

# **SERVICE MANUAL**

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## **SERVICE MANUAL SECTION**

### **FRONT AXLES: INTERNATIONAL BY SPICER I-BEAM**

**Unit Code: 02ADA**

**Unit Code: 02ADB**

**Unit Code: 02ADC**

**Unit Code: 02ADD**

**Unit Code: 02ADE**

**Unit Code: 02ADG**

**Unit Code: 02ADH**

**Unit Code: 02ADJ**

**Unit Code: 02ADK**

**Unit Code: 02ADL**

**Unit Code: 02ADM**

**Unit Code: 02ADN**

**Unit Code: 02ADP**

**Unit Code: 02ADT**

**Unit Code: 02KDA**

**s02004t, Formerly CTS-5026T**

**02/07/1996**

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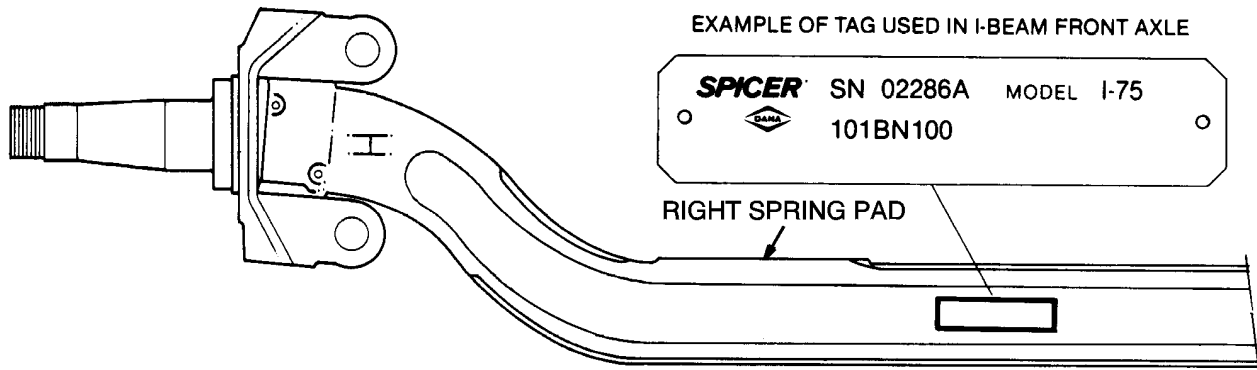
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## DESCRIPTION

### GENERAL



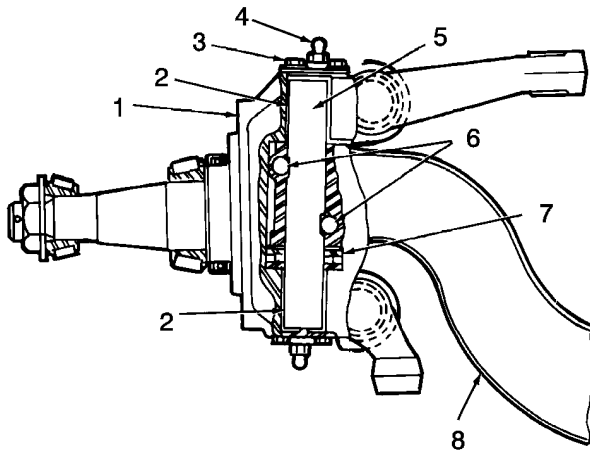
**Figure 1 Spicer Model Number With Axle Rating Capacity (Front Side of Axle)**

Most of the axles that this section applies to are identified with a tag located by the right hand side of the spring pad, on the front side of the I-beam axle (Figure 1).

The axle tag contains the serial number, the model number, and the assembly number.

The front axles covered in this section are I-beam type, non-driving units. Front axles are machined with different king pin angles to compensate for crowned road surfaces. It is important that the axle be installed with the axle front toward the front of the vehicle. The front of the axle is identified by the identification tag on the front and either an "F" forged into the axle near the center or an "F" stamped on the lower flange from center to spring pad.

Figure 2 illustrates the steering knuckle.

