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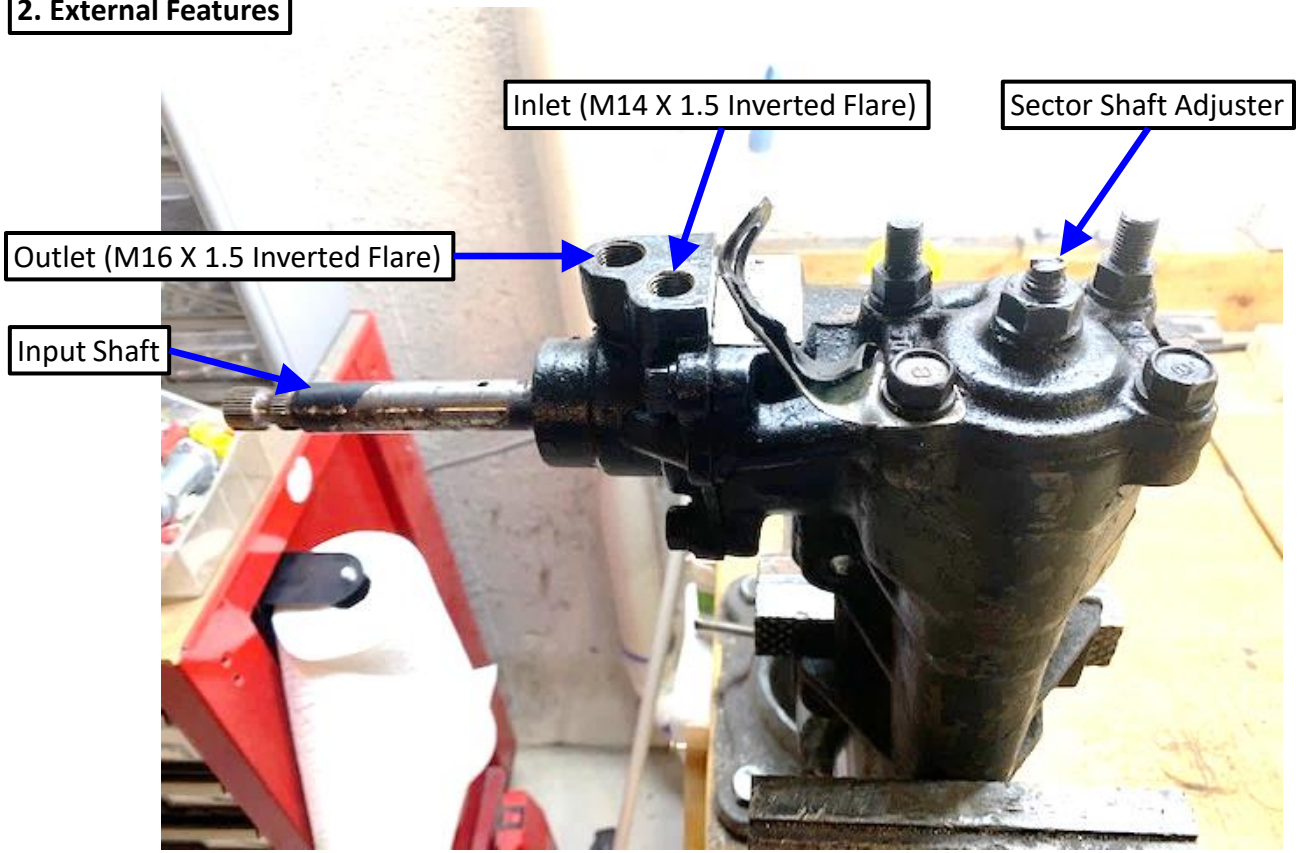
Vehicle: 1984 Mazda RX-7

Component: Power Steering Gear

1. Objectives:

- Disassemble the power steering gear
- Understand the general operation
- Modify it for use in manual mode

2. External Features



1984 Mazda RX-7 Power Steering Gear

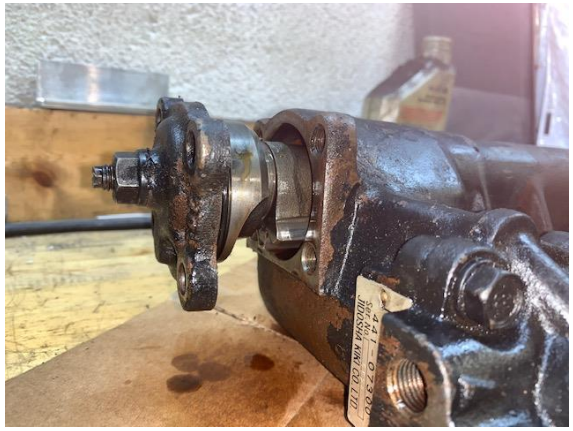
- Gear was retrieved from a car that was immobile for many years
- Input shaft did not turn freely; required vise grips
- Backlash wasn't assessed prior to disassembly

