

GROUP 4

**PROPELLER SHAFT
AND DIFFERENTIAL**

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PROPELLER SHAFT AND CENTRAL JOINT

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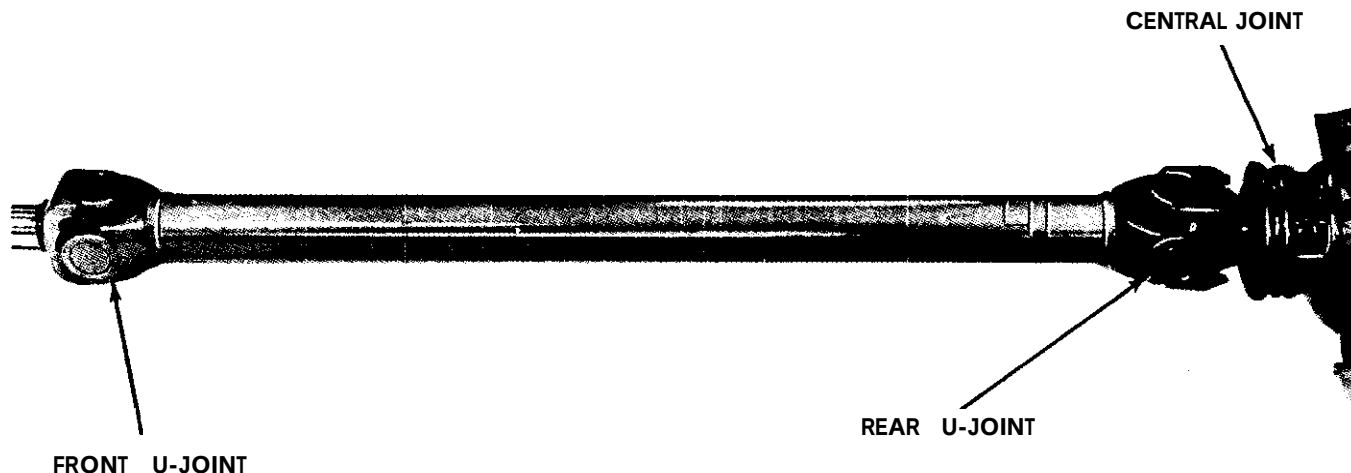
DESCRIPTION AND OPERATION

PROPELLER SHAFT AND CENTRAL JOINT

Due to the use of both automatic and manual transmissions, propeller shafts of various lengths are required depending upon vehicle, engine, and transmission (manual or automatic) application. The propeller shaft is of a strong design due to increased engine torque. It is also a one piece tubular shaft, but it has two universal joints. See Figure 4A-1. The front universal joint attaches to the transmission output shaft by a **splined** slip joint. The rear universal joint attaches to the pinion extension shaft flange by

two U-bolts. The splines of both propeller shafts are lubricated internally with transmission lubricant. An oil seal in the rear of the transmission extension prevents loss of lubricant and entrance of harmful foreign material.

The torque tube which houses the drive pinion extension shaft is bolted to the differential housing. The torque tube is pivoted in rubber elements of the central joint support bracket which is bolted to the floor panel. The support bracket and rubber parts of the torque tube **are** termed the central joint. The front end of the drive pinion extension shaft rides in a ball bearing mounted in rubber in the central joint.



4A-1

Figure 4A-1 Propeller Shaft

MAJOR REPAIR

PROPELLER SHAFT REMOVAL AND INSTALLATION

Removal

1. Raise rear of car and support on jack stands at rear jack brackets.
2. Disconnect parking brake cable equalizer from rod.
3. On the Opel 1900 and Manta, unhook parking brake cable from floor panel.
4. On the Opel 1900 and Manta, unhook exhaust system and let it down.
5. Mark the mating parts of the U-joint **and** the drive pinion extension shaft flange.
6. Loosen bolt locks and remove bolts or nuts.
7. Work propeller shaft slightly forward, lower rear end of shaft **and** slide assembly rearward. Remove thrust spring from front of propeller shaft.
8. Install plug in transmission extension housing to prevent loss of lubricant.

Installation

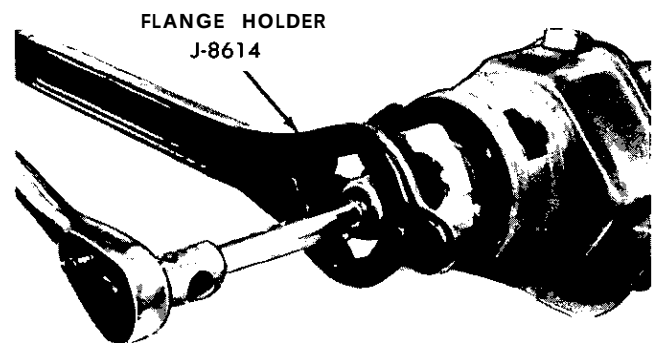
CAUTION: Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

1. Remove plug from rear of transmission.
2. Slide thrust spring onto transmission output shaft and slide propeller shaft through the oil seal and onto the transmission output shaft. Make certain transmission rear seal is not damaged.
3. Align rear universal joint and pinion flange locating marks and secure with respective bolts and lock plates. Torque bolts to 11 lb.ft. Bend lock plate tangs to secure bolts or nuts.
4. Connect parking brake cable equalizer to brake rod and adjust to specifications.
5. On the Opel 1900 and Manta connect parking brake cable to floor panel.

DISASSEMBLY AND ASSEMBLY OF THE CENTRAL JOINT

Disassembly of Central Joint

1. Raise and support rear of car under axle tubes.
2. Release brake line bracket from rear of torque tube.
3. Disconnect parking brake cable equalizer and return spring from brake rod.
4. On the Opel 1900 and Manta, unhook exhaust system and let it down.
5. Mark universal joint and flange. Disconnect propeller shaft from flange and support it out of the way.
6. Support torque tube with floor jack using minimum pressure.
7. Remove the central joint bracket to underbody attaching bolts.
8. Allow floor jack to lower the torque tube.
9. Disconnect torque tube from differential carrier by removing the attaching bolts.
10. Install pinion flange holder J-8614 and remove self-locking flange **nut**. See Figure 4A-2.