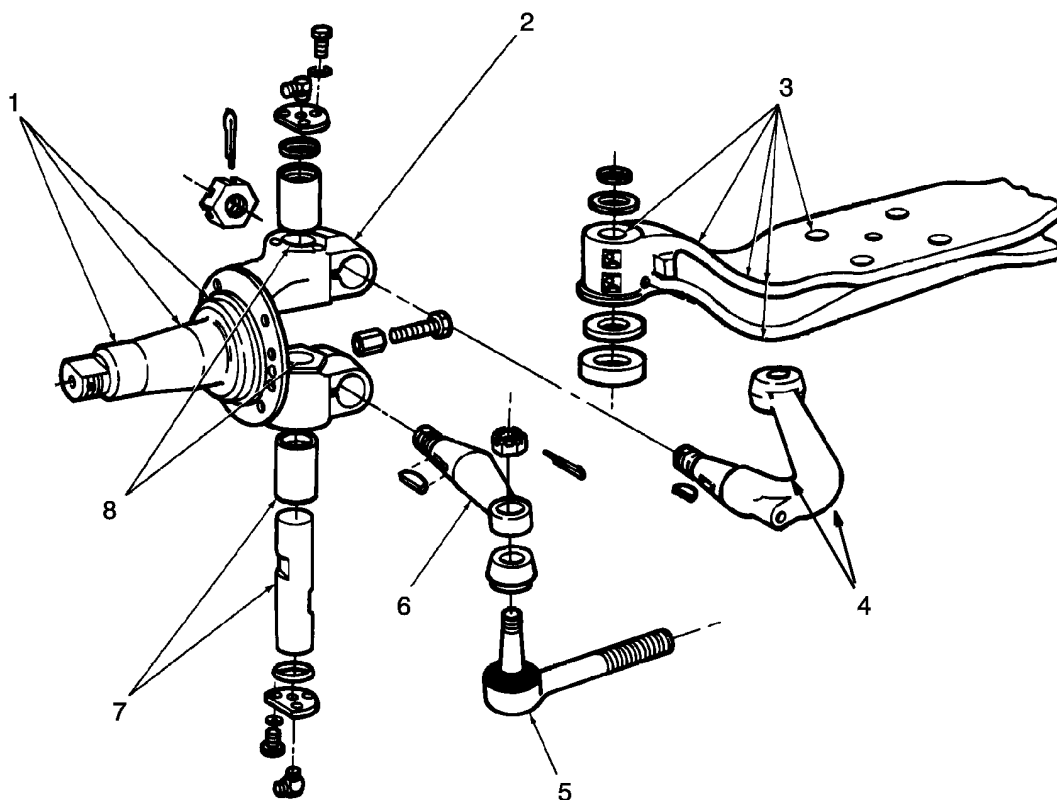


**Figure 2 Typical Steering Knuckle**

1. KNUCKLE
2. BUSHING
3. CAP & BOLTS (UPPER AND LOWER)
4. LUBRICATOR (UPPER AND LOWER)
5. KING PIN
6. DRAW KEYS
7. THRUST BEARING
8. I-BEAM

### **INSPECTION**

Refer to Figure 3.



**Figure 3 Axle, Steering Knuckle Assembly Inspection Areas**

1. BEARING & SEAL SURFACE SCORING & PITTING
2. FATIGUE CRACKS WHERE STEERING & TIE ROD ARMS ATTACH
3. ELONGATED BORES OR FATIGUE CRACKS
4. BENDING & FATIGUE CRACKS
5. LOOSENESS, WEAR & BENDING
6. BENDING & FATIGUE CRACKS
7. ABNORMAL WEAR OR SCORING
8. NICKS, BURRS & FATIGUE CRACKS

Thoroughly inspect steering components for indications of wear or stress. Replace as required to avoid costly front axle difficulties.

### TROUBLESHOOTING

For Troubleshooting Guide, refer to GROUP 02 - FRONT AXLE GENERAL SERVICE INFORMATION AND FRONT WHEEL ALIGNMENT Section in the CTS-5000 Master Service Manual.

### PRECAUTIONS

International strictly prohibits the modifying of any front non-driving axle component for any reason. Spicer recommends replacing any component which is damaged or out of specification. All major components are heat treated and, therefore, cannot be bent, twisted, welded, heated or reconditioned without experiencing a strength and/or fatigue life reduction.

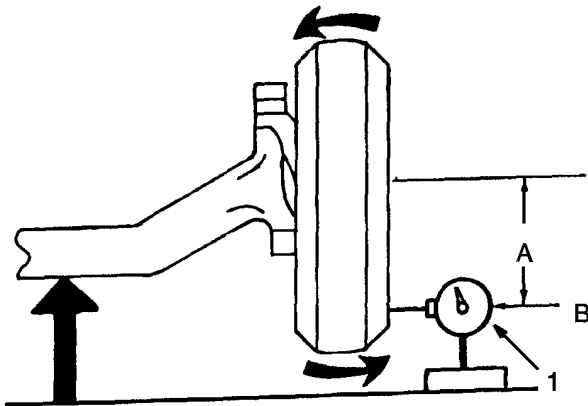
Examples of specific prohibited operations are:

1. Hot or cold bending or twisting of I-beam, tie rod assemblies, spindles, steering arms or tie rod arms for any reason.
2. Welding of, or to, steering arms, tie rod arms, I-beams, steering knuckles, king pins or tie rod assemblies.
3. The redrilling or reboring of I-beam king pin holes for a bushing.
4. Milling or machining of any component.
5. Spray welding of bearing diameters or other machined surfaces.
6. The redrilling or reboring of draw key holes.
7. Relocation or removal of tie rod clamps.

## 1. MAXIMUM LIMITS FOR FRONT AXLE KING PIN

This procedure is for determining if front axle king pin bushing wear (side play) and spindle vertical end play measurements exceed the maximum wear limits for normal service and decide if maintenance is necessary.

