HFB, TAS/RCS, TAS/RCB, HFB/RCB

1. Fill the reservoir nearly full. Do not steer. Start and run the engine for 10 seconds, then shut it off. Check and refill the reservoir. Repeat at least three times, checking the reservoir each time.
2. Start the engine and let it idle for 2 minutes. Do not steer. Shut off the engine and check the fluid level in the reservoir. Refill as required.
3. Start the engine again. Steer the vehicle from full left to full right several times. Add fluid, as necessary, to the full line on the dip stick.

   Automatic bleed systems should now be free from trapped air

Manual Bleed Systems

Used for single TAS or HFB gears with a manual bleed screw, and dual systems when either the gear or the rotary cylinder has a manual bleed screw: TAS, HFB, TAS/RCS, TAS/RCB, HFB/RCB

1. Fill the reservoir nearly full. Do not steer. Start and run the engine for 10 seconds, then shut it off. Check and refill the reservoir. Repeat at least three times, checking the reservoir each time.
2. Start the engine and let it idle for 2 minutes. Do not steer. Shut off the engine and check the fluid level in the reservoir. Refill as required.
3. Start the engine again. Steer the vehicle from full left to full right several times. Add fluid, as necessary, to the full line on the dip stick.
4. With engine idling, steer from full left turn to full right turn several times. **Stop steering with the road wheels at straight ahead, and loosen the manual bleed screw 2-3 turns.** Allow air and aerated fluid to "bleed out" until only clear fluid is seen. Close the bleed screw, refill the reservoir if required.

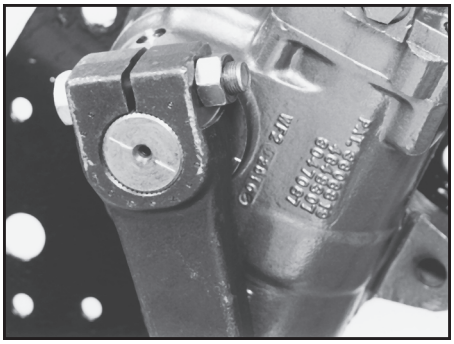
   Repeat step 4 three to four times until all the air is discharged. Torque manual bleed screw to **30 lbf•in.**

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

Sector Shaft Adjustment

Tools Required	Materials Required
Screwdriver ¾" Socket ¾" Open end wrench	

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



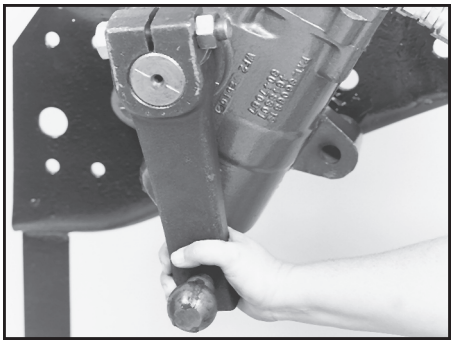
Center the sector shaft

1. With the engine on, rotate the steering wheel until the timing mark on the sector shaft of the rotary cylinder lines up with the mark on the housing. The sector shaft is now on its "center of travel". Turn the vehicle off.

Remove the drag link

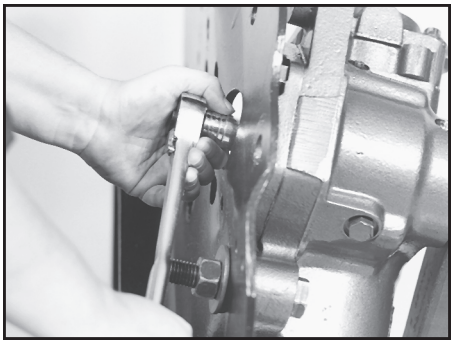
2. Remove the drag link from the pitman arm.

⚠ CAUTION **To avoid resetting the poppets, do not rotate the sector shaft more than 20° from the "center of travel" position while the drag link is disconnected.**



Check for sector shaft lash

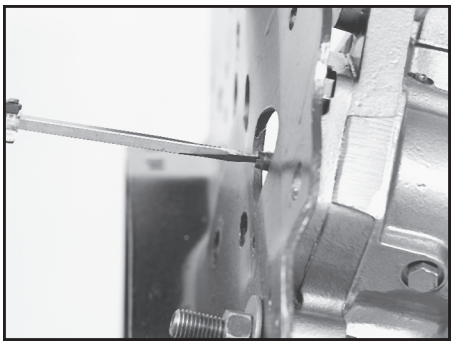
3. From the "center of travel" position, grasp the pitman arm and gently try to rotate it back and forth. If looseness or lash is felt at this point, the sector shaft is out of adjustment.



Loosen the jam nut

¾" Socket

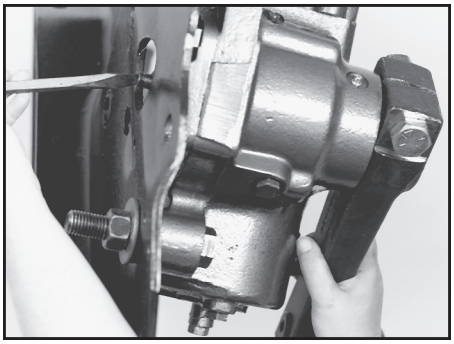
4. Loosen the jam nut.



Position adjusting screw

Screwdriver

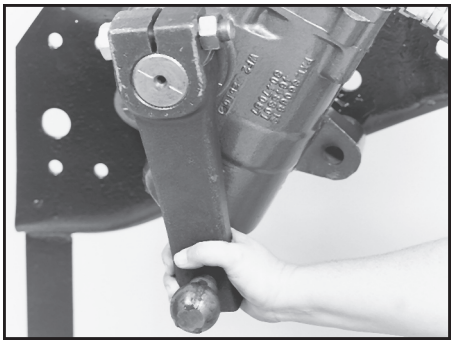
5. If no lash was detected in step 3, turn the shaft adjusting screw counterclockwise until you feel lash at the output shaft.



Adjust shaft

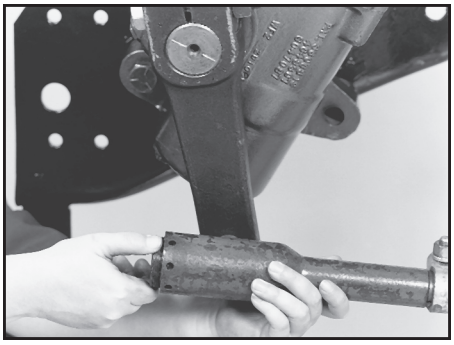
Screwdriver
¾" Open end wrench

6. Slowly turn the shaft adjusting screw clockwise until you feel no lash at the output shaft without using more than 10 lbf•ft (14 N•m) of torque. From this position, turn the screw clockwise ⅛ to 3⁄16 of a turn more. Hold the adjusting screw in place, and tighten the jam nut. **Final jam nut torque 43 lbf•ft** (58 N•m).



Recheck for lash

7. Loosely reconnect the drag link and turn the steering wheel ¼ turn each side of center, then back to center and recheck the pitman arm for lash. You should feel no lash; if there is lash, repeat steps 4, 6 and 7.



Connect drag link

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

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

Poppet Readjustment - Dual Gears

Mirror Image Systems and Reversed Image Systems

Before setting poppets on a dual gear system, you must determine whether the system has mirror image gears or reversed image gears. The procedures are slightly different for each type of system.

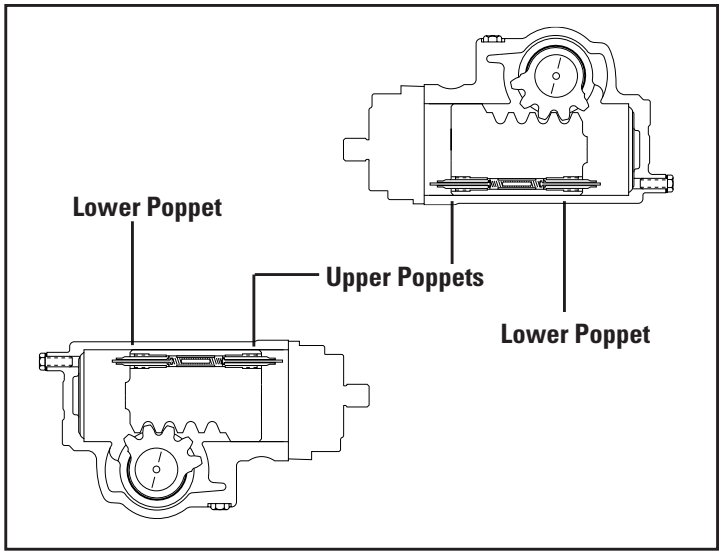
1. Park the vehicle with the wheels turned all the way to the axle stop in either direction. Turn the engine off.

2. Look at the output shaft timing mark nearest the housing piston bore on the master gear. Is this mark pointing toward the poppet screw or away from it?

3. Now check the same timing mark on the rotary cylinder. Does it point toward the poppet screw or away from it?

   If they point to opposite ends of the gears you have a mirror image system.

   If they both point toward the poppet screws or both point toward the end opposite the poppet screws, you have a reversed image system.



Poppet Readjustment - Dual Gears - Mirror Image

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

This resetting procedure will work in most cases with at least 1¾ hand-wheel-turns from each side of center. If you're making a large reduction in wheelcut and this procedure does not work, you may have to replace or internally reset the poppets using the procedure described in the Poppet Component section of this Service Manual.

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

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

2. If new poppet adjusting screws and nuts will be used, turn each screw into the non-sealing end of the jam nut until the drive end of screw is flush with the nut.