4A-2

Figure 4A-2 Removing Pinion Flange Nut

11. Pull pinion flange using J-8614 adapter. See Figure 4A-3.
12. Remove drive pinion extension shaft from torque tube using a soft faced mallet. See Figure 4A-4.
13. Removal ball bearing from cushion.
14. With torque tube placed in vise remove support

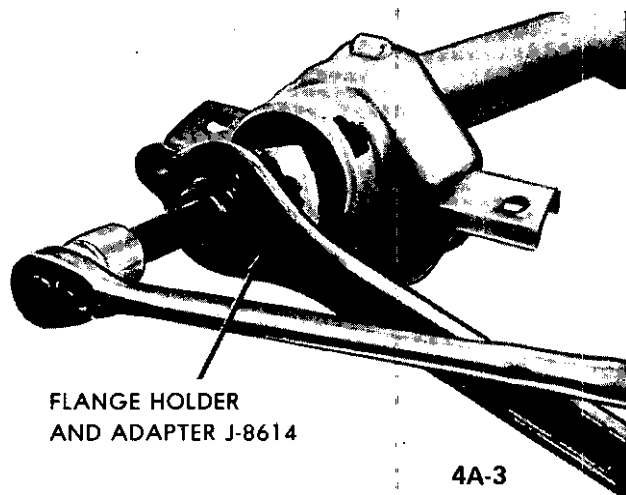


Figure 4A-3 Removing Pinion Flange

bracket to support cushion bolts and pull central joint support from torque tube. See Figure 4A-5:

Assembly of Central Joint

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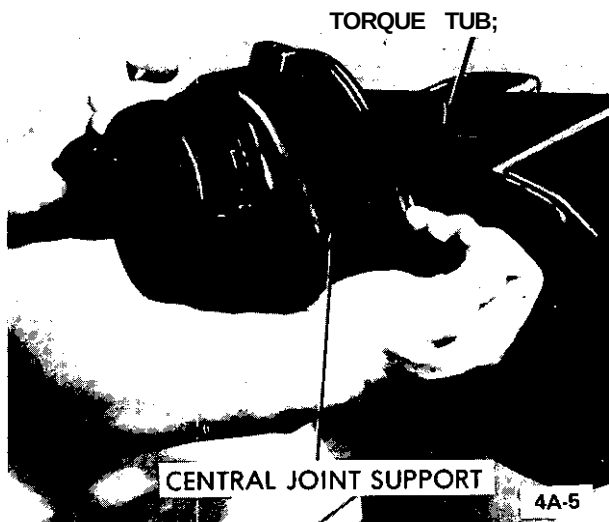


Figure 4A-5 Disassembling Central Joint

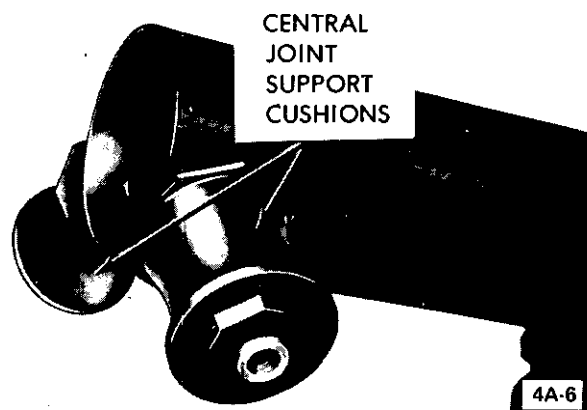


Figure 4A-6 Support Cushions Installed on Torque Tube

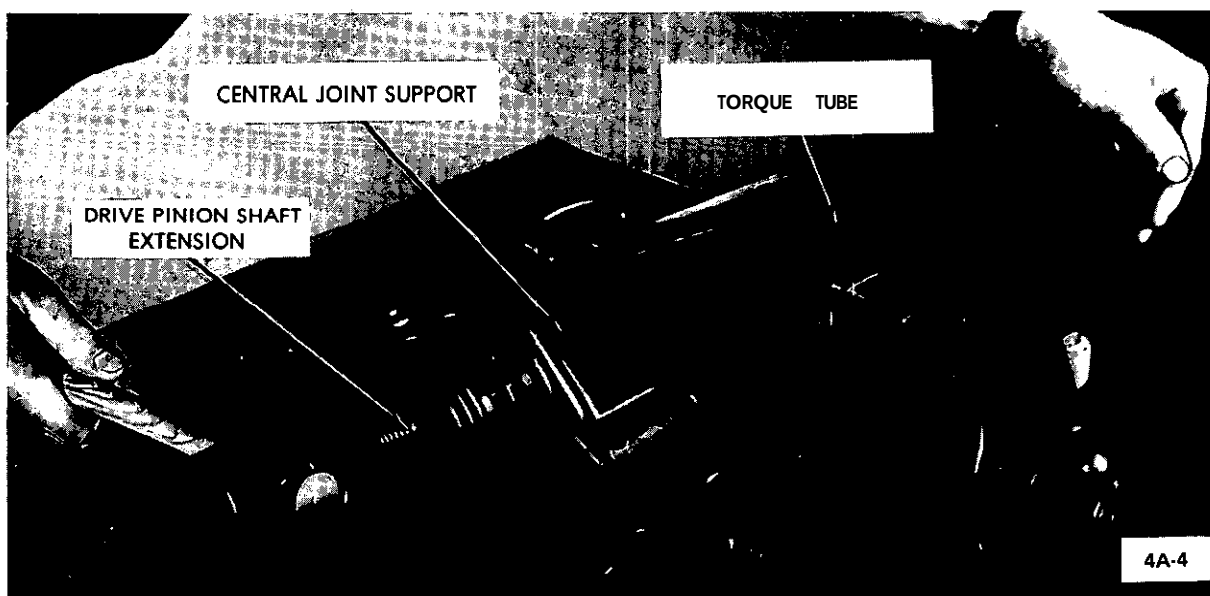
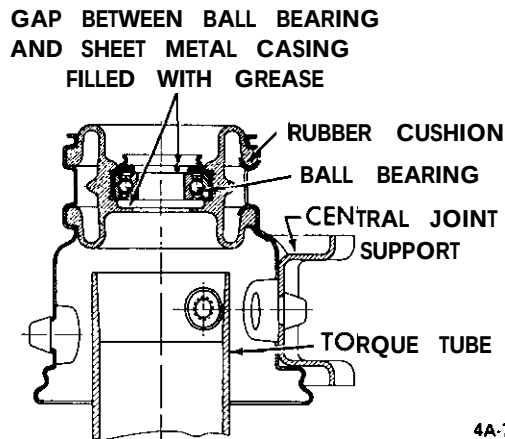