The International method for checking king pin looseness is to use a dial indicator. Instructions for the use of the dial indicator in this particular operation are as follows (Figure 4):



**Figure 4 King Pin Bushing Wear Measurement**

- A. 17.5 INCHES (443 MM) RADIUS
- B. MEASURE MOVEMENT HERE 1/8 INCH (3.175 MM) MAXIMUM MOVEMENT
- 1. DIAL INDICATOR

**NOTE – King pins and bushings must NOT have been recently lubricated before making this check. Measurements must be made BEFORE lubrication**

1. Block the rear wheels.
2. Raise and support axle on **two** jack stands. If the axle is supported on only one jack stand, a false reading will be obtained.



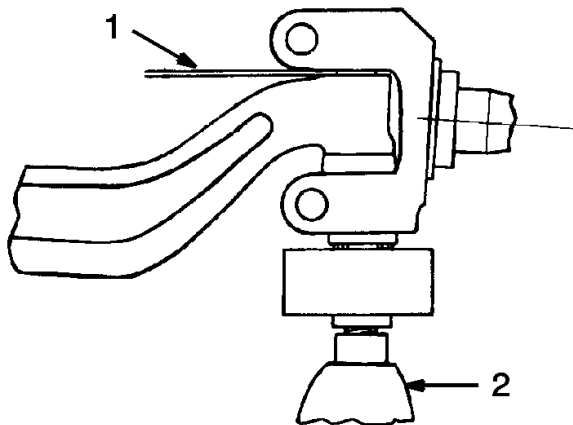
3. Mark the tire at 17.5 inch (444.5 mm) radius from the center of the spindle. Position a dial indicator at the 17.5 inch (444.5 mm) mark to measure tire movement. **Accurate results depend upon measurement at specified radius.**
4. Apply brakes to eliminate wheel bearing play and to assure getting a correct reading. Failure to do so will result in a false reading.

Push the wheel inward at the top and measure the movement obtained on the dial indicator at the 17.5 inch (444.5 mm) radius mark on the tire (Figure 4).

If more than 1/8 inch (3.175 mm) is obtained at the 17.5 inch (444.5 mm) mark (Figure 4), the king pin bushings should be replaced at the next scheduled service interval. Vehicles with more than 3/8 inch (9.515 mm) should be taken out of service until vehicle is repaired.

## 1.2. MEASURING SPINDLE VERTICAL END PLAY

1. Block rear wheels.
2. Raise and support the axle.
3. Lift the wheel and tire (spindle only if wheel is removed) so that all clearance is taken up between the steering knuckle and the axle king pin boss.
4. Using a feeler gauge, measure clearance (Figure 5).



**Figure 5 Spindle Vertical End Play Check**

1. FEELER GAUGE
2. JACK

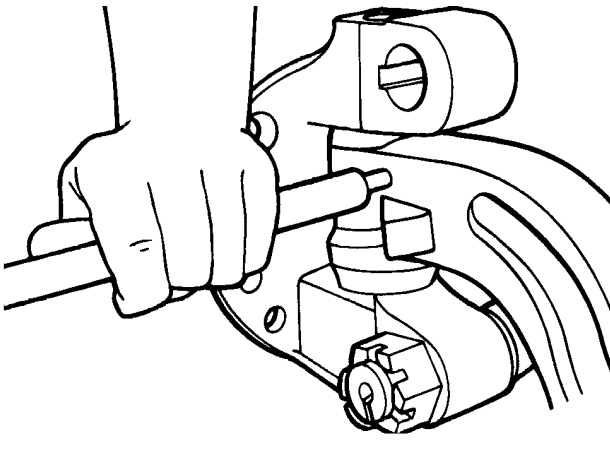
If more than .060 inch (1.524 mm) is measured, add shims as needed to reduce clearance to .005 - .015 inch (.1270 - .3810 mm).

## 2. KING PIN BUSHING REPLACEMENT

### 2.1. STEERING KNUCKLE REMOVAL

The following procedure applies to one knuckle, repeat the procedure for the remaining knuckle.

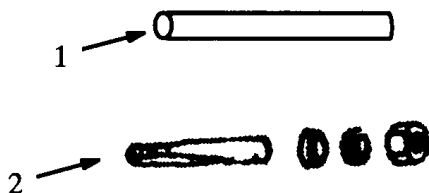
1. Block rear wheels.
2. Raise the vehicle. Support vehicle on stands; each stand by the spring pad area of the axle.
3. Remove wheels. Refer to GROUP 17 - WHEELS, RIMS AND TIRES Section in the CTS-5000 Master Service Manual.
4. Remove brake assembly from knuckle. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
5. Remove tie rod assembly and drag link from steering arms. If necessary, remove steering arms from knuckle. Refer to GROUP 05 - STEERING in the CTS-5000 Master Service Manual.
6. Remove draw key.
  - a. Staked draw keys: drive the staked draw key out at the opposite end of staking using a drift and brass hammer (Figure 6).