   Your steering gear and rotary cylinder will both have either fixed stop bolts or adjusting screws. If the adjusting screw is already part of the gear or cylinder, back the nut off of the adjusting screw until it is flush with the end of the adjusting screw.

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

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

4. On **BOTH** the master gear and the rotary cylinder, turn the adjusting screw and sealing nut assembly, without rotating the nut on the screw, into the housing until the nut is firmly against the housing using a 7⁄32" allen wrench. Tighten the sealing nut against the housing.

5. Refill system reservoir with approved hydraulic fluid.

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

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

7. **a)** Start the engine and let it run at idle speed.

   b) Turn the steering wheel in the direction that makes the timing mark on the master gear move toward the adjusting screw just installed. Turn in this direction until axle stop contact is made.

   c) Pull hard on the steering wheel (put 40 lbs. rim pull on a 20" dia. steering wheel) after the axle stop is contacted.

8. **a)** Turn the steering wheel in the opposite direction (end of timing mark on the master gear away from adjusting screw) until the other axle stop is contacted.

   b) Pull hard on the steering wheel (put 40 lbs. rim pull on a 20" dia. steering wheel).

   c) Release the steering wheel and shut off the engine.

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

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

10. **a)** Start the engine and let it idle.

    b) Turn the steering wheel in the original direction (end of timing mark on the master gear toward adjusting screw), until axle stop contact is made.

    c) Hold the steering wheel in this position (with 40 lbs. rim pull) for 10 seconds, then release. Repeat this hold and release process as many times as necessary while completing steps 11 & 12.

11. **a)** With steering wheel held at full turn, loosen the jam nut on the master gear and hold it in place with a wrench.

    b) Turn the adjusting screw in (clockwise) using finger- pressure only (don't use a ratchet), until the Allen wrench comes to a stop (make sure the gear relieves). Do not attempt to turn it in farther. Pause the turning-in process each time the driver releases the steering wheel; Continue turning only while the wheel is held at full turn.

    c) Back off the adjusting screw 3¼ turns and tighten the sealing nut. Torque the sealing nut to **33-37 lbf•ft.**

    d) Release the steering wheel and shut off the engine.

12. **a)** Start the engine and let it idle.

    b) Turn the steering wheel in the opposite direction (end of timing mark on master gear away from adjusting screw), until axle stop contact is made.

    c) Hold the steering wheel in this position (put up to 40 lb. rim pull on a 20" dia. steering wheel) for 10 seconds, then release. Repeat this hold and release process as many times as necessary while completing step 14

13. **a)** With steering wheel held at full turn, loosen the jam nut on the rotary cylinder and hold it in place with a wrench.

    b) Turn the adjusting screw in (clockwise) using finger- pressure only (don't use a ratchet), until the Allen wrench comes to a stop (make sure the gear relieves). Do not attempt to turn it in farther. Pause the turning-in process each time the driver releases the steering wheel; Continue turning only while the wheel is held at full turn.

    c) Back off the adjusting screw 3¼ turns and tighten the sealing nut. Torque the sealing nut to **33-37 lbf•ft.**

    d) Release the steering wheel and shut off the engine.

14. The poppets have now been completely reset. Lower the vehicle . Check the reservoir and fill if required.

⚠ WARNING **The length of the adjusting screw beyond the nut must be no more than 1 1/16" (27 mm) for proper thread engagement.**

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

Poppet Readjustment - Dual Gears - Reversed Image

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

This resetting procedure will work in most cases with at least 1¾ hand-wheel-turns from each side of center. If you're making a large reduction in wheelcut and this procedure does not work, you may have to replace or internally reset the poppets using the procedure described in the Poppet Component section of this Service Manual.

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

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

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

   Your steering gear and rotary cylinder will have either fixed stop bolts or adjusting screws. If the adjusting screw is already part of the steering gear or cylinder, back the nut off of the adjusting screw until it is flush with the end of the adjusting screw.

3. Make sure the engine is off and the road wheels are in straight ahead position. Remove and discard the poppet fixed stop bolts (if equipped) and washers (if equipped) from the lower end of housing on both the master gear and the rotary cylinder.

   If the unit has poppet adjusting screws and sealing nuts that need to be replaced, remove and discard them.

4. Turn the adjusting screws and sealing nut assemblies, without rotating the nut on the screw, into the housing until the nut is firmly against the housing, on **BOTH** the master gear and the rotary cylinder, using a 7⁄32" allen wrench. Tighten the sealing nut against the housing.

5. Refill system reservoir with approved hydraulic fluid.

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

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

7. **a)** Start the engine and let it run at idle speed.

   b) Note which output shaft timing mark is nearest the housing piston bore.

   c) Turn the steering wheel in the direction that makes this timing mark move toward the adjusting screws just installed on both the gear and the cylinder. Turn in this direction until axle stop contact is made.

   d) Pull hard on the steering wheel (put 40 lbs. rim pull on a 20" dia. steering wheel) after the axle stop is contacted.

8. **a)** Turn the steering wheel in the opposite direction (end of timing mark away from adjusting screw) until the other axle stop is contacted.

   b) Pull hard on the steering wheel (put 40 lbs. rim pull on a 20" dia. steering wheel).

   c) Release the steering wheel and shut off the engine.

9. Loosen the sealing nut and back out the adjusting screw until 1" is past the nut on both the master gear and the rotary cylinder. Tighten the sealing nuts against both housings.

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

10. **a)** Start the engine and let it idle.

    b) Turn the steering wheel in the original direction (end of timing mark toward adjusting screw), until axle stop contact is made.

    c) Hold the steering wheel in this position (with 40 lbs. rim pull) for 10 seconds, then release. Repeat this hold and release process as many times as necessary while completing steps 11 and 12, first on the master gear, then on the rotary cylinder.

11. **a)** With steering wheel held at full turn, loosen the jam nut on the master gear, and hold it in place with a wrench.

    b) Turn the adjusting screw in (clockwise) using finger- pressure only (don't use a ratchet), until the Allen wrench comes to a stop (make sure the gear relieves). Do not attempt to turn it in farther. Pause the turning-in process each time the driver releases the steering wheel; Continue turning only while the wheel is held at full turn.

    c) Back off the adjusting screw 3¼ turns and tighten the sealing nut. Torque nut to **33-37 lbf•ft.**

12. **a)** With steering wheel held at full turn, loosen the jam nut on the rotary cylinder and hold it in place with a wrench.

    b) Turn the adjusting screw in (clockwise) using finger- pressure only (don't use a ratchet), until the Allen wrench comes to a stop (make sure the gear relieves). Do not attempt to turn it in farther. Pause the turning-in process each time the driver releases the steering wheel; Continue turning only while the wheel is held at full turn.

    c) Back off the adjusting screw 3¼ turns and tighten the sealing nut. Torque nut to **33-37 lbf•ft.**

13. The poppets on both the master gear and rotary cylinder have now been completely reset. Lower the vehicle . Check the reservoir and fill if required.

⚠ WARNING **The length of the adjusting screw beyond the nut must be no more than 1 1/16" (27mm) for proper thread engagement.**

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

Section 4 Reseal & Repair

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 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 cylinder 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 cylinder with the automatic poppet adjustment feature to rotate more than 20° 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.**

Identify and mark the lines before removing them from the cylinder. Make sure lines are replaced to the same ports from which they are removed. Remove the hydraulic lines from the gear, and immediately plug all port holes and fluid lines.

⚠ WARNING **RCS auxiliary cylinders can weigh up to 110 pounds (50 kg) dry. Exercise caution when you remove, lift, carry, or fix in a bench vise.**

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

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

As you disassemble the cylinder, 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 cylinder. Replace them with new parts only.

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

Disassembly

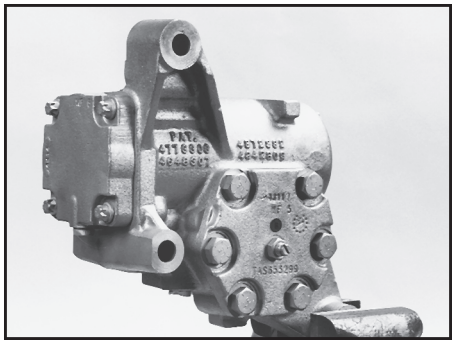
Tools Required

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

Vise

Materials Required

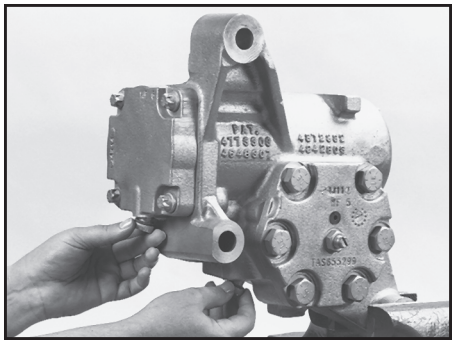
Emery cloth
Masking tape



Position gear in vise

1. Put the unit in a vise, clamping firmly against the housing mounting flange or boss. Side cover and end cover should be accessible for disassembly.