Figure 4A-4 Removing Drive Pinion Extension Shah

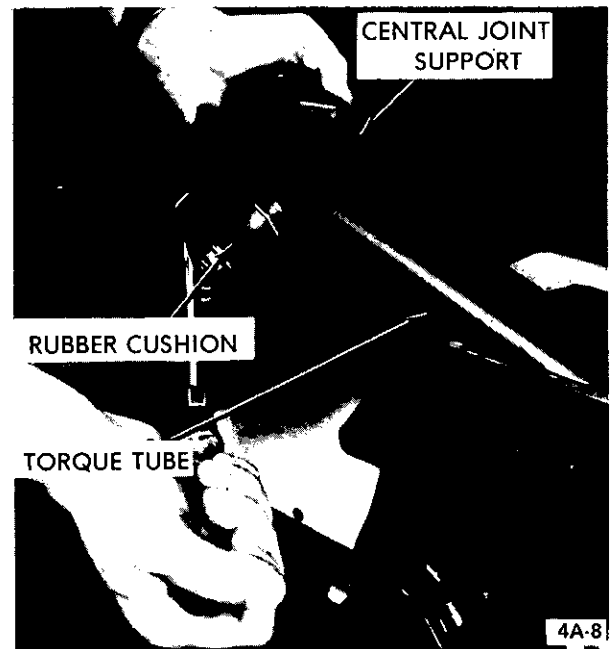
1. Check condition of support cushions. If new cushions are installed, torque to 29 lb. ft. See Figure 4A-6.
2. Install ball bearing into rubber cushion with the flange facing toward front of car. Pack area in front of bearing with water resistant grease. See Figure 4A-7.



4A-7

Figure 4A-7 Torque Tube Bearing Installed

3. Install support **bracket onto torque tube** in such a manner that one cushion is in place, then pry the other cushion into place with a **screwdriver**. Torque attaching bolts to 15 lb. ft.
4. Install drive pinion extension shaft into torque tube from the rear. Tap in place with soft face mallet.
5. Install flange. Tap-flange onto drive pinion extension shaft, with a soft face mallet, at least far enough to install nut.
6. Assemble flange holder J-8614 to **flange**, install new self-locking nut and torque to 87 **lb.ft.**
7. Install torque tube assembly onto differential carrier using only three of the four bolts. The fourth bolt will be used later to install the brake pipe bracket.



4A-8

Figure 4A-8 Installing Support Bracket on Torque Tube

8. Position floor jack under torque tube and raise it far enough to install central joint support to underbody bolts **finger tight**. Remove jack.
9. Jounce rear of car so springs will assume normal position and torque the central joint support to underbody bolts to 36 lb. ft.
10. Align mating marks of universal joint and flange, connect universal joint to flange with respective bolts and lock plates. Torque nuts to 11 lb. ft. Bend lock plate tangs to retain bolts.
11. Assemble parking brake cable equalizer and return spring to brake rod and adjust to specifications.
12. Connect brake line bracket to torque tube.
13. Remove supports **from** rear of car and lower to the floor.

SPECIFICATIONS

PROPELLER SHAFT AND CENTRAL JOINT
SPECIFICATIONS

Tightening Specifications

Use a reliable torque wrench. Specifications are for clean and lightly-oiled threads.

Part	Location	Torque Lb.Ft.
Bolt	Drive Pinion Extension Shaft Flange to Universal Joint	11
Bolt	Central Joint Support to Underbody	36
Bolt	Central Joint Support to Rubber Cushion	15
Torque	Tube Rubber Cushion to Torque Tube	15
Bolt	Support Cushion	29

REAR AXLE

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DESCRIPTION AND OPERATION

REAR AXLE DESCRIPTION

The Opel rear axle is a semi-floating type that carries car weight through the axle shafts by way of ball bearings which are located on the outer ends of each axle shaft. The rear axle assembly is attached to the under body by way of the shock absorbers, track rod, central joint support, and lower control arms. A stabilizer rod is used on all Wagons, as well as Fast Backs and Sedans. The GT is not equipped with a stabilizer rod. The rear springs have a progressive spring rate which is attained by a gradual reduction of coil thickness. The springs are arranged between the spring seats welded onto the rear axle tubes and the under body side members. The upper and lower ends are seated in profiled rubber dampening rings. The differential housing is a malleable iron casting with tubular axle housings pressed into the sides to form a complete assembly. An oil **feed** passage to the pinion bearings and an oil return hole are provided to allow lubricant to circulate. A removable steel cover is bolted on the rear of the differential housing to permit service of the differential without removing the rear axle assembly from the vehicle. A breather fitting is located on top of the right axle tube.