**Figure 6 Removing Draw Key**

- b. Threaded draw keys: remove nut and Belleville washers. Strike the threaded end of draw key with drift and brass hammer.

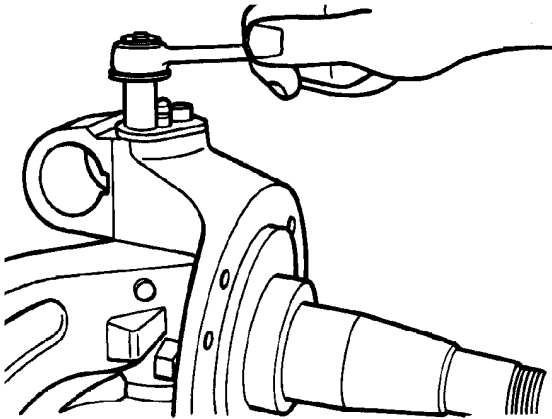
**NOTE – Medium and heavy-duty axles all use dual draw keys. Medium duty axle codes 02ADA and 02ADB use staked draw keys. Heavy-duty axle codes 02ADC, 02ADD, 02ADE and 02ADG have threaded draw keys (Figure 7).**



**Figure 7 Draw Keys**

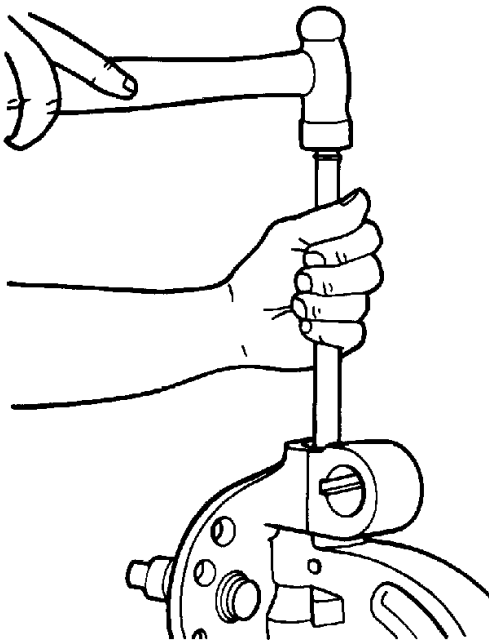
1. STAKED DRAW KEY
2. THREADED DRAW KEY

7. Remove top and bottom steering knuckle caps (Figure 8). If there are O-rings under the caps, they must be removed.



**Figure 8 Removing or Installing Steering Knuckle Cap**

8. Drive out the king pin using a brass drift punch and hammer (Figure 9). If the king pin is difficult to remove, a hydraulic press can be used. Refer to SPECIAL TOOLS.



**Figure 9 Removing King Pin**

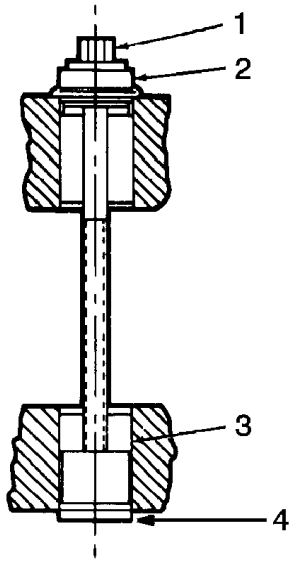
**NOTE – Draw key must be removed prior to king pin removal.**

9. Remove steering knuckles, thrust bearings and any spacer shims present. Keep spacer shim(s) together.
10. Thoroughly clean all parts and dry.

## 2.2. KING PIN BUSHING REMOVAL

**IMPORTANT** – Screw threads **MUST** be lubricated with high pressure lubricant prior to being used.

1. Select the appropriate service tool kit (pilots, remover and installer) for axle code number. All axles incorporate pre-sized bushings. Refer to SPECIAL TOOLS.
2. Secure knuckle in a vise using brass jaws. Assemble screw, support plate and remover (Figure 10).



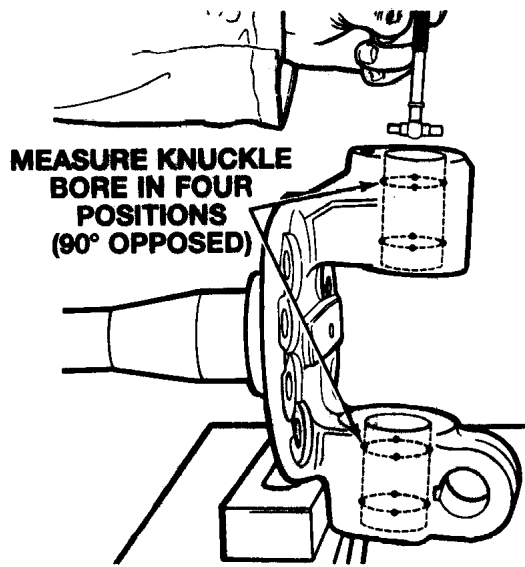
**Figure 10 Bushing Removal**

1. SCREW ASSEMBLY
2. SUPPORT PLATE
3. OLD BUSHING
4. REMOVER/INSTALLER

3. Tighten screw with wrench until bushing is removed from knuckle.
4. Remove knuckle from vise. Secure opposite end of knuckle. Assemble tool at opposite end to remove remaining bushing.