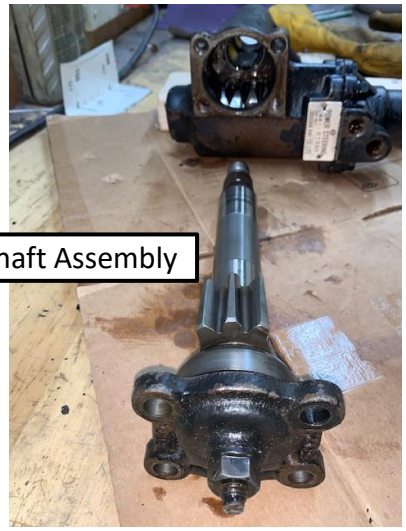
3. Product Identification

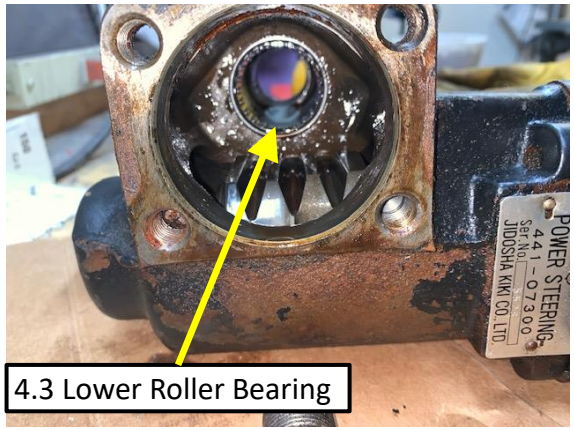
1984 Mazda RX-7 Power Steering Gear

- Jidosha Kiki Co, PN 441-073.00
- Mazda PN FA55-32-120
- Sector Shaft adjuster shows signs of previous adjustment