Within the differential carrier, the differential case is supported **by** two tapered roller side bearings. These side bearings are **preloaded** by shims located between the bearing inner races and differential case. During installation, varying the shim thickness from side to side also determines the ring gear to pinion backlash.

The differential case houses two side gears meshed with two pinions. The pinions and side gears are backed by thrust washers. The pinion gears are held in place by a pinion shaft which is anchored in the differential case by a lock pin.

The inner end of the axle shafts engage and extend through the **splines** of the side gears with a floating fit.

The axle shafts have an enlarged diameter from **mid**-shaft to the flange end.

A ball bearing and oil seal are used on all models, and are pressed onto the outer end of the axle shaft as an **assembly**.

The drive pinion is mounted in two roller bearings in the rear axle housing. Pinion setting is established by shims located between the differential carrier and the **rear pinion** bearing outer race.

DIAGNOSIS

DIFFERENTIAL TROUBLE DIAGNOSIS

Condition	Possible Cause
1. Noise is the same in "Drive" or "Coast".	1. a) Road noise. b) Tire noise. c) Front wheel bearing noise. d) Front or rear U-joint angle too great.
2. Noise changes on a different type of road.	2. a) Road noise. b) Tire noise.
3. Noise lowers tone as car speed is lowered.	3. Tire noise.
4. Similar noise is produced with car standing and driving.	4. a) Engine noise. b) Transmission noise. c) Driveline angle.
5. Vibration	5. a) Rough rear wheel bearing. b) Tire unbalance. c) Worn universal joint in propeller shaft. d) Front or rear U-joint angle too great. e) Mis-indexed, propeller shaft at companion flange. f) Companion flange runout too
6. A knock or click approximately every two (2) revolutions of rear wheel.	6. A brinelled rear wheel bearing
7. Noise most pronounced on turns.	7. Differential side gear and pin
8. A continuous low pitch whirring or scraping noise starting at relatively low speed.	8. Pinion bearing.
9. Drive noise, coast noise or float noise.	9. Ring and pinion gear.
10. Clunk on acceleration or deceleration.	10. a) Worn differential cross shaft in case.
11. Groan in "Forward" or "Reverse".	11. Wrong lube in differential.
12. Clunk or knock on rough road operation.	12. a) Excessive end play of axle to differential cross shaft b) Excessive differential gear clearance.

MAJOR REPAIR

REMOVAL AND INSTALLATION OF REAR AXLE ASSEMBLY

Removal

1. Raise rear of car with floor jack under differential carrier and position jack stand under jack bracket on each side of car. Remove rear wheel assemblies and one brake drum.
2. Disconnect parking brake cable equalizer and return spring from brake rod.
3. Detach parking brake cable from actuator lever and backing plate at wheel with brake drum removed. Disconnect cable from lower control arm brackets and pull loose end over exhaust system.
4. Disconnect shock absorbers at lower end.
5. Disconnect track rod at left end.
6. On cars equipped with a stabilizer rod, disconnect the shackles at rear axle housing.

7. Disconnect universal joint from pinion flange and support or tie propeller shaft out of way after marking mating areas. If propeller shaft is removed, install plug in rear of transmission to prevent loss of lubricant.

8. Disconnect brake hose from brake pipe at differential and remove retaining clip.

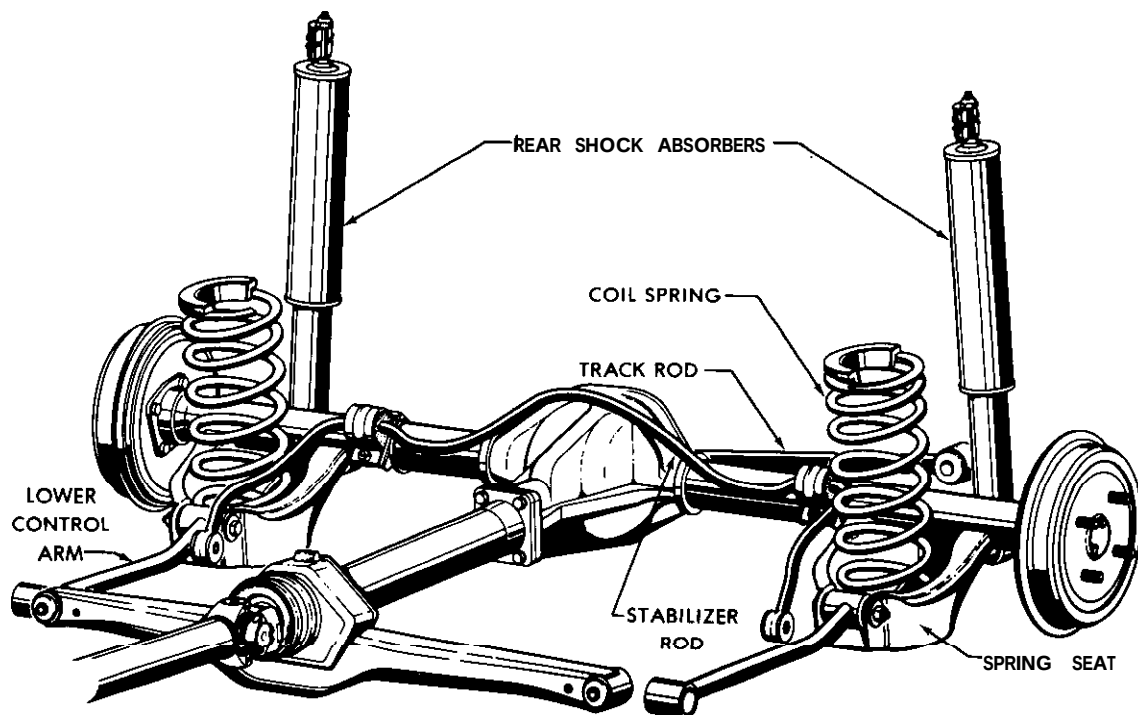
9. Lower rear axle assembly far enough to remove coil springs.