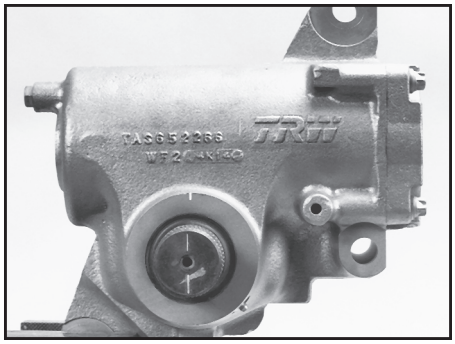
⚠ CAUTION **Do not clamp against body of housing. If mounting boss or flange is not accessible, fabricate and attach a mounting plate to the housing mounting bosses.**



Unplug ports

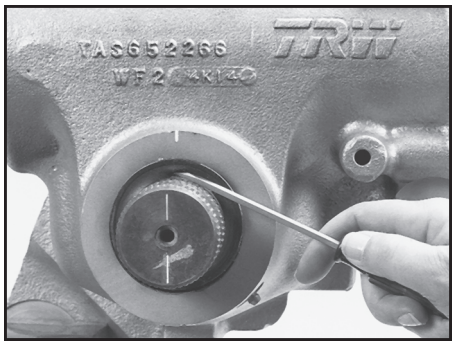
Appropriate size socket or open-end wrench

2. Prepare for fluid drainage and unplug hydraulic ports.



Position sector shaft

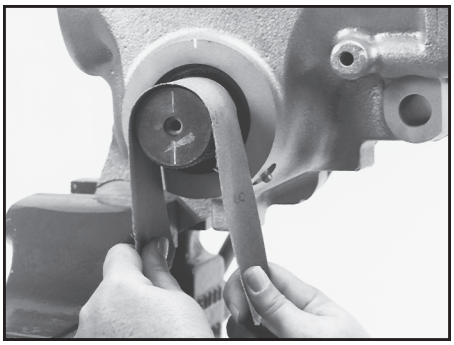
3. Rotate the sector shaft until the timing mark on the end of the sector shaft is in line with the timing mark on the end of the housing. This will position the sector shaft for removal.



Remove dirt & water seal

Small screwdriver

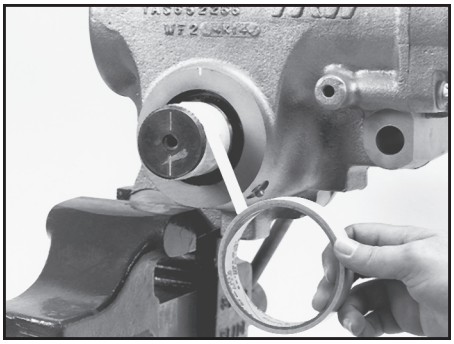
4. **Standard cylinders only** - Remove and discard dirt & water seal (39) from the housing trunnion.



Clean sector shaft

Fine grade emery cloth

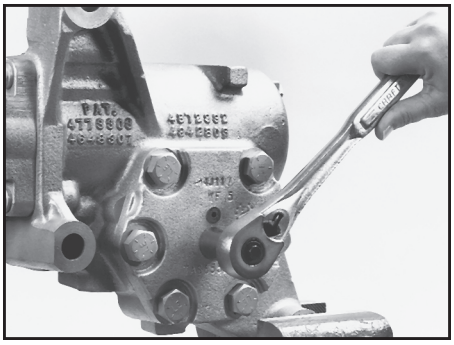
5. Remove any paint or corrosion from the exposed area of the sector shaft (42).



Tape sector shaft

Masking tape

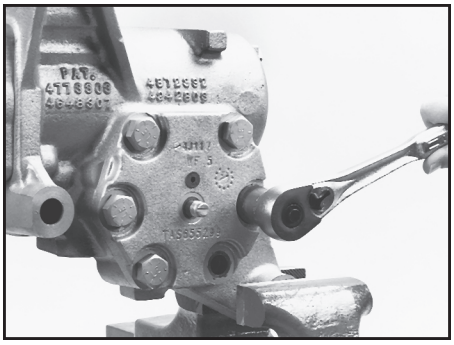
6. Tape the serrations and bolt groove of the sector shaft with one layer of masking tape. The tape should not extend onto the sector shaft bearing diameter.



Remove jam nut

¾" Socket

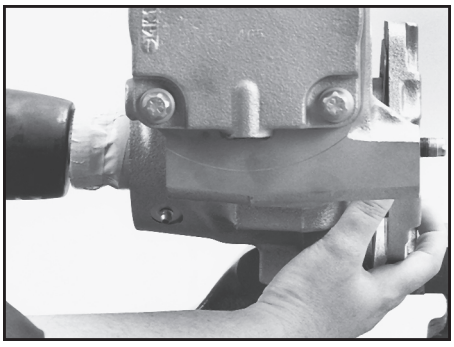
7. Remove the sector shaft adjusting screw jam nut (47).



Remove side cover bolts

15⁄16" Socket or 13⁄16" Socket

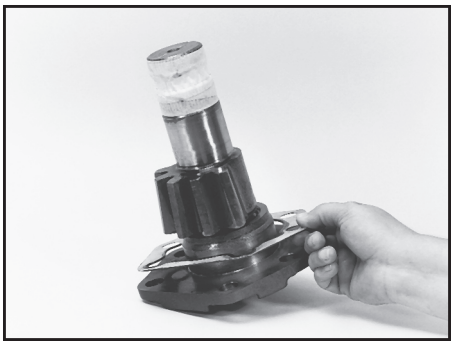
8. Be prepared for more fluid drainage and remove the six or eight special bolts (48) from the side cover (46).



Remove side cover

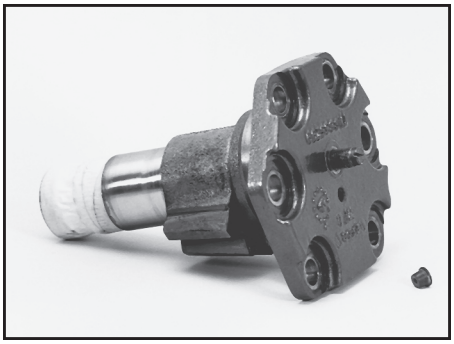
Soft mallet

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.



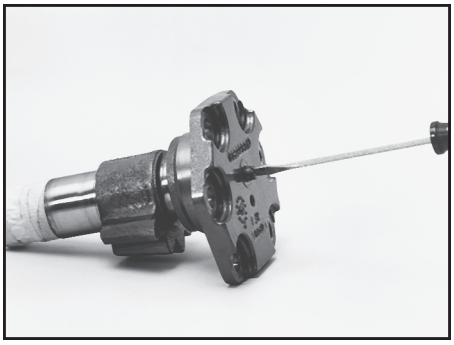
Discard gasket

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



Remove vent plug

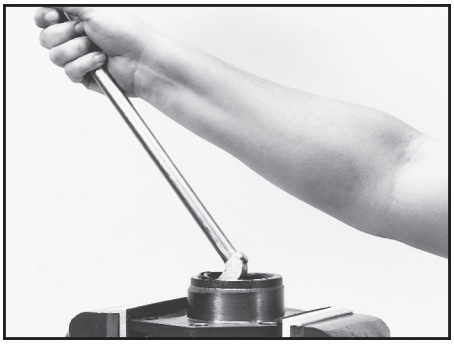
11. Remove and discard the vent plug (49).



Remove sector shaft from cover

Screwdriver

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

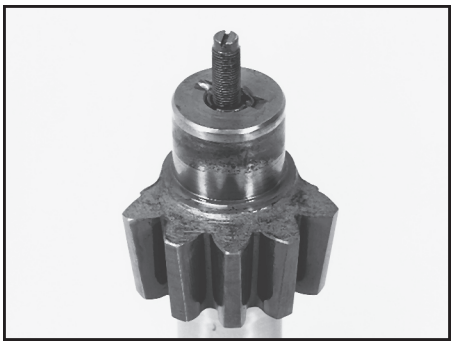


Remove side cover seal

⅜" Drive socket
Rolling head pry bar

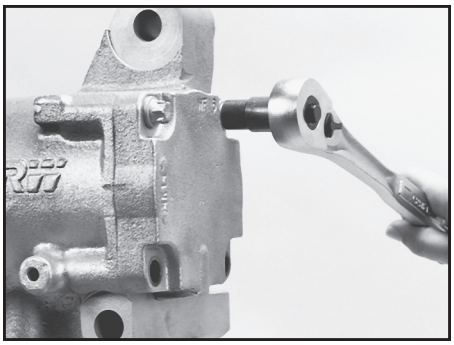
13. **⚠ CAUTION** **Don't damage the bore or DU bushing when removing the seal. RCS85 cylinders are not equipped with the DU bushing.**

Clamp the side cover in a vise. Place a standard ⅝" or 1 1⁄16" - ⅜ drive socket in the center of the side cover. pry the seal (41) out with a rolling head pry bar, using the socket for support. Discard the seal and remove the socket.



Inspect adjusting screw and retainer

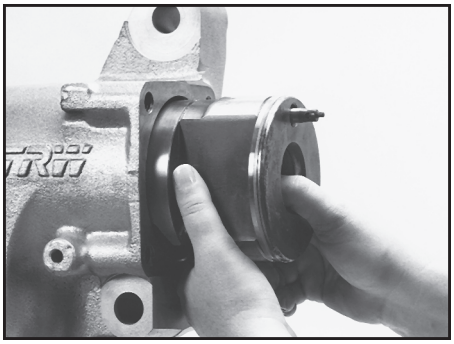
14. Inspect the sector shaft assembly for damaged adjusting screw threads. The retainer (44) must be securely staked in place. The adjusting screw must rotate by hand with no perceptible end play (lash).



Remove end cover bolts

Torx socket
E-16 or E-18

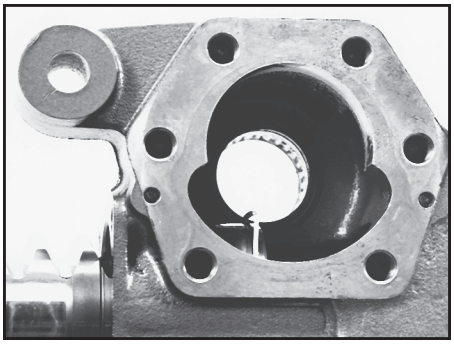
15. Mark the orientation of the end cover to the housing prior to removal of the end cover. Remove the four torx head end cover bolts (1), and the end cover (5).