## 2.3. CLEAN AND INSPECT

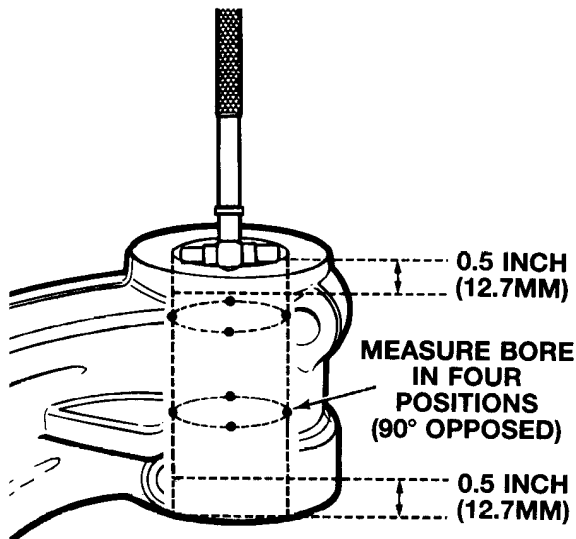
1. Clean knuckle assembly and axle bore, and air dry.
2. Inspect and replace any parts that are worn, cracked or damaged. Check for cracks with a die check or a magnetic or fluorescent particle inspection. If spacer shim(s) are to be replaced, replace with the same size spacer shim(s).
3. Use a micrometer and a telescoping gauge to measure the bore in the knuckle. Rounding at the top and bottom edges of the bore is acceptable. Make sure the bushing is removed from the knuckle (Figure 11).



**Figure 11 Measuring Knuckle Bore**

Measure the bore in four positions at the centerline of the side of the knuckle (Figure 11). If the average measurement is more than the Knuckle Bore Maximum Diameter specification, replace the knuckle.

4. Use a micrometer and a telescoping gauge to measure the bore in the I-beam. Rounding at the top and bottom edges of the bore is acceptable (Figure 12).

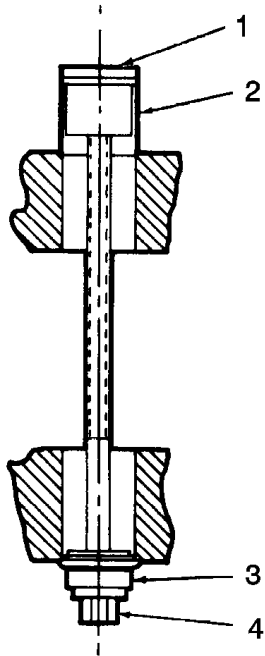


**Figure 12 Measuring I-Beam Axle Bore**

5. Measure the bore in four positions at the centerline of the side of the beam between 1/2 inch (25 mm) from the top of the bore and 1/2 inch (25 mm) from the bottom of the bore (Figure 12). If the average measurement is more than the I-Beam Bore Maximum Diameter specification, replace the I-beam.

## 2.4. BUSHING INSTALLATION (PRE-SIZED TYPE)

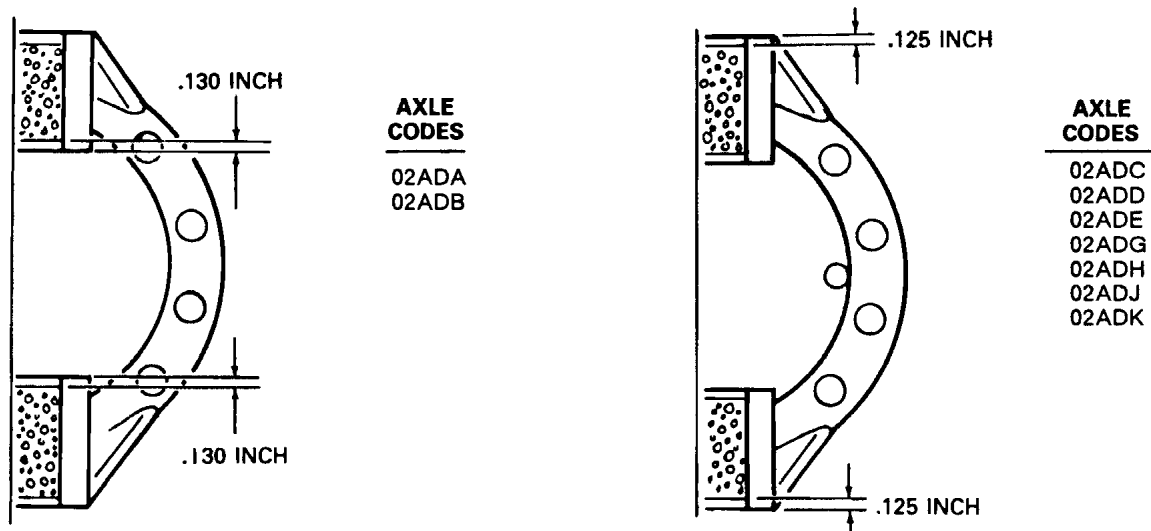
1. Secure knuckle in vise.
2. Assemble screw, support plate and installer with upper bushing (Figure 13).