10. Remove central joint support bracket to underbody retaining bolts.

11. Disconnect lower control arms at rear axle assembly bracket and roll the assembly from under the car. See Figure 4B-2.

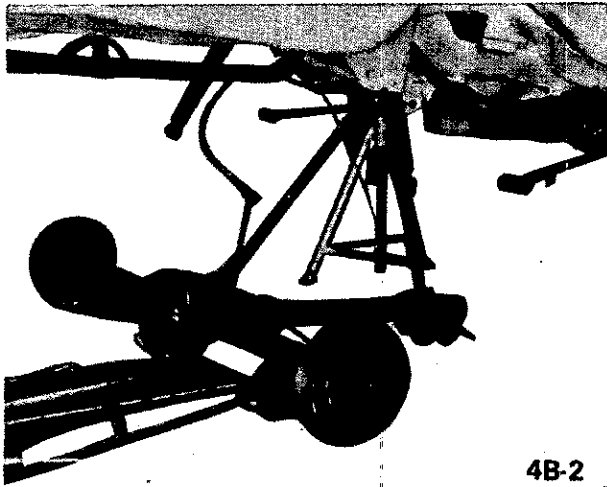
Installation

CAUTION: Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with



4B-1

Figure 4B-1 Differential and Rear Suspension Assembly



4B-2

Figure 4B-2 Removing Rear Axle Assembly

an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

1. Roll rear axle assembly under car on floor jack and loosely attach lower control arms to rear axle housing.
2. Attach central joint support, to underbody with bolts only finger tight.
3. Lower rear axle assembly, install lower damper rings in spring seats, coil springs and upper damper rings on springs. Make certain the damper rings and springs are properly positioned.
4. Install track rod on axle housing.
5. On Opel 1900 and Manta, place a load of approximately 350 lbs. in luggage compartment or on the GT, place a load of approximately 150 lbs. on drivers seat and raise rear axle far enough for underbody to clear jack stands.
6. Torque central joint support to underbody bolts to 36 lb.ft.
7. Torque lower control arm to axle housing bolts to 18 lb.ft. on the GT and 22 lb.ft. on the Opel 1900 and Manta.
8. Torque track rod to rear axle attaching nut to 40 lb.ft. on the GT and to 76 lb.ft. on the Opel 1900 and Manta and remove added weight.
9. Install shock absorbers and tighten nuts to 15 lb.ft. on the GT and to 47 lb.ft. on the Opel 1900 and Manta.

10. If car is equipped with stabilizer rod, connect shackles to axle housing. Tighten to 25 lb. ft.

11. Connect brake hose to brake pipe and install retaining clip.

12. Thread parking brake cable over exhaust system and connect to lower control arm brackets, parking brake actuating lever and brake backing plate. Install brake drum.

13. Align mating marks and connect propeller shaft to pinion flange. Tighten universal joint attaching bolts to 11 lb.ft. Bend respective lock plate tabs to secure nuts or bolts.

14. Connect parking brake cable equalizer and return spring to brake rod and adjust to specifications.

15. Bleed rear brake system and fill master cylinder.

16. Install wheel assemblies and tighten lug nuts to 65 lb.ft.

17. Remove jack stands and lower car to the floor.

REMOVAL AND INSTALLATION OF AXLE SHAFT ASSEMBLY

Removal

1. Raise and support rear of car at jack brackets.
2. Remove wheel and brake drum as necessary.
3. Unscrew rear axle shaft retaining plate and with axle shaft puller J-8805 coupled with slide hammer J- 2619 on axle shaft flange, remove axle shaft.
4. For replacement of the bearing parts, first remove retaining ring by cutting off with a chisel. See Figure 4B-3.
5. Press off bearing, using rear pinion bearing remover J-22912.

Installation

CAUTION: Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

1. Check radial runout of axle shaft at ball bearing

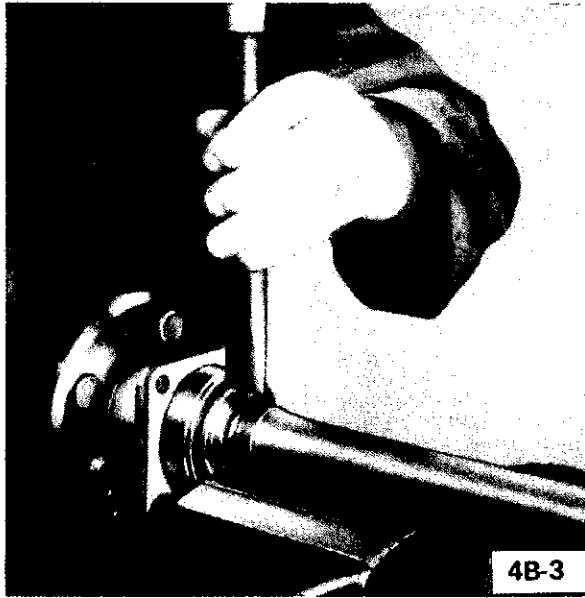


Figure 4B-3 Removing Axle Bearing Retaining Ring

seat and lateral runout of axle shaft flange near largest diameter.

Permissible radial runout is .002", and permissible "lateral runout is .004". An axle shaft which exceeds these tolerances, or one which has been otherwise damaged during removal, must be replaced.

