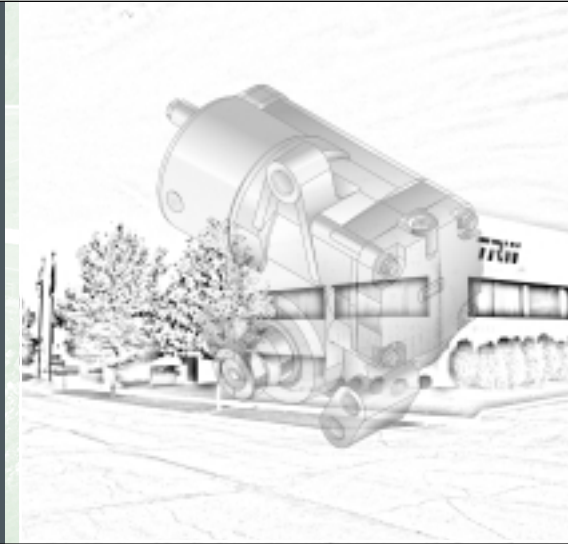






TRW Automotive
Commercial Steering Systems

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.

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Filling and Air Bleeding the System

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

CAUTION

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

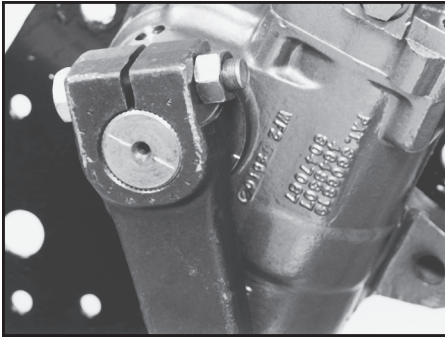
Sector Shaft Adjustment

Tools Required

Screwdriver
3/4" Socket
3/4" Open end wrench

Materials Required

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

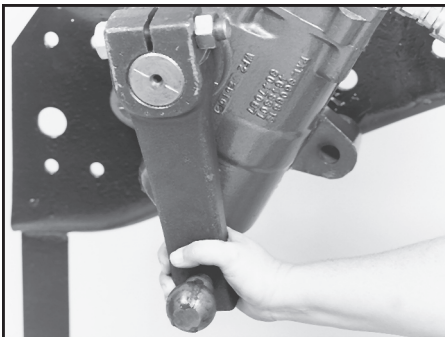
1. With the engine on, rotate the steering wheel until the timing mark on the sector shaft of the rotary cylinder lines up with the mark on the housing. The sector shaft is now on its "center of travel". Turn the vehicle off.



Remove the drag link

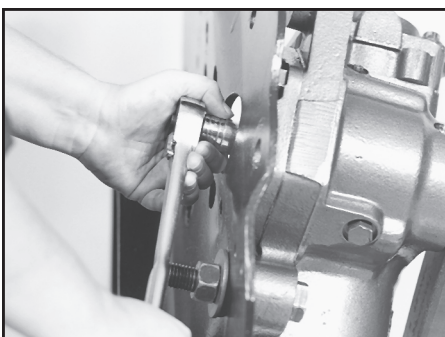
2. Remove the drag link from the pitman arm.

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

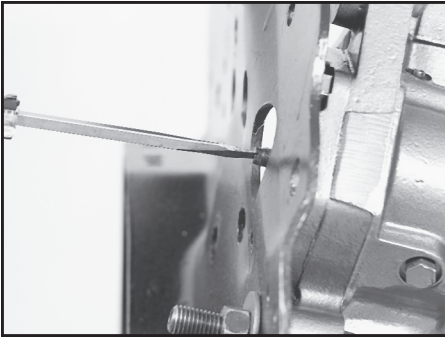
3. From the "center of travel" position, grasp the pitman arm and gently try to rotate it back and forth. If looseness or lash is felt at this point, the sector shaft is out of adjustment.



Loosen the jam nut

3/4" Socket

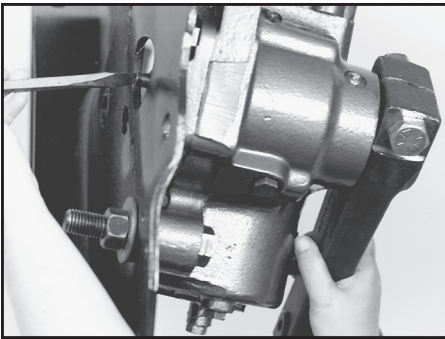
4. Loosen the jam nut.



Position adjusting screw

Screwdriver

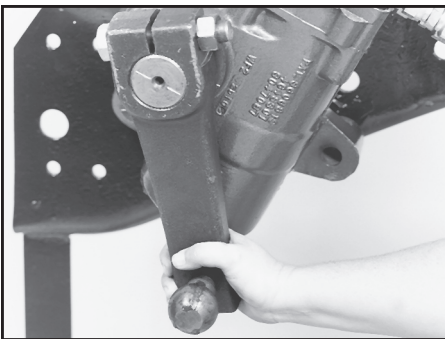
5. If no lash was detected in step 3, turn the shaft adjusting screw counterclockwise until you feel lash at the output shaft.



Adjust shaft

Screwdriver
3/4" Open end wrench

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



Recheck for lash

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



Connect drag link

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

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

Poppet Readjustment - Dual Gears

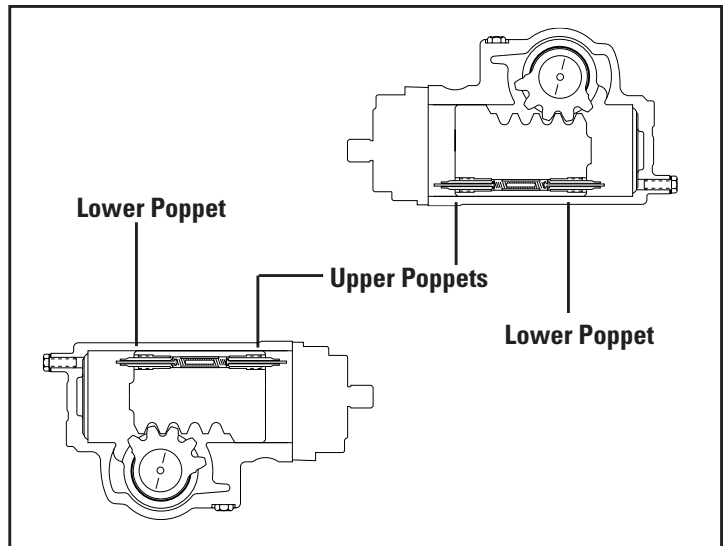
Mirror Image Systems and Reversed Image Systems

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

7/32" Allen wrench
5/8" Open end wrench
3/4" Open end wrench
3/4" Socket
Lbf•lb Torque wrench

Materials Required

Hydraulic fluid
Jack

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 <u>no more than 1¼" (27 mm) for proper thread engagement.</u>
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NOTE	The length of adjusting screw beyond the sealing nut may be different for each vehicle.
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Poppet Readjustment - Dual Gears - Reversed Image

Tools Required

7/32" Allen wrench
5/8" Open end wrench
3/4" Open end wrench
3/4" Socket
Lbf•lb Torque wrench

Materials Required

Hydraulic fluid
Jack

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 <u>no more than 1 1/16" (27mm)</u> for proper thread engagement.
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NOTE	The length of adjusting screw beyond the sealing nut may be different for each vehicle.
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