**Figure 13 Installing Pre-sized Bushings**

1. REMOVER/INSTALLER
2. NEW BUSHING
3. SUPPORT PLATE
4. SCREW ASSEMBLY

3. Tighten screw to pull bushing into knuckle. Install bushing to specified dimension (Figure 14).



**Figure 14 Bushing Seating Depth**

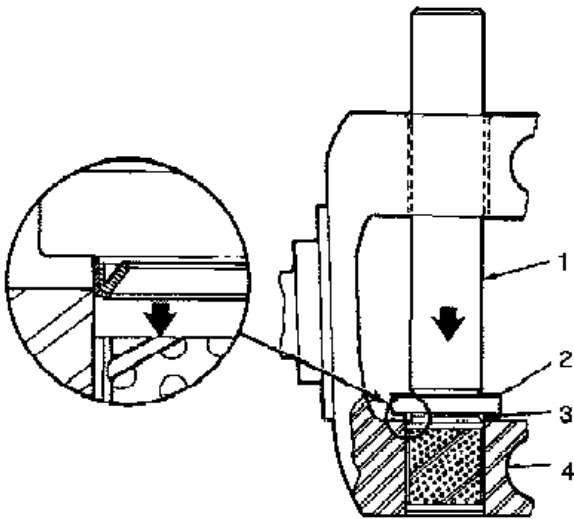
4. Install lower bushing following the same procedure used in installing the upper bushing (except opposite end).

**NOTE** – If bronze type bushings are to be used instead of pre-sized Garlock bushings, installation is the same procedure. For reaming the bushings, measure the king pin with a micrometer and add .002 inch to the king pin diameter. This total figure will be the maximum bore size of the reamed bushings.

## 2.5. KING PIN SEALS INSTALLATION (ALL AXLES)

### Installing Upper Seal

1. Position knuckle in a vise upside down to install seal in upper bore.
2. Hand-start seal with sealing lip out or rounded edge into bore (Figure 15).



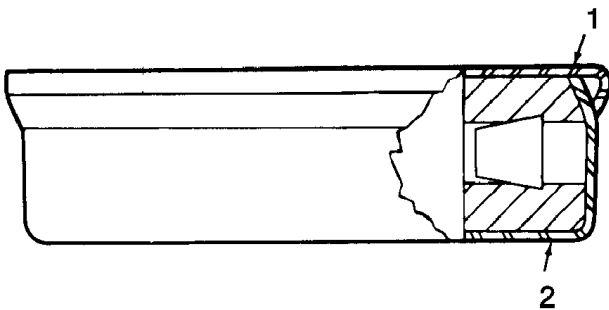
**Figure 15 King Pin Bushing Seal Installation (For Upper and Lower)**

1. DRIFT OR PIN
2. PLATE
3. SEAL
4. KNUCKLE

3. For lower seal, invert knuckle and repeat steps 2 and 3 above to complete seal installation.

## **2.6. STEERING KNUCKLE INSTALLATION**

1. Before installing the king pins, lubricate inside of bushings and outside of king pins with Fleetrite EP2 Moly Grease or equivalent NLGI No. 2 multi-purpose lithium grease to provide initial lubrication.
2. Make certain that knuckle pin hole in axle center is clean and dry.
3. There may be two styles of thrust bearings. One Type is installed on thrust bearing with seal on top (Figure 16). Position and support the steering knuckle assembly on the axle end.

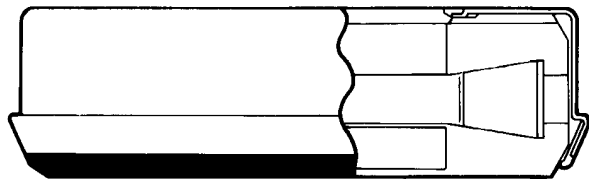


**Figure 16 Thrust Bearing Seal Installation**

1. SEAL CAP
2. THRUST BEARING



The second style thrust ing is a one piece design with the seal **lip** installed **towards** the bottom of the knuckles as shown in Figure 17 .