2. Using installer ring J-21721-2, press on bearing so that oil seal groove on bearing faces shaft splines.

3. Using installer ring J-21721-2, press on retainer ring so that shoulder faces bearing.

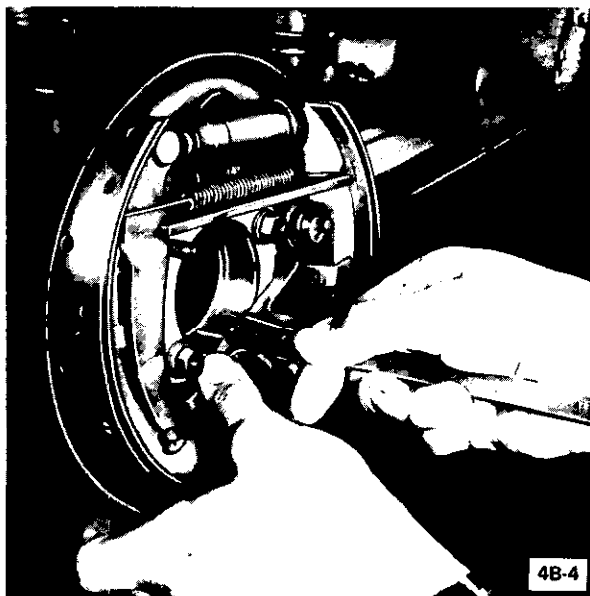


Figure 4B-4 Measuring for Axle Shaft Bearing Depth

4. Check axle shafts end play as follows:

a. Using a depth gauge, measure depth of rear axle bearing seat in axle housing (backing plate and gaskets in place). See Figure 4B-4.

b. Measure width of bearing outer race. The difference between the two measurements indicates the required thickness of the shims. The maximum permissible end play is .002". If necessary to reduce end play, add .004" shims behind bearing as necessary. A slight crush fit (up to .006") is desirable.

5. Coat rear axle shaft splines with hypoid gear lubricant prior to installation.

6. Insert axle shaft into housing; using a mallet, drive axle shaft completely into housing.

7. Install lock washers and nuts. Torque to 20 lb.ft.

8. Install brake drum and wheel assembly.

9. Remove supports and lower rear of car to floor.

DISASSEMBLY AND ASSEMBLY OF THE DIFFERENTIAL

Removal and installation of parts for service described in the following sub-paragraph can be performed with the rear axle assembly in the car. The car must be raised and adequately supported to permit access to the parts to be serviced.

Removal and Disassembly of Differential Case

1. With car suitably supported at rear jack bracket on each side, remove differential cover bolts and let lubricant drain into suitable container.

2. Disconnect left end of track rod and wire to left shock absorber.

3. Remove both rear wheels and brake drums.

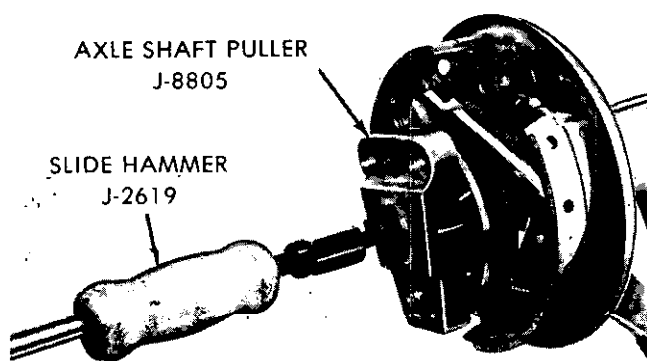
4. Working through access holes in axle shaft flange, remove four nuts and washers that retain the axle shaft dust shield and brake backing plate to the axle housing.

5. Unscrew rear axle shaft retaining plate.

6. Install axle shaft puller J-8805 coupled with slide hammer J-2619 on axle shaft flange to remove rear axle. In removing axle shaft, care should be exercised to avoid damage to the oil seal. See Figure 4B-5.

7. Remove differential cover and discard gasket.

8. Check and record ring gear backlash.



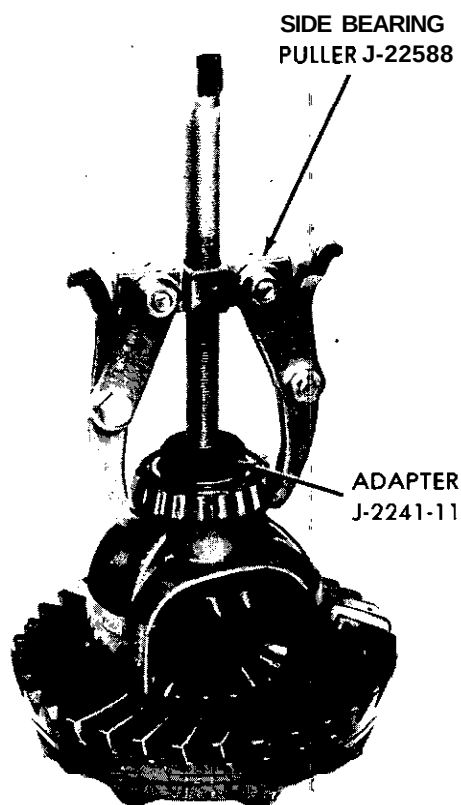
4B-5

Figure 4B-5 Removing Axle Shaft

9. Mark differential side bearing caps and carrier with a prick punch, so the caps can be reinstalled in their original positions.

10. Remove differential side bearing cap bolts and caps.

11. Using two wooden hammer handles, pry differential case assembly from carrier. Do not drop or interchange differential side bearing outer races.



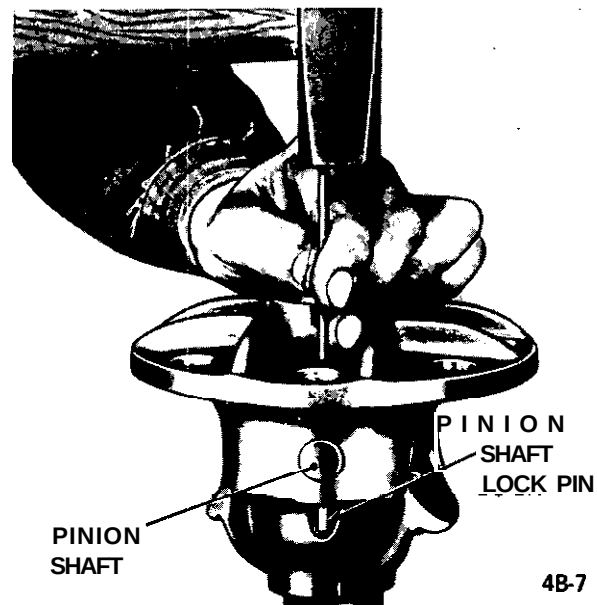
4B-6

Figure 4B-6 Removing Differential Side Bearings

12. Insert adapter J-2241-1 1 in differential case bearing hub and remove side bearings using puller J-22588 with adapter leg J-22939. See Figure 4B-6.