4. Sector Shaft Removal







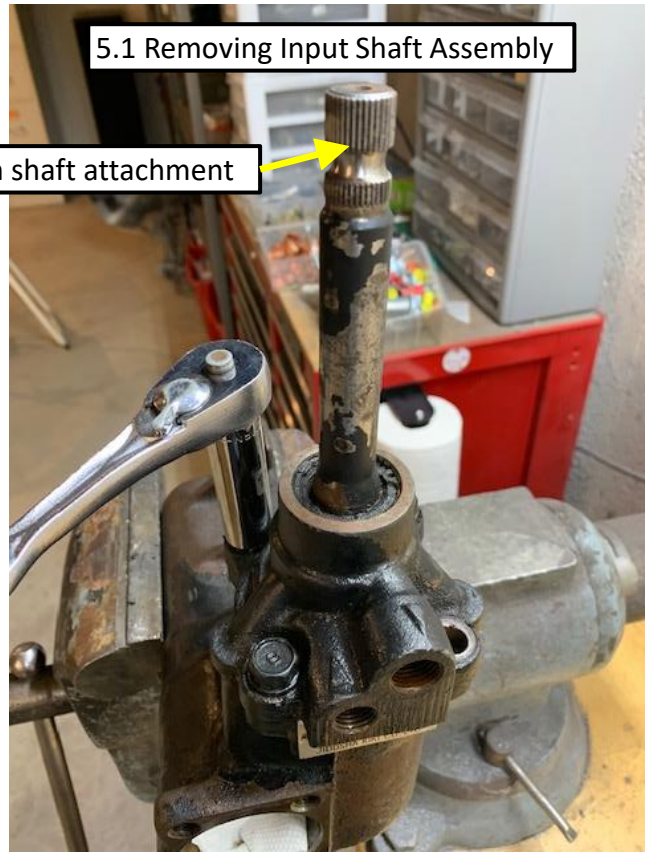
Sector Shaft

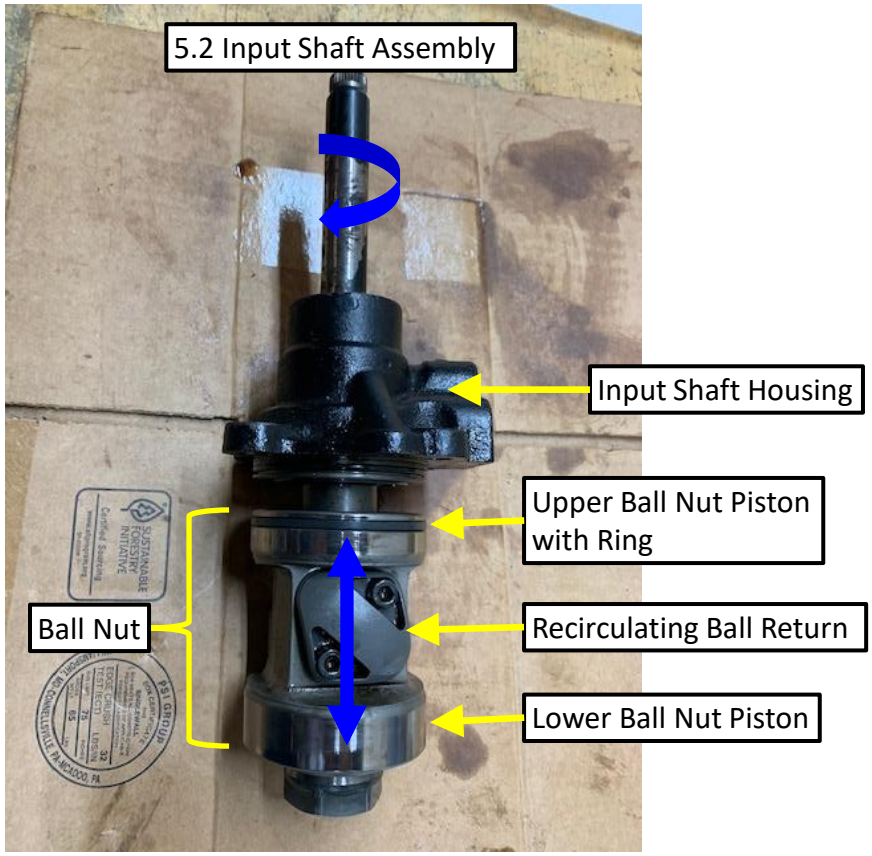
4.1 Sector shaft cap seals to housing with an O-ring

4.3 Sector shaft rides on roller bearings

- Upper roller bearing not visible (buried inside the sector shaft cap)
- Lower roller bearing visible in image #3
- Lower seal is a typical lip seal with garter spring