**Figure 17 1-Piece Sealed Thrust Bearing**

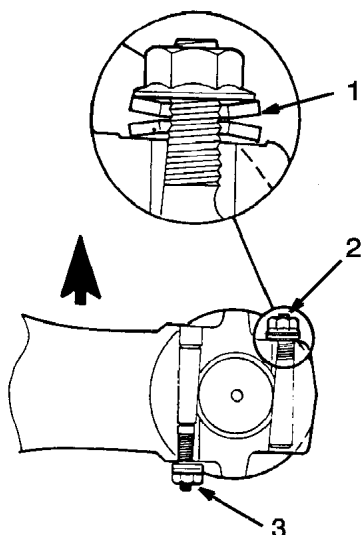
4. Slide spacer shim(s) between upper face of axle and upper steering knuckle yoke.
5. Slide the thrust bearing between the lower face of axle center and lower steering knuckle yoke.
6. Align the steering knuckle yoke holes with axle and thrust bearing holes.
7. Install king pin from the top **taking care to align notch with draw key holes in I-beam.**

**NOTE – The machined flats are located closer to the top of the king pin to allow installation of the thrust bearing, while maintaining correct vertical position of king pin. The flats are also wider than the draw key allowing slight adjustment. The king pin must be vertically centered in the knuckle. This allows both top and bottom king pin end caps to be installed without interference.**

8. Install draw keys as follows. (Apply chassis grease in draw key bores.)

Threaded draw keys on axle codes 02ADC, 02ADD, 02ADE and 02ADG will replace staked draw keys.

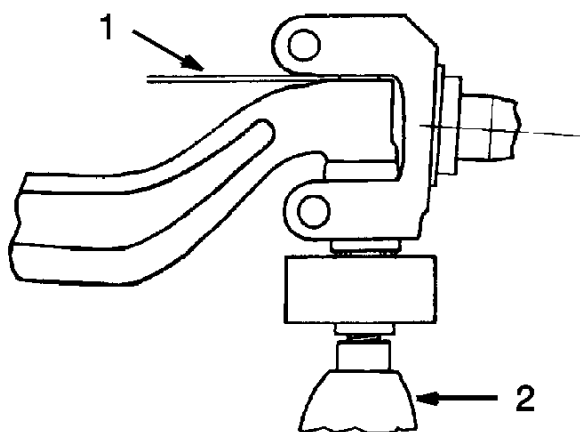
- a. Install top draw key with the threaded end of key to front of axle as shown in Figure 18 .



**Figure 18 Draw Key Installation To Front of Axle**

- 1. BELLVILLE WASHERS
- 2. TOP DRAW KEY
- 3. BOTTOM DRAW KEY

- b. Install bottom draw key with threaded end to rear of axle. Stake draw key(s) at unthreaded ends by striking with brass drift and hammer. Do not tighten at this time.
- 9. Place a jack under the lower side of steering knuckle yoke and raise knuckle so that all clearance is taken up between lower yoke, thrust bearing and lower face of axle center end (Figure 19).



**Figure 19 Spindle Vertical End Play Check**

- 1. FEELER GAUGE
- 2. JACK

- 10. Check the clearance between the top face of upper axle center end and lower face of upper knuckle pin boss. Shims are available in various thicknesses to provide a desired clearance of .005 to .015 (.1270 - .3810 mm) (Figure 19).

11. Tighten draw keys.
  - a. Install draw key Belleville washers and nut to upper and lower keys.
  - b. Torque draw key nuts to 25 - 30 ft-lbs. (34 - 41 N·m).
  - c. Seat draw keys again and repeat step B.
12. Install king pins caps and O-ring (Figure 7). Torque cap bolts to 12 - 16 ft-lbs. (16 - 22 N·m).
13. To make sure the king pins will accept lubricant, lubricate upper and lower king pin bushings through the cap grease fittings before installing brake assembly.
14. Re-install tie rod and drag link to steering arms. Refer to GROUP 05 - STEERING in the CTS-5000 Master Service Manual.
15. Re-install brake components. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
16. Clean and inspect the front wheel bearings. The bearings will either be grease or oil lubricated. Install the bearings in the hub assembly using new seals, and install hub assembly. Refer to the GROUP 17 - WHEELS, RIMS, AND TIRES in the CTS-5000 Master Service Manual.
17. Install wheel and tire as instructed in GROUP 17 - WHEELS, RIMS AND TIRES in the CTS-5000 Master Service Manual.
18. Remove vehicle from floor stands.
19. Check and adjust toe-in. Refer to Group 02 - GENERAL SERVICE INFORMATION and FRONT WHEEL ALIGNMENT in the CTS-5000 Master Service Manual.

### 3. STEERING KNUCKLE STOP ADJUSTMENT

The steering arm stop bolt should be adjusted to permit maximum turning angle. With power steering, the stop bolt should be adjusted to assure that the power steering unit will not override the axle stop. Refer to GROUP 02 - GENERAL SERVICE INFORMATION AND FRONT WHEEL ALIGNMENT in the CTS-5000 Master Service Manual.

### 4. LUBRICATION

For lubrication intervals and type of lubricant, refer to the vehicle Operator's Manual or GROUP 10 - LUBRICATION in the CTS-5000 Master Service Manual.