13. Remove the differential case to ring gear bolts and tap ring gear off case using a soft faced hammer.

14. Remove the differential pinion shaft retaining pin using a 1/8" pin punch. See Figure 4B-7. Remove pinion shaft, pinion gears, differential side gears and thrust washers.

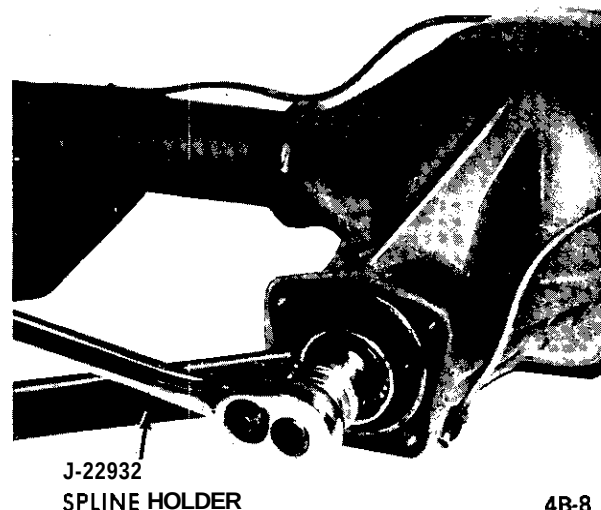


4B-7

Figure 4B-7 Removing Pinion Shaft Lock Pin

Removal and Disassembly of Drive Pinion

1. Remove torque tube assembly.



4B-8

Figure 4B-8 Removing Pinion Preload Nut

2. Using Special Tool J-22932 hold barrel spline and remove pinion preload nut. See Figure 4B-8.

3. With the aid of Special Tool J-22937 remove barrel spline from drive pinion. See Figure 4B-9.



Figure 4B-9 Removing Barrel Spline Sleeve

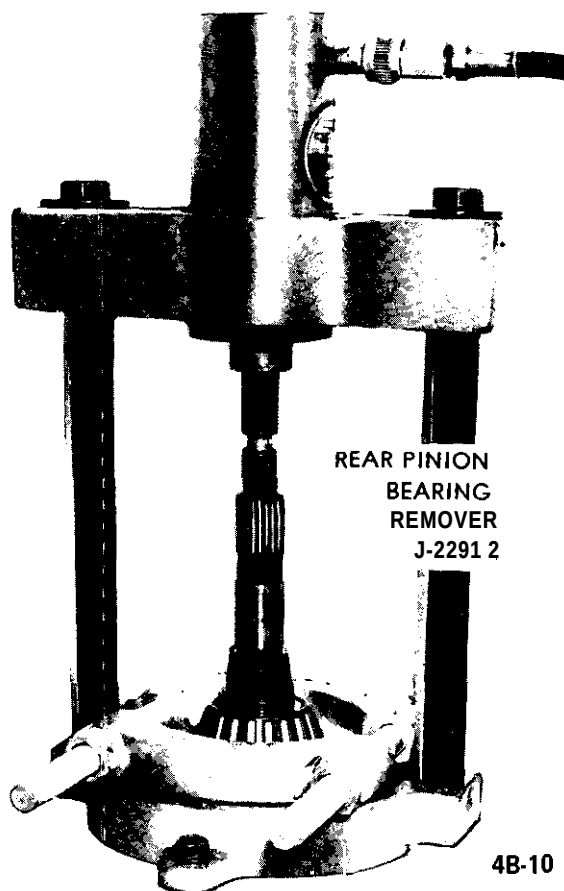


Figure 4B-10 Removing Rear Pinion Bearing

4. Remove drive pinion by tapping rearward with a soft faced hammer.

5. Remove rear pinion bearing using Special Tool J-22912. See Figure 4B-10.

6. Remove pinion bearing outer races using a brass drift.

Assembly and Installation of Drive Pinion

Prior to assembly or installation, all parts should be clean and inspected for imperfections.