Remove end cover, worm and rack subassembly

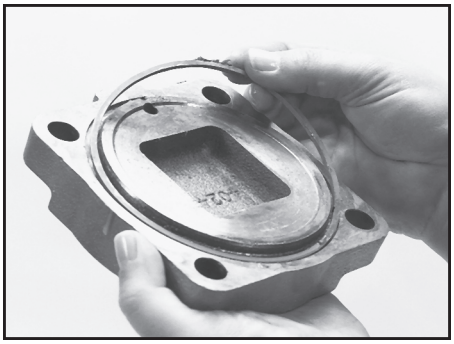
16. Be prepared for more fluid drainage and remove the rack piston.

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



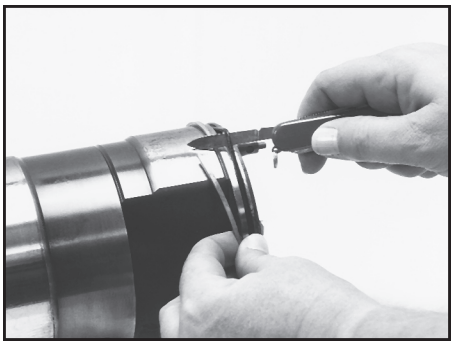
Pocket knife

16A. **NOTE** If your unit is short "V" construction, the rack piston seal is on the end of the rack piston closest to the poppet fixed stop screw. Remove the seal before removing the rack piston to prevent the Teflon rack piston seal ring (20) from "hanging up" when it exits the housing. Expose the seal through the sector shaft cavity, then cut and remove the seal ring from the rack piston.



Remove seal

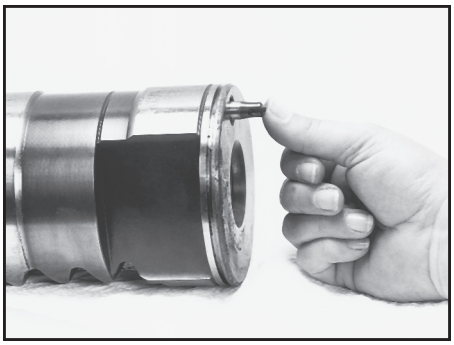
17. Remove and discard the end cover seal ring (6).



Remove seal ring and o-ring

Pocket knife

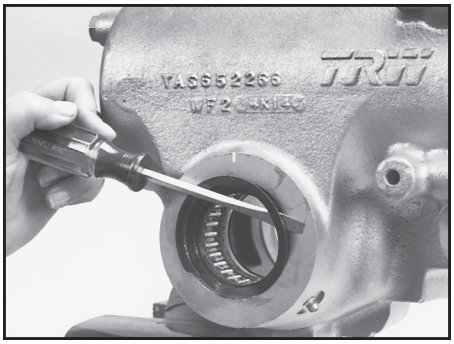
18. Cut and remove the Teflon seal ring (20) and o-ring (21) from the rack piston if not removed during disassembly step 16A.



Inspect poppet assemblies

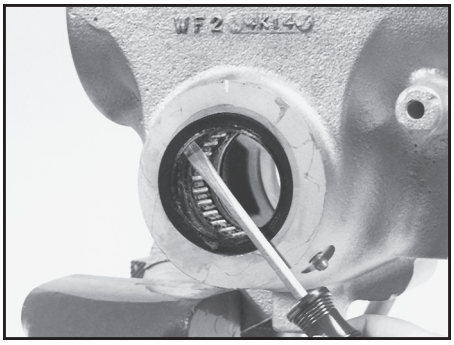
19. Push poppet stems, they should spring back. Push poppet seat, it should not move by hand. If components are bent or broken, poppet stems don't spring back, or poppet seat moves by hand, go to **Poppet Component Replacement** section on page 37. Otherwise, proceed to step 20.

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



Remove retaining ring (if equipped)

20. **Standard cylinders only** - Remove the retaining ring (36) that is closest to the output end of the housing trunnion.

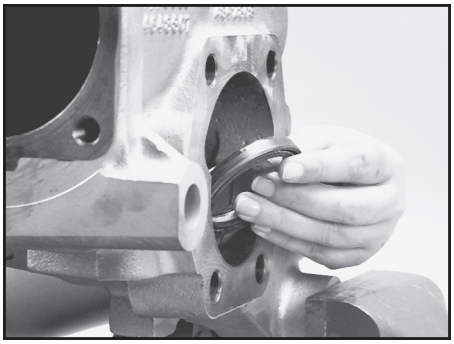


Remove dirt seal

Screwdriver

21. **Standard cylinders** - Remove and discard dirt seal (38).

Step bore cylinders - Remove and discard the dirt and water seal (61).

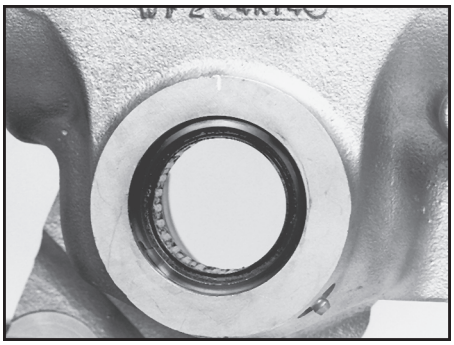


Remove pressure seal (and spacer washer if equipped)

Screwdriver

22. **Standard cylinders** - Insert a screwdriver into the bearing bore from the trunnion end, and carefully push the seal (41) and spacer washer (40) out of the other end of the bearing bore ***without damaging the sealing area of the bore***. Discard the seal.

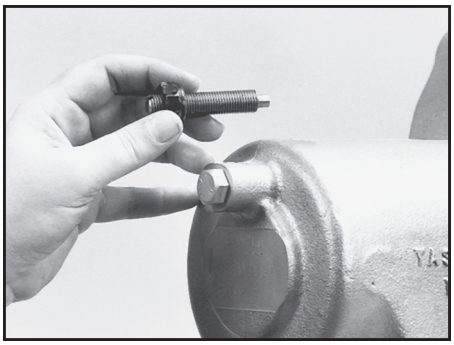
Step Bore cylinders - Remove the retaining ring (63) through the side cover opening. Then insert a screwdriver through the trunnion opening, and carefully push the seal (41) out ***without damaging the sealing area of the bore***. Discard the seal.



Inspect roller bearing

23. **Standard cylinders** - Inspect roller bearing (37) in the housing for brinelling or spalling. Inspect retaining ring for damage. If replacement of either part is required, go to **Roller Bearing or Retaining Ring Replacement** on page 40. If not, proceed to step 24.

Step Bore cylinders - Inspect the roller bearing (37) for brinelling or spalling. If replacement is required, go to **Roller Bearing Replacement - Step Bore** on page 40. If not, proceed to step 24.



Inspect housing screws, and plugs

24. Inspect the following for damage:

- Poppet fixed stop screw (52 or 52A) and washer (53) if equipped.
- Poppet adjusting screw (59) and sealing nut (60)
- Auto-bleed plug (51)
- Manual bleed screw (50)

If any are damaged, go to **Replace Housing Ports, Plugs and Screws** on page 41. If not, proceed to the Inspection Section.

Inspection

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

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

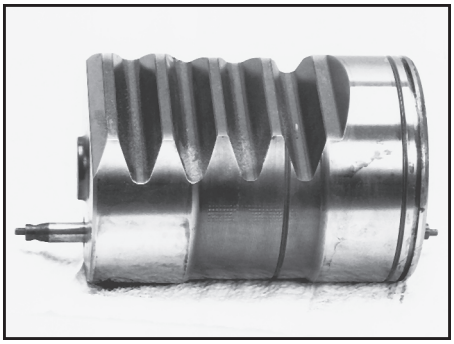
⚠ WARNING **Because they are flammable, be extremely careful when using any solvents. Even a small explosion or fire could cause injury or death.**

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

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

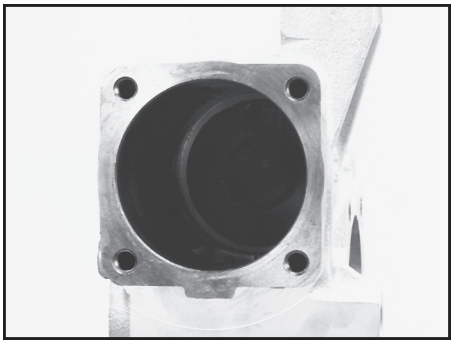
Condition	Area
Cracks or Breaks	• Sector shaft teeth • Rack piston teeth • Housing
Twisted serrations	• Output shaft serrations

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.