5. Input Shaft Removal





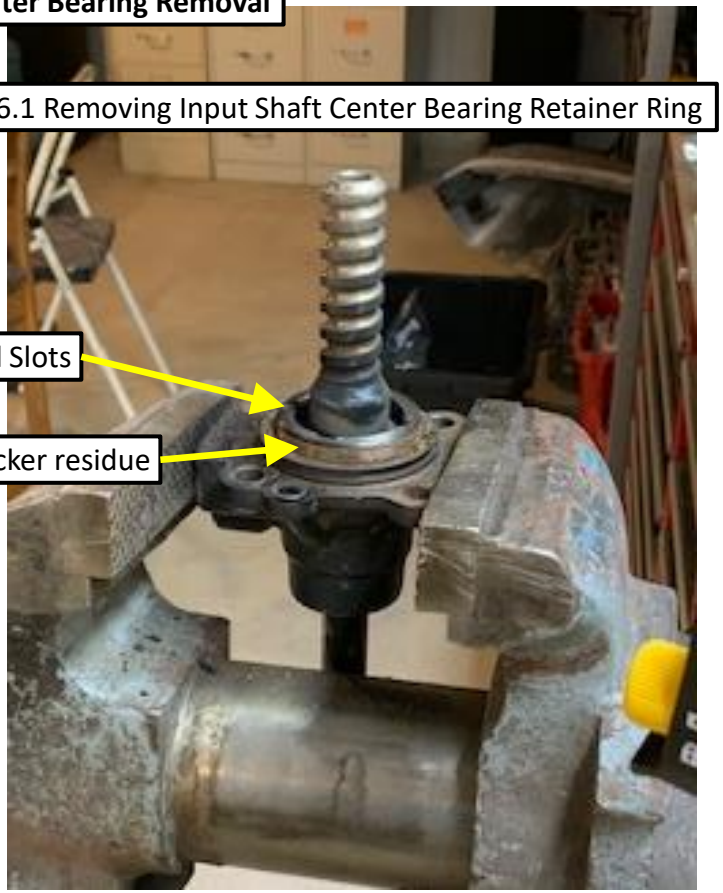
Input Shaft

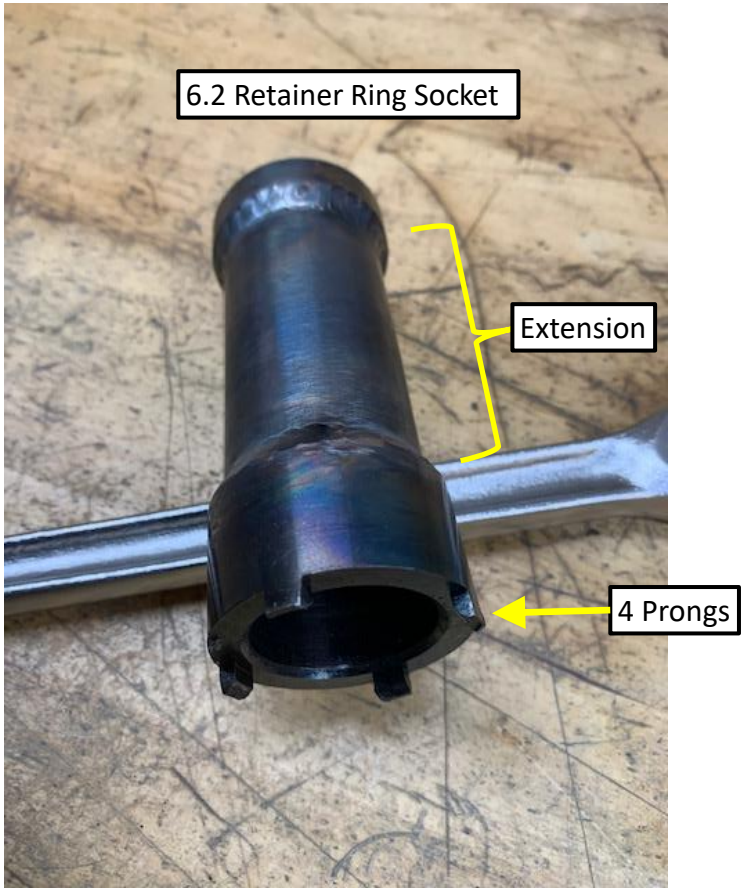
5.1 The 2-piece steering column shaft attaches to the steering gear via a rubber u-joint (not shown)

5.2 As the input shaft rotates, the ball nut moves up and down (blue arrows)

- Helical thread on input shaft mates with helical thread inside the ball nut with ball bearings to reduce friction
- Ball bearings are recirculated to the opposite end of the helix during operation

6. Input Shaft Center Bearing Removal





Input Shaft Center Bearing Retainer Ring

6.1 The retainer ring has 4 internal slots that measure approx 46.4mm OD
- There is a very strong threadlocker that must be burned away with a torch

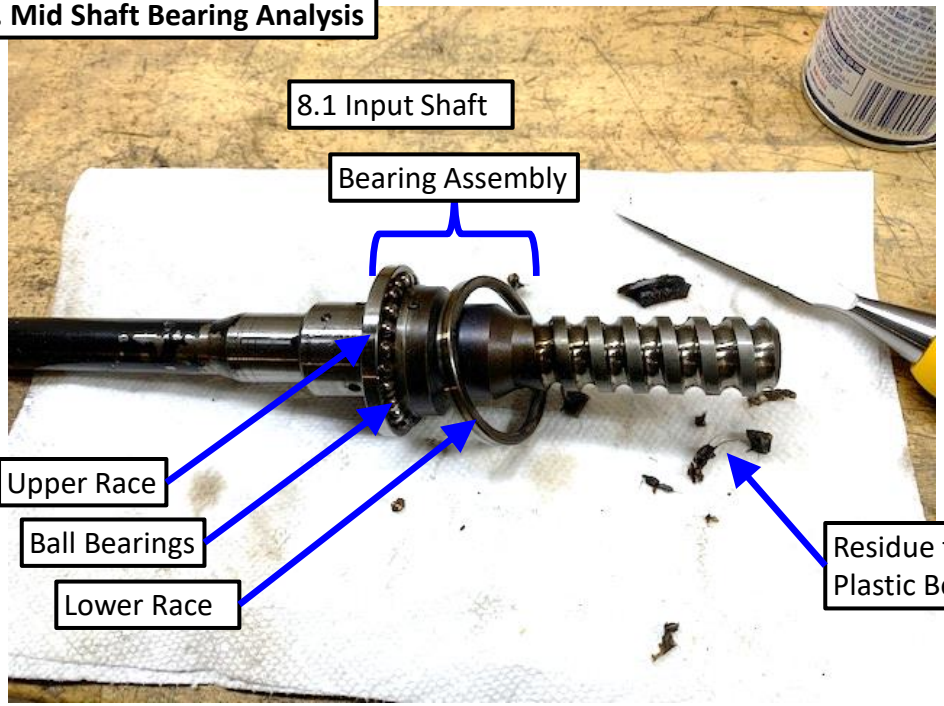
6.2 A tool will be necessary to remove the retainer ring
- An axle locknut socket for GM (7217) measures 1-7/8” OD, which is close enough
- The locknut socket will need to be extended to clear the helical portion of the input shaft, and some minor grinding will be required on the prongs
- An impact gun works better than a breaker bar