## SPECIFICATIONS

### SPECIFICATION CHART

**Table 1** Specification Chart

INTERNATIONAL CODE (SPICER MODEL)	02ADA (I-60S) 02ADB (I-80S)		02ADC (I-100S) 02ADD (I-120S) 02ADL, 02ADN, 02ADP		02ADE (I-140S) 02ADH (I-160S) 02ADJ (I-180S) 02ADK (I-200S) 02ADM, 02ADT, 02KDA	
	Inch	mm	Inch	mm	Inch	mm
King Pin Bushing Diameter/I.D.	1.3615/ 1.3600	34.58/ 34.54	1.924/ 1.922	48.87/ 48.82	2.049/ 2.047	52.05/ 51.99
King Pin Diameter	1.3592/ 1.3587	34.52/ 34.51	1.9212/ 1.9207	48.80/ 48.79	2.0462/ 2.0457	51.97/ 51.96
Maximum I-Beam Bore Diameter	1.3607/ 1.3597	34.56/ 34.54	1.9230/ 1.9220	48.84/ 48.82	2.0480/ 2.0470	52.02/ 51.99
Knuckle Bore Nominal Diameter	1.4840	37.69	2.046	51.97	2.171	55.14

## TORQUE

**Table 2** Torque Chart

LOCATION	SIZE		TORQUE			
	Diameter (Inches)	No. Threads	Ft. Lbs.		N·m	
			Minimum	Maximum	Minimum	Maximum
Tie Rod End Nut Drag Link End Nut (Note 1)	3/4	16	85	105	105	143
Tie Rod End Nut Drag Link End Nut (Note 1)	7/8	14	120	160	160	218
Tie Rod Clamp Bolt	1/2	13	40	50	54	68
Tie Rod Clamp Bolt	5/8	11	70	85	95	115
Drag Link Arm Nut & Tie Rod Arm Nut (Note 1)	1-1/8	12	300		407	
Drag Link Arm Nut & Tie Rod Arm Nut (Note 1)	1-1/4	12	775		1050	
King Pin Draw Key Nut (Note 2)	3/8	16	25	30	34	41

**Table 2 Torque Chart (cont.)**

LOCATION	SIZE		TORQUE			
	Diameter (Inches)	No. Threads	Ft. Lbs.		N·m	
			Minimum	Maximum	Minimum	Maximum
King Pin Cap Bolts	5/16	18	12	16	16	22
<p>NOTE 1: If cotter pin cannot be installed after minimum torque is attained, the nut must be advanced until cotter pin can be installed. Do not back off. Torque specified is for taper and threads which are clean and oil free.</p> <p>NOTE 2: Torque to specifications, tap unthreaded end of draw key sharply with a hammer, and retorque draw key nut to specifications.</p>						

## SPECIAL SERVICE TOOLS

**Table 3 Special Tools Chart**

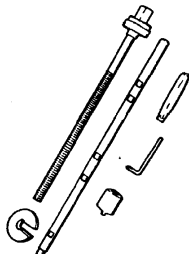
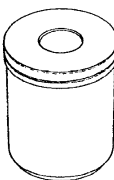
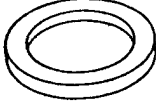
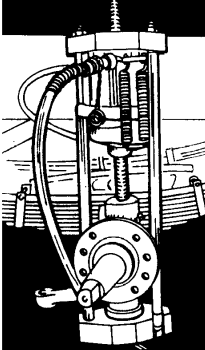
ORDER NO.	ILLUSTRATION	DESCRIPTION	APPLICATION
ZTSE4330 PT4375		<b>King Pin Bushing Service Set</b> - Includes all the necessary adapters to easily remove and install front axle, bronze or Garlock king pin bushings. Storage case included.	All front axles
ZTSE4330-1A PT4370-30		<b>Bushing Installer:</b> Pre-sized Bushings - 1.609 Inch Diameter King Pin used with Basic Kit	Spicer Codes I-60S, I-80S International Codes 02ADA, 02ADB
ZTSE4330-2A PT4370-40		<b>Bushing Installer:</b> Pre-sized Bushings - 1.921 Inch Diameter King Pin used with Basic Kit	Spicer Codes I-100S, I-120S, I-140S International Codes 02ADC, 02ADD, 02ADE
ZTSE4330-3A PT4370-50		<b>Bushing Installer:</b> Pre-sized Bushings - 2.046 Inch Diameter King Pin used with Basic Kit	Spicer Codes I-160S, I-180S, I-200S International Codes 02ADH, 02ADJ, 02ADK

Table 3 Special Tools Chart (cont.)

ORDER NO.	ILLUSTRATION	DESCRIPTION	APPLICATION
ZTSE4330-11		<b>Seal Installer Upper/Lower</b> -1.609 Inch Diameter King Pin	Spicer Codes I-60S, I-80S
			International Codes 02ADA, 02ADB
ZTSE4330-22		<b>Seal Installer Upper/Lower -</b> 1.921 Inch Diameter King Pin	Spicer Codes I-100S, I-120S, I-140S
ZTSE4330-33		<b>Seal Installer Upper/Lower -</b> 2.046 Inch Diameter King Pin	Spicer Codes I-160S, I-180S, I-200S
			International Codes 02ADH, 02ADJ, 02ADK
OEM-4240		Hydraulic Press with adapters for removing king pins	All models