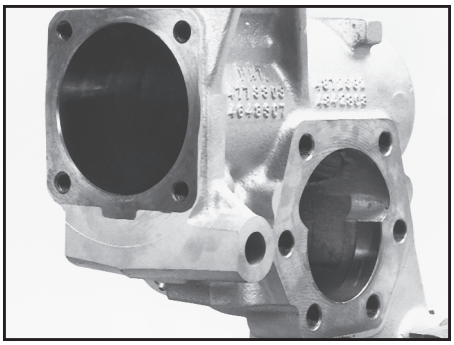
Inspect rack piston teeth

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



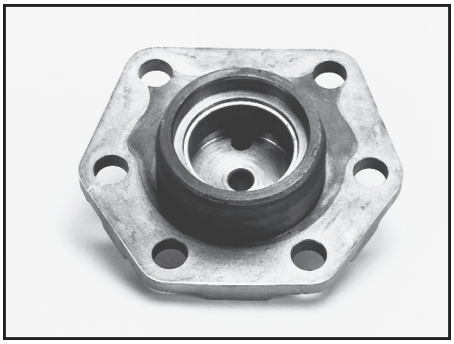
Inspect housing cylinder bore

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



Inspect housing faces

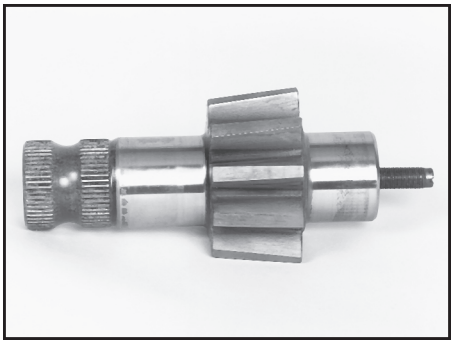
3. Inspect the housing faces for nicks that would prevent proper sealing. Replace the gear housing if these nicks are present and cannot be easily removed with a fine-tooth flat file without changing the dimensional characteristics.



Inspect side cover bushing/bearing

4. **RCS40, 55, 65:** Inspect side cover (46) DU bushing for damage. Also check side cover bushing to sector shaft clearance. If damage exists, or if clearance exceeds .008" (0.20 mm) replace side cover/bushing assembly.

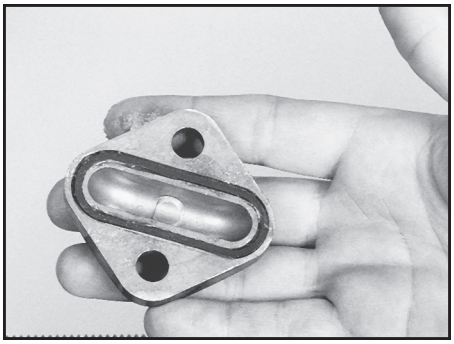
   RCS85: Inspect roller bearing in side cover assembly (46) for brinelling or spalling. If either condition exists, replace the side cover and bearing assembly.



Inspect sector shaft assembly

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

   NOTE A service sector shaft will come assembled with the adjusting screw (43) and retainer (44).



Replace ball cap and seal

6. Place a new ball return guide cap seal (29) in the seal groove of the cap (30). Make sure the seal makes full contact with the rack piston surface. Install two new Allen or Torx head screws (31) and torque each screw alternately until a final torque of **18 lbf•ft** (24.5 N•m) is achieved.

   ⚠ 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.**

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 cylinder.

TRW Commercial Steering Division makes complete seal kits available. These parts can be purchased through most OEM parts distributors. Contact your local dealer for availability.

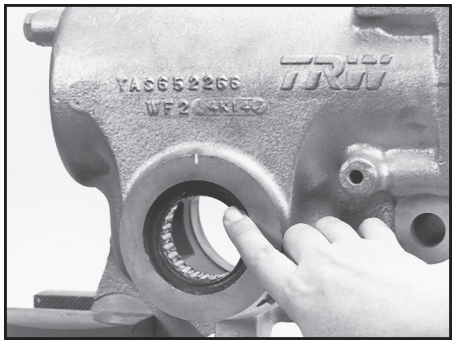
Assembly

Tools Required

- 5/32" Allen wrench
- Lbf•ft Torque wrench
- Hammer
- J37705 (TAS40)
- J37071 (TAS55/65)
- J38779 (TAS85)
- Press
- Punch
- Ratchet
- Screwdriver
- Sockets
- Torx sockets
- Vise

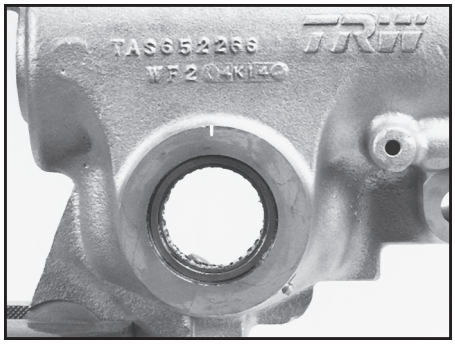
Materials Required

- ATF oil
- Grease (Exxon Unirex* RS460
- Masking tape
- 7/16"-14 x 7¼" All Thread
- Seal kit: Ross TAS400004, TAS550004, TAS650012, TAS850005



Install dirt seal

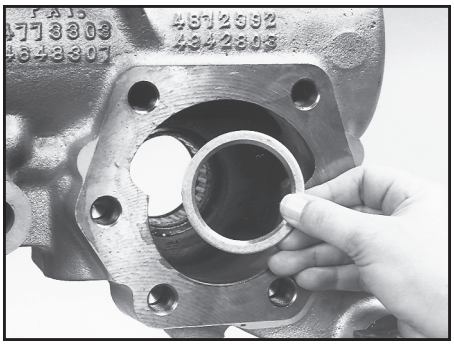
1. **Standard cylinders** - Install new dirt seal (38) into the trunnion end of the housing sector shaft bore and against the bearing, with the seal lip out.



Install retaining ring

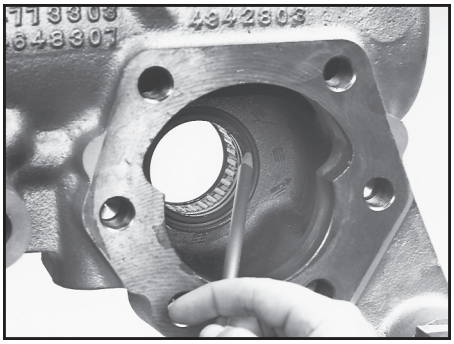
2. **Standard cylinders only** - Install the outside retaining ring (36), seating it firmly in the housing retaining ring groove.

*Trademark of Exxon Oil Corp.



Install washer

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

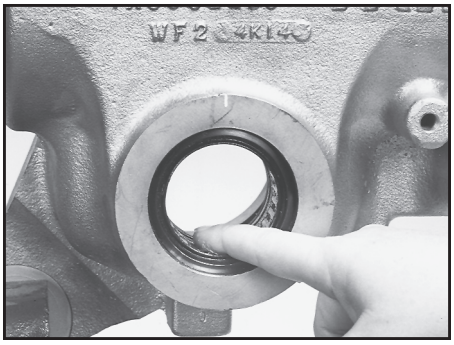


Press seal into housing

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

4. **All cylinders** - Assemble new seal (41) onto bearing and seal tool so the lip with the garter spring is toward the shoulder of the tool. Working from the side cover side of the housing, pilot the seal tool into the washer and bearing and press with a force of 100-800 lb (445-3,560 N) until the seal is seated firmly.

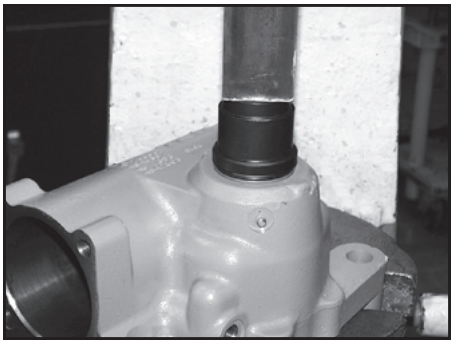
   Step Bore cylinders only - Install the inside retaining ring (63) from the side cover opening. Seat the ring firmly in the retaining ring groove.



Grease the bearing and seal area

Grease

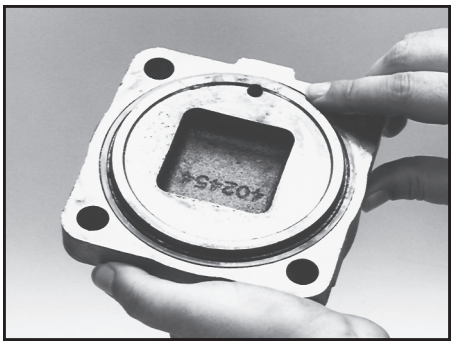
5. **Standard cylinders** - Liberally pack the area between dirt seal (38) and pressure seal (41) including roller bearing with clean, high temperature industrial grease, 406038 Exxon Unirex* RS460.



Install dirt & water seal

KM Tool
Press

6. **Step Bore cylinders** - Install the dirt & water seal (61) with the bearing and seal tool, making sure it is not cocked. Liberally pack the roller bearing and new seals with clean, high temperature industrial grease, Exxon Unirex* RS460.

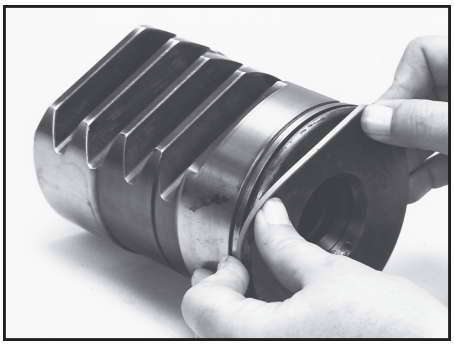


Assemble seal ring

7. **RCS40, 55, 65:** Oil new seal ring (6) and assemble in end cover mounting face groove.

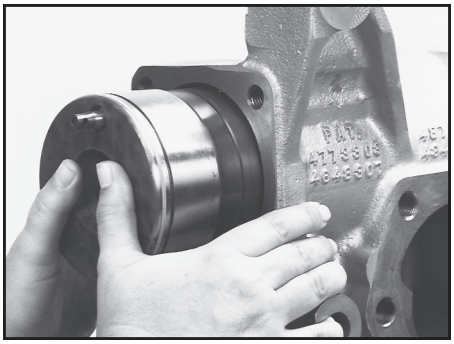
   RCS85: Oil new seal ring (6) and assemble in end cover pilot groove.