7. Retainer Ring Removal

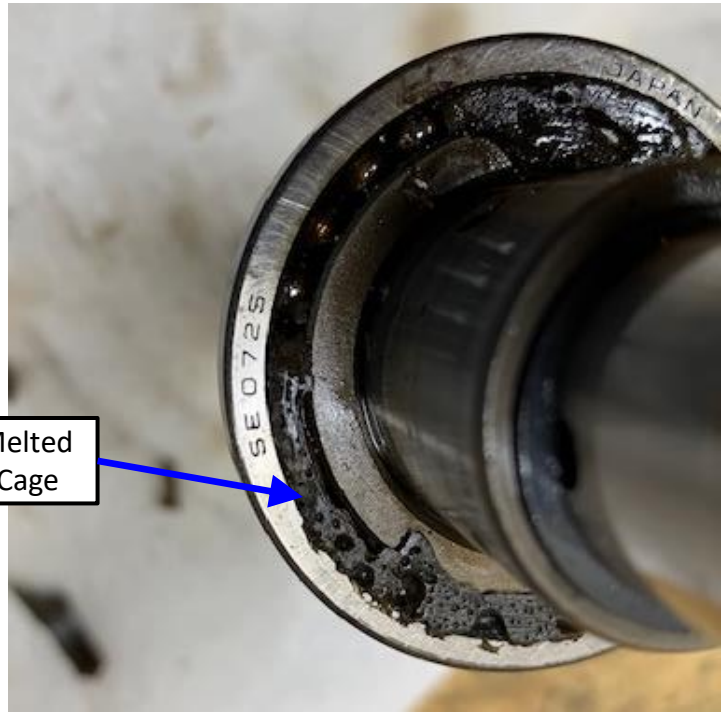
7.1 Socket on Impact Gun

7.2 Successful Removal

8. Mid Shaft Bearing Analysis



8.2 Mid Shaft Bearing PN



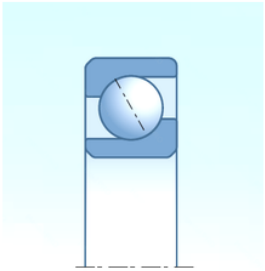
Mid Shaft Bearing Analysis

8.1 The mid shaft bearing assembly is comprised of 4 components
- Upper race
- Ball Bearings
- Lower Race (seen in the photo)
- Inner race (integral to the input shaft)

8.2 Bearing PN is NTN SE0725
- The residue is the remains of the plastic bearing cage that melted during retainer ring removal

9. Mid Shaft Bearing

Bearing SE0725 (NTN)