*Trademark of Exxon Oil Corp.



Install rack piston o-ring and seal ring

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



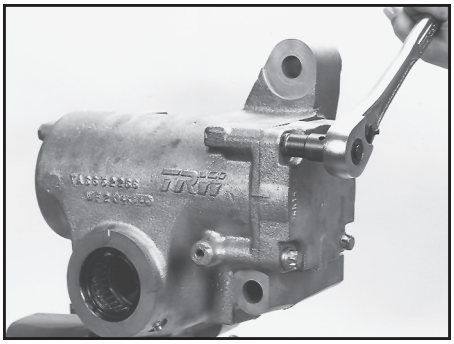
Position rack piston in housing

Oil

9. Apply clean oil to housing cylinder bore and Teflon seal ring. Place the rack piston (19) in the housing piston bore with the rack piston teeth toward the sector shaft opening

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

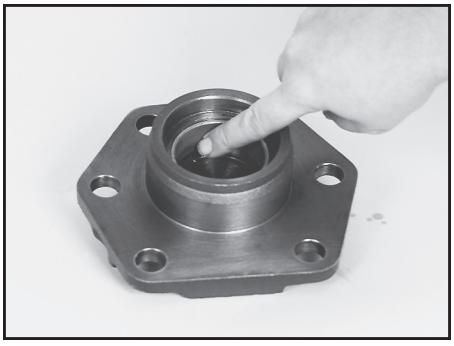
⚠ CAUTION **The poppet seat and sleeve assemblies (22) must not bottom against the internal poppet stops in the steering gear until the gear is installed on the vehicle and the poppet adjustment procedures are performed.**



Install end cover bolts

E-16 Torx socket (TAS40, 55, 65)
E-18 Torx socket (TAS85
Lbf•ft Torque wrench

10. Lubricate and install the four end cover bolts (1) into the housing. Torque the **RCS40, 55 and 65 bolts alternately to 80 lbf•ft** (108.5 N•m). Torque **RCS85 bolts to 118 lbf•ft** (160 N•m).

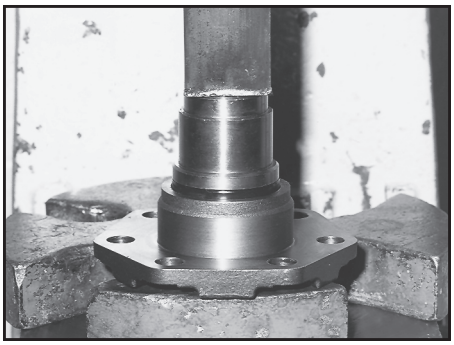


Lubricate side cover bushing/ bearing

11. **RCS40, 55, 65:** Lightly oil DU bushing. **Do not grease.**

RCS85 only: Apply a generous amount of Exxon Unirex* RS460 (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.**

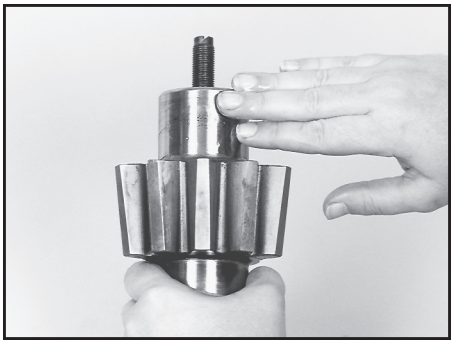


Press seal in side cover

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

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

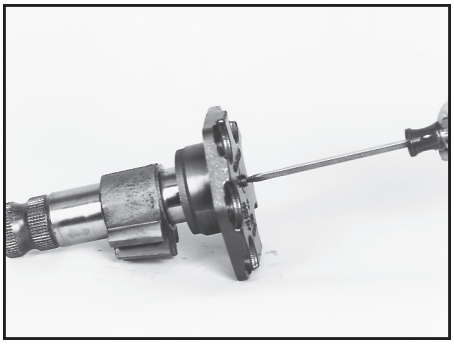
⚠ CAUTION **Make sure the OD of the seal, and the ID of the bore are free from grease and dust, for proper engagement of the seal.**



Lubricate sector shaft

13. **RCS40, 55, 65:** Lightly oil short bearing area of sector shaft. **Do not grease.**

RCS85 only: Apply a generous amount of Exxon Unirex* RS460 to the short bearing area of the sector shaft.

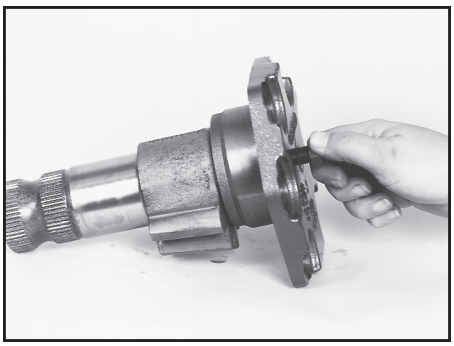


Install sector shaft into side cover

Screwdriver

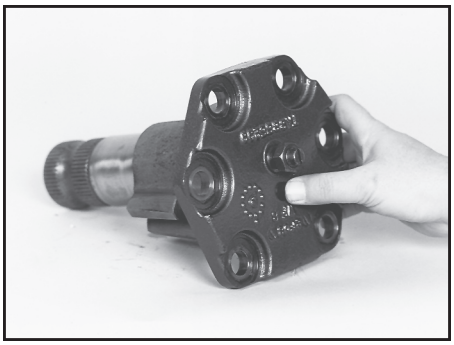
14. Insert the sector shaft (42) into the side cover subassembly (46), and screw the sector shaft adjusting screw (43) counterclockwise into the side cover until the screw reaches solid height.

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



Install jam nut

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

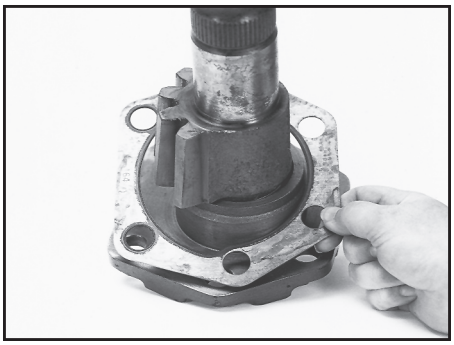


Assemble vent plug

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

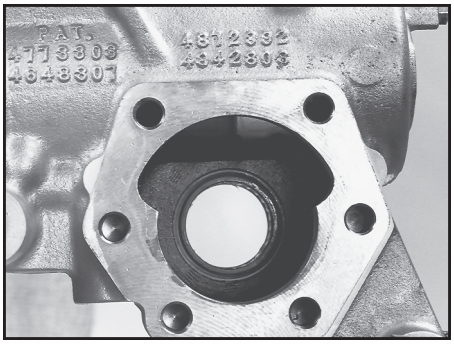
⚠ WARNING **Do not weld or otherwise plug this hole in any permanent manner. This is a safety vent which functions only if the side cover seal fails. If the seal fails and the plug cannot vent, the auxiliary cylinder may lock-up or otherwise malfunction.**

*Trademark of Exxon Oil Corp.



Install side cover gasket

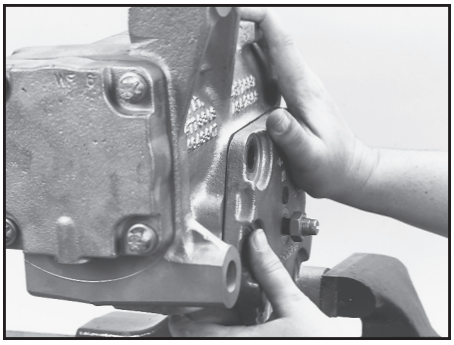
17. Apply clean grease to the new side cover gasket (45) to hold it in place and assemble it onto the side cover (46).



Center rack piston

18. There are four teeth on the rack piston. 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.**

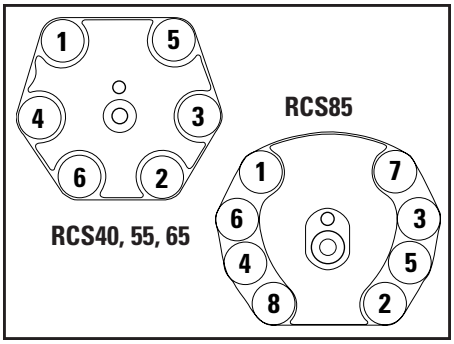


Install sector shaft and side cover into housing

Masking tape

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

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

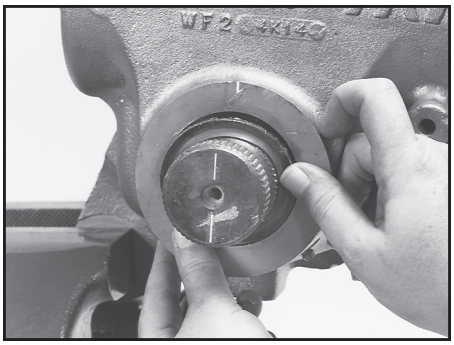


Install side cover bolts

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

20. Lubricate and install RCS40, 55 and 65 bolts in positions 3 and 4 first, by hand. For RCS85, Install in positions 3 and 6 first, by hand. Install the remaining special side cover bolts (48) into the side cover and torque them in the sequence shown. If bolts must be replaced, use bolts of the same design, type and length as those you removed. Do not use a substitute.

Torque RCS40 side cover bolts to **118 lbf•ft** (160 N•m), RCS55, 65 and 85 bolts to **170 lbf•ft** (230 N•m).



Remove tape, install dirt & water seal

21. **Standard cylinders** - 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 Unirex* RS460. Apply more of the grease to the inside of the new trunnion dirt seal (39) and assemble it over the sector shaft and into the trunnion bore.

Step bore cylinders - remove tape from the sector shaft.

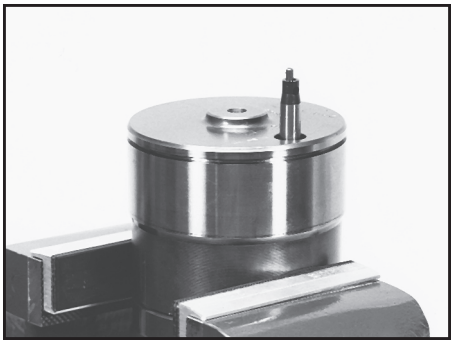
Poppet Component Replacement

Tools Required

2 lb Sledge
Lbf•ft Torque wrench
J36452-A
Press
⅜" x 6" drill rod
Ratchet
Soft-jawed vise

Materials Required

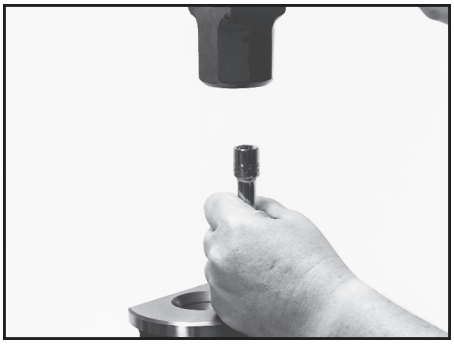
Locquic "T" primer
Loctite RC680



Place rack piston in vise

Soft-jawed vise

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

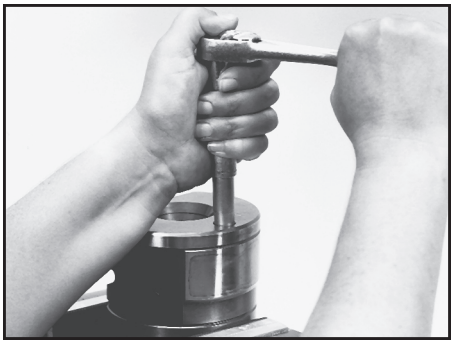


Loosen poppet adjuster seat

J36452-A
2 Lb Sledge

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

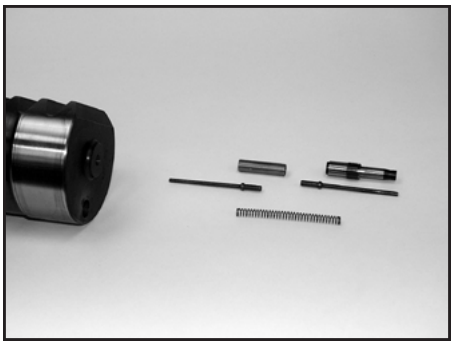
⚠ CAUTION **Poppet adjuster seat and sleeve assemblies (22) are retained by Loctite applied to the threads which makes the assemblies difficult to remove.**



Remove poppet adjuster seat

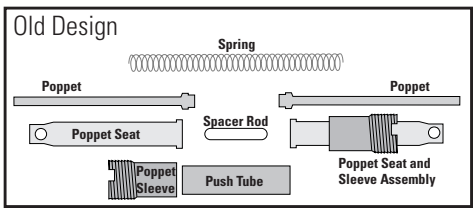
J36452-A

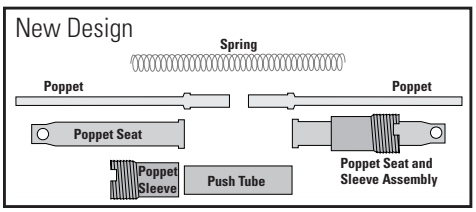
3. With a ratchet applied to the tool, turn one adjuster seat and sleeve assembly out of the rack piston. If the ratchet does not turn easily, strike the adjuster removal tool again with a hammer. If the engaging tangs won't stay in place while torquing, it might be necessary to hold in place with an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

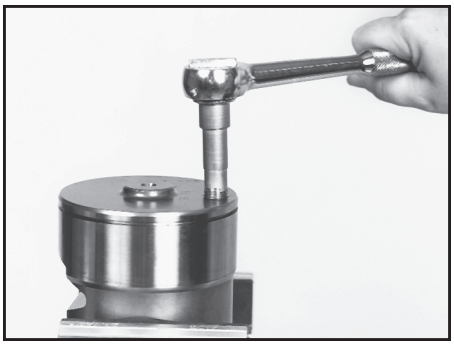


Remove poppet components

4. Remove the two poppets (23 or 23A), spring (24), and push tube (26). Some gears will also have a spacer rod (25) to be removed.



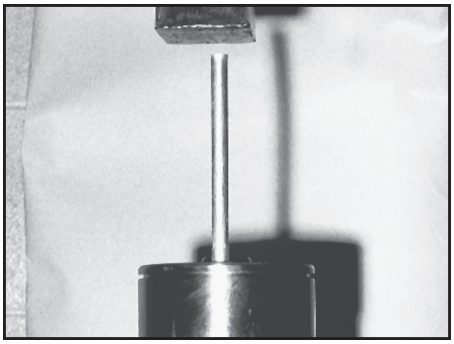




Remove other seat & sleeve if necessary

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

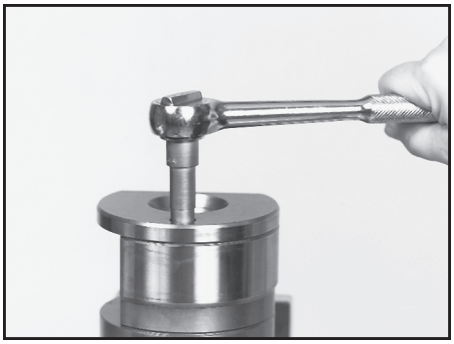
6. If one poppet seat and sleeve assy. (22) was left in rack piston, it can be reset for automatic poppet adjustment by inserting a ⅜" (9.52 mm) diameter X 6" (152.4 mm) drill rod down through the poppet seat hole at the opposite end of the rack piston and against the adjuster seat to press the seat in until it bottoms against the adjuster sleeve.

Apply Locquic "T" primer and Loctite RC680

Locquic "T" primer
Loctite RC680

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

⚠ 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.**



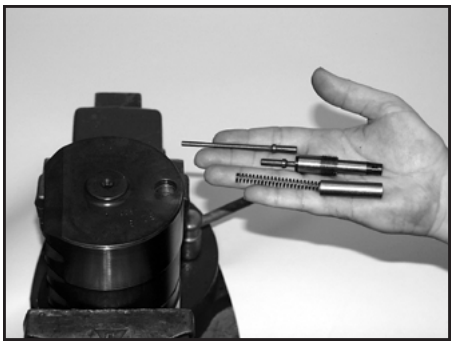
Install one poppet seat and sleeve assembly

Soft-jawed vise

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

Place rack piston (19) in a soft-jawed vise and turn one new poppet adjuster seat and sleeve assembly (22), (slotted end out) into the poppet hole in one end of rack piston.

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

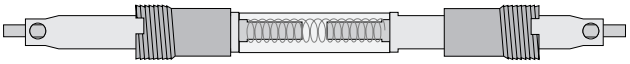


Install remaining poppet components

J36452-A
Lbf•ft Torque wrench

9. From the other end of the poppet hole in the rack piston, install: one poppet (23A), poppet spring (24), push tube (26), other poppet (23A), and the other new poppet adjuster seat and sleeve assembly (22). The new components will stack up as shown below.

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



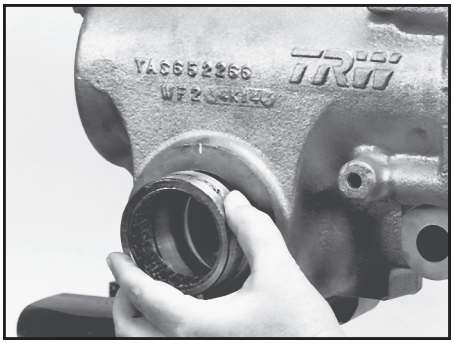
Return to step 20, page 28.

Roller Bearing or Ret. Ring Repl. - Standard

Tools Required

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

Materials Required

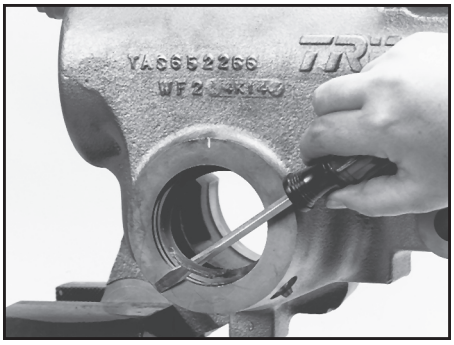


Remove roller bearing if required

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

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

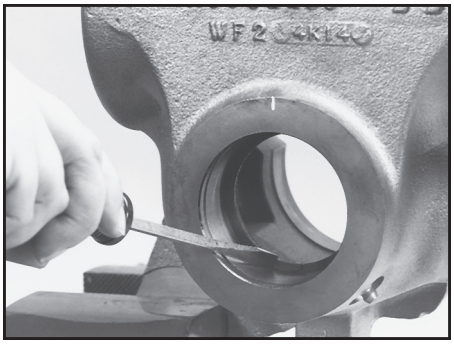
⚠ CAUTION **The bearing must be pressed out from the side cover side to protect the seal counterbore. Be sure to use a bearing removal tool that will clear the retaining ring.**



Remove retaining ring

Screwdriver

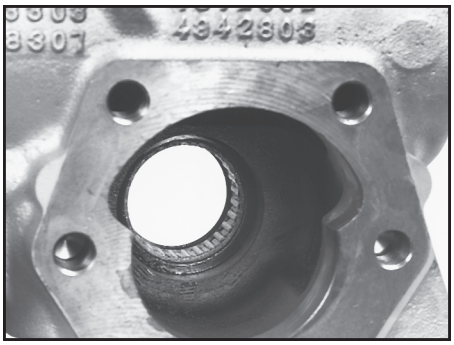
2. **Standard Gears Only:** If the retaining ring (36) that is still in the housing bearing bore needs to be re-placed, remove it through the trunnion end of the bearing bore to protect the pressure seal bore area from being damaged.