Angular contact ball bearings SE0725

Bearing number : SE0725

Size (mm) : 36.443x52x10

Brand : NTN

Bore Diameter (mm) : 36,443

Outer Diameter (mm) : 52,000

Width (mm) : 10,000

Bearing dimensions and specification in NTN catalogue:

d - 36,443 mm

D - 52,000 mm

B - 10,000 mm

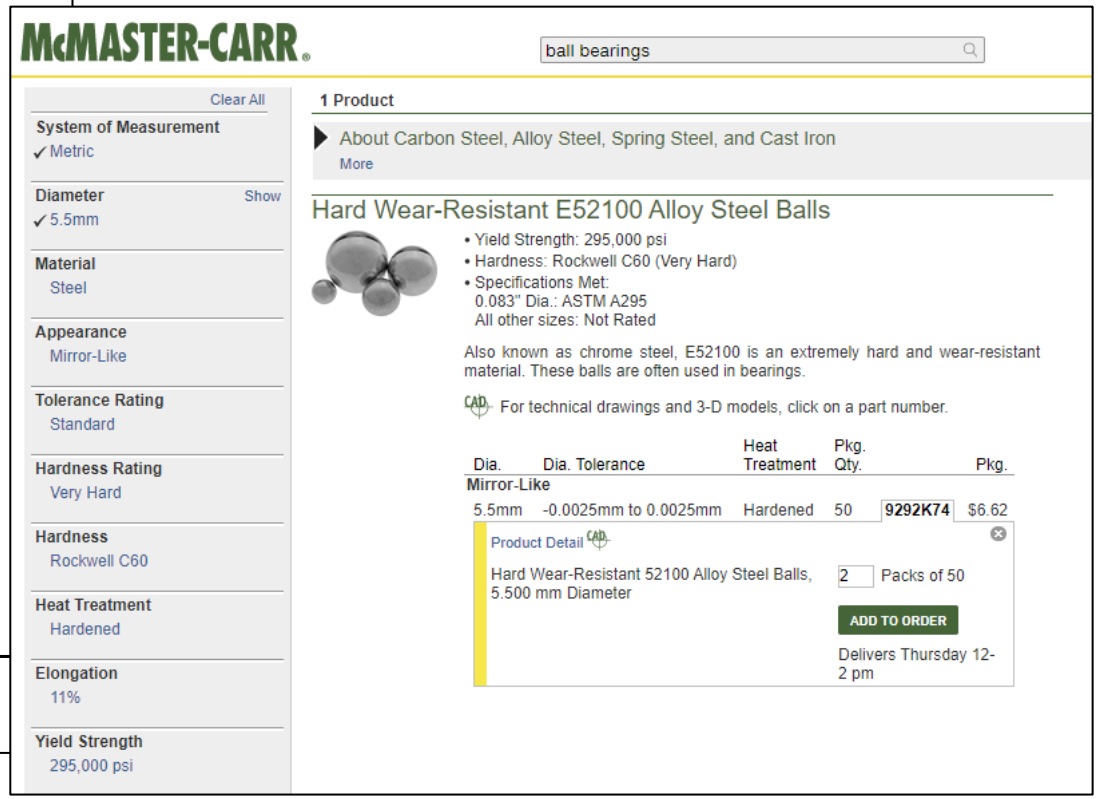
C - 10,000 mm

Weight - 0,04 Kg

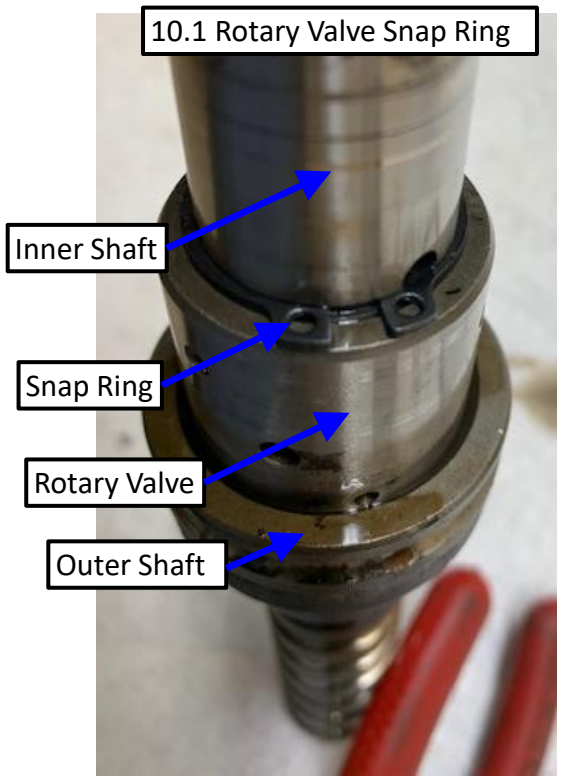
Tags : **NTN , 36.443x52x10**

Ball dia:	5.5mm
Original Qty:	17

- I was unable to locate the NTN SE0725 bearing; even NTN couldn't source it
- Cardone offers a rebuild service, but they require the customer to send them the steering gear, then they turn it around in a few days
  - They claim that all the bearings and seals will be replaced
  - Since the bearing is NLA, I suspect they only change the seals
- I decided to replace just the balls, without a plastic cage, thereby ending my time-consuming bearing search



10. Rotary Valve



Rotary Valve

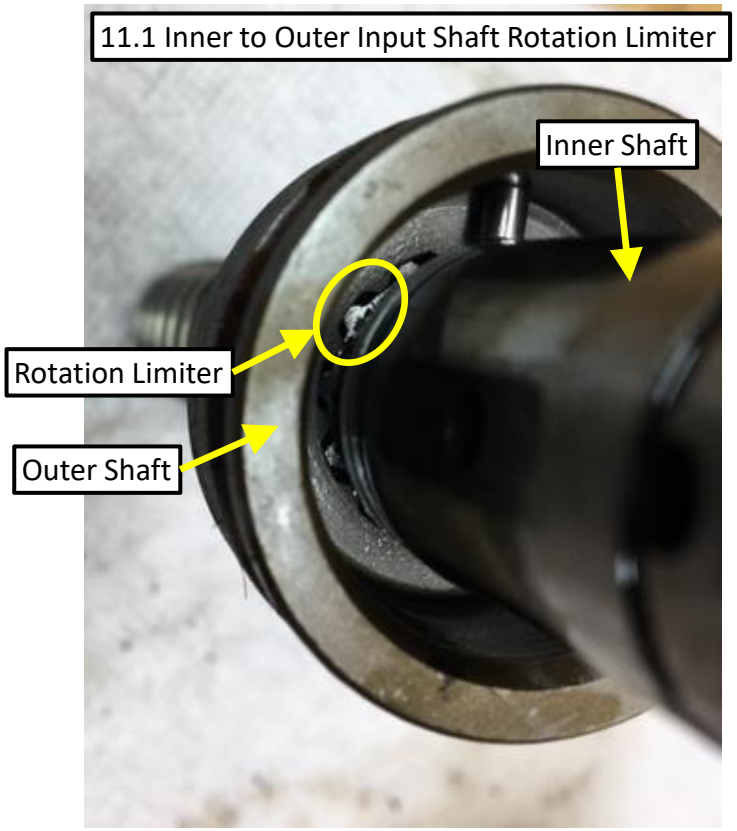
10.1 The rotary valve is retained to the input shaft by a snap ring

10.2 The snap ring is removed with ordinary snap ring pliers

10.3 The rotary valve slides off easily

- The rotary valve is keyed to the outer shaft
- The input shaft contains a torsion spring, which allows the rotary valve and outer shaft to rotate with respect to the inner shaft
- 4-way design rotary valve directs high pressure hydraulic fluid to the upper or lower side of the ball nut to provide steering assistance

11. Torsion Spring



Torsion Spring

11.1 Rotation Limiter

a. The torsion spring provides centering torque for the inner shaft vs the outer shaft

b. The geared interface between the inner and outer shafts provides hard limits to relative rotation

11.2 Torsion Spring Removal

a. It wasn't possible to separate the torsion spring from the input shaft assembly, even with a hydraulic press

b. It was decided that the teardown was sufficient to:

- Understand construction and function
- Develop modifications to optimize the power steering gear for manual use

12. Modifications / Rebuild

Modifications / Rebuild

12.1 Rotary Valve: Discard, since it won't be needed to direct fluid

12.2 Input Shaft: Install Pins Between the Outer Shaft and Inner Shaft to lock them together and effectively obviate the torsion spring (Qty 3 of 1/8" solid steel pins equally spaced around the perimeter, staked in place)

12.3 Ball Nut Cylinder Ring: Discard, since there is no need to seal against hydraulic pressure

12.4 Ball Nut Cylinders: Cut qty 4 of ¼" dia relief slots around the circumference to allow free fluid flow and reduce steering effort

5. Lightened Housing

Modifications / Rebuild (Continued)

13.5 Housing: Lighten by strategic material removal

13.6 O-Rings and Shaft Seals: Replace (Gates rebuild kit # 348439)

13.7 Bearing Balls: Replace (McMaster-Carr #9292K74)

13.8 Sector Shaft: Adjust backlash

13.9 Fluid: Change from Power Steering Fluid to 90W High Pressure Gear Oil, supplied from a remote reservoir