Install retaining ring

Grease

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



Press in housing roller bearing

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

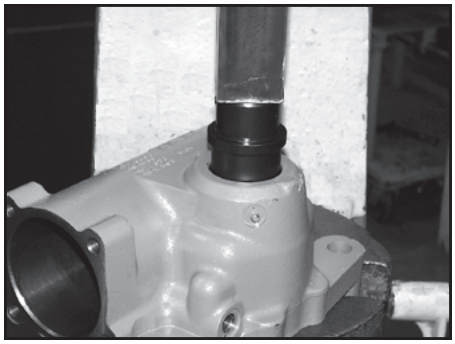
4. **Standard Gears Only:** Press the roller bearing (37) into the housing from the trunnion end of bearing bore until it is seated against the retaining ring. Be sure the housing is square with the press base and the bearing is not cocked.

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

Return to step 24, page 29.

Roller Bearing Replacement - Step Bore

Tools Required	Materials Required
Press KM Tool J37071-A Screwdriver	



Remove roller bearing if required

J37071-A
Press

1. If roller bearing (37) in housing needs to be replaced, place the bearing removal end of the bearing and seal tool against the 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 (37) 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. 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.**

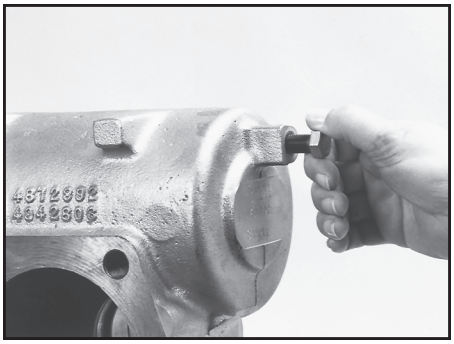
Return to step 24, page 29.

Replace Housing Ports, Plugs, Screws, Fittings

Tools Required

Allen wrench
Torx sockets
Sockets
Lbf•in. Torque wrench
Lbf•ft Torque wrench

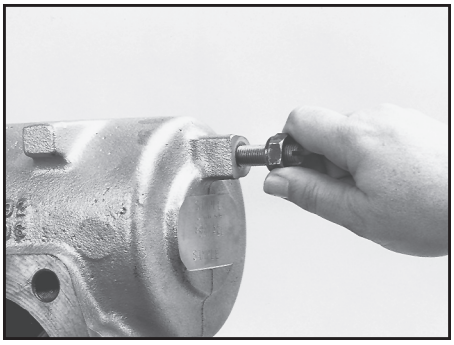
Materials Required



Replace poppet fixed stop screw

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

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

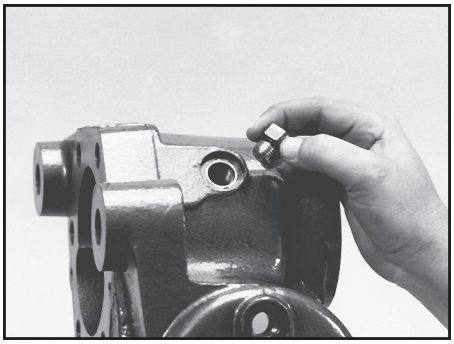


Replace poppet adjusting screw

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

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

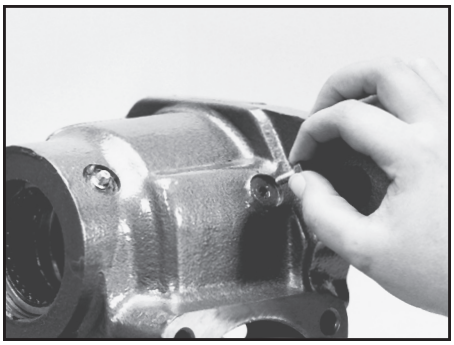
   Assemble the new nut onto the new adjusting screw, matching its position to the nut and screw removed. Torque sealing nut to **35 lbf•ft** (47 N•m).



Replace automatic bleed screw, and aux. port plugs

E-14 Torx socket
Lbf•ft Torque wrench

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



Replace manual bleed screw

5/16" Hex socket
Lbf•in. Torque wrench

4. If damaged, remove and replace manual bleed screw (50). Torque to **30 lbf•in.** (3.4 N•m).

Return to inspection section, page 30.

Final Adjustments

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

Center steering gear

1. To center the cylinder, rotate sector shaft until the timing mark is in line with the timing mark on the end of housing trunnion.

Torque adjusting screw

2. Torque the side cover adjusting screw to 5-10 lbf•ft, (7-14 N•m) then back out the screw one half turn.

Check rotational torque

3. Check the torque to rotate the sector shaft through approximately 20° each side of center.

Increase rotational torque

4. Screw in the adjusting screw to provide a torque rise of 40-80 lbf•in (5-9 N•m). over the previously established torque as the sector shaft passes through center.

Torque jam nut

5. Torque the jam nut to 40-45 lbf•ft (54-61 N•m).

NOTE	Torque to rotate the sector shaft must not exceed 380 lbf•in. at any point in travel of the cylinder.

Section 5 Reinstallation

Reinstallation

- Verify that axle stops are set to manufacturer's wheelcut or clearance specifications.
- Bolt cylinder to frame, torque to vehicle manufacturer's recommendation.
- Connect the auxiliary ports from the main gear to the appropriate RCS ports. Follow the markings you made when you removed the lines

> **⚠ CAUTION** **Installing the hoses to the wrong ports could result in damage to the tie rod. Make sure you reconnect hoses to the same ports from which they were removed.**

- Install pitman arm on output shaft, with timing marks aligned. Torque bolt to vehicle manufacturer's recommendation.
- Connect drag link to pitman arm.

Poppet Resetting

IF Poppets remain unchanged from when gear was removed from vehicle, and gear is being installed on the same vehicle with no change in axle stops or linkage. →	After installation, check to make sure poppets relieve in both turns just before axle stop contact is made. If not, use resetting procedure beginning on page 18.
IF Poppets were replaced with new components or reset during gear disassembly, and are ready for automatic positioning. →	Use poppet setting procedure on page 13.
IF Poppets may have been moved during disassembly or reassembly procedures, or gear is being installed on a different vehicle. →	Use poppet resetting procedure beginning on page 18.

Maintenance Tips

Never high-pressure wash or steam clean a power steering gear or rotary cylinder 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 and rotary cylinder.

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.

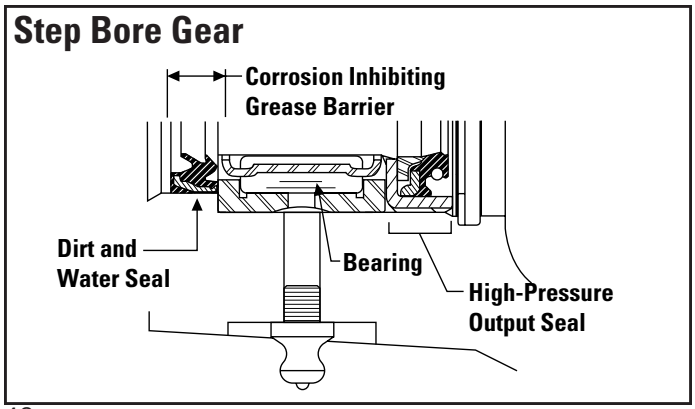
Always **clean off around the reservoir filler cap** before you remove it. Prevent dirt or other foreign matter from entering the hydraulic system.

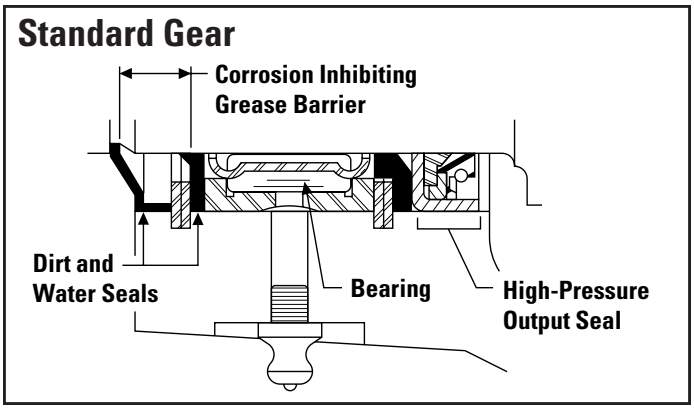
Investigate and correct any external leaks, no matter how minor.

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 sector 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 1 or 2 multipurpose chassis lube, and use only a hand operated grease gun on fitting. Add grease until it begins to extrude past the sector shaft dirt and water seal.





Glossary

Aerated Fluid
Fluid with air bubbles

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

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

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

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

Scoring
Scratch

Shock Load
Shake or jar

Spalling
Flaking or chipping

Subassembly
An assembled unit that fits into a larger unit

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.

TRW Automotive
Commercial Steering Systems
800 Heath Street
Lafayette, IN 47904
Tel 765.423.5377
Fax 765.429.1868
http://www.trw.com/commercialsteering

TRW1116 Rev. 3/00