1. Install front pinion bearing outer race using installer J-861 1-01 and driver handle J-8092. See Figure 4B-11.

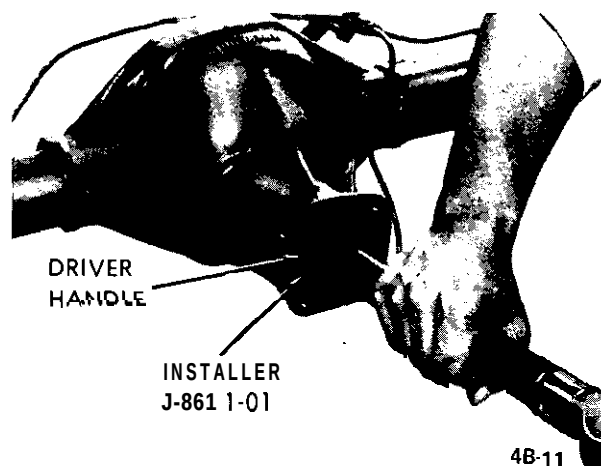


Figure 4B-11 Installing Front Pinion Bearing Outer Race

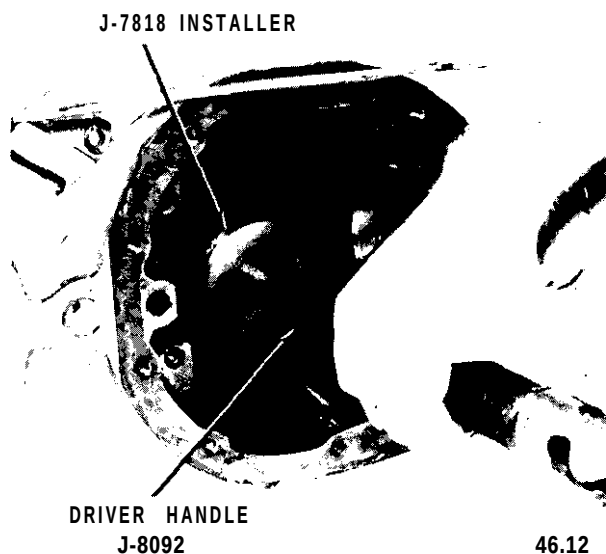
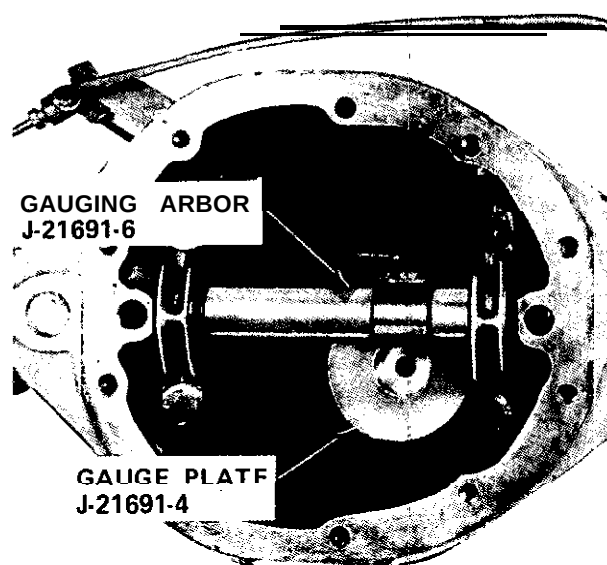


Figure 4B-12 Installing Rear Pinion Bearing Outer Race

2. Install rear pinion bearing outer race (without shims) using installer J-7818 and driver handle J-8092. See Figure 4B-12.

3. To determine the correct pinion depth setting use the following procedures:

a. Assemble gauge plate J-21691-4, rear pinion bearing (lubricated), stud J-21691-7, front pinion bearing (lubricated), pilot washer J-21691-5 and nut into differential carrier. See Figure 4B-13.



4B-13

Figure 4B-13 Pinion Depth Gauging Tools Installed

b. Alternately tighten and rotate until a torque of 7-12 lb.in. (9 lb.in. desired) new bearings or 5-7 lb.in. (6 lb.in. desired) with used bearings is required to rotate the gauge plate assembly.

c. Position gauging arbor J-21691-6 in side bearing bores of the carrier, install side bearing caps in their respective positions and torque the bearing cap bolts to 33 lb.ft. See Figure 4B-13.

d. Position adjustable height block J-21691-3 firmly against the face of gauge plate J-21691-4. Allow the movable plunger to bear against the machined surface of gauging arbor J-21691-6 and tighten the plunger set screw. See Figure 4B-14.

e. Remove the adjustable height block and use a 1" to 2" micrometer to measure the distance from the bottom of the height block to the top of the extended plunger. See Figure 4B-15.

f. Select the correct pinion depth shim thickness as follows:

(1) Record the height block dimension as determined in step (e).

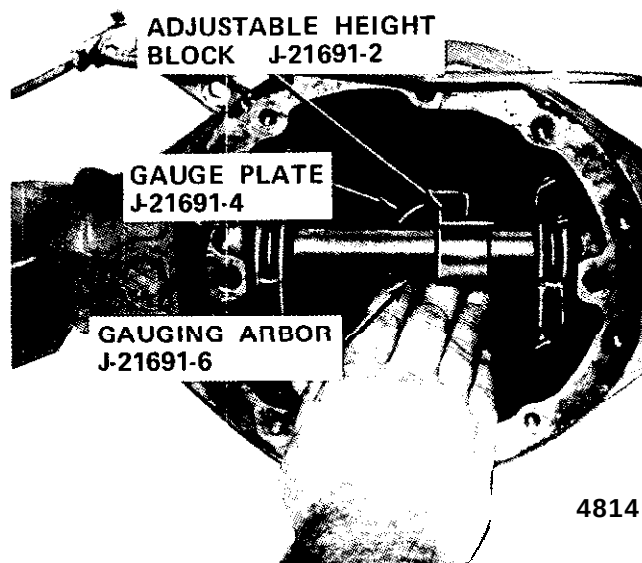


Figure 4B-14 Gauging Pinion Depth

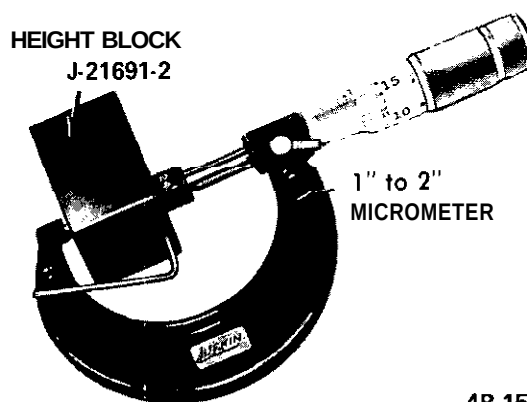


Figure 4B-15 Measuring Adjustable Height Block

(2) The control figure (on face of pinion) is shown in Figure 4B-16.

If the CONTROL FIGURE (underlined) is plus, convert the figure from millimeters to inches and subtract from Step (1). If the CONTROL FIGURE (underlined) is minus, convert the figure from millimeters to inches and add to Step (1).

(3) Record the result from Steps (1) and (2).

(4) Subtract from Step (3) the nominal figure 1.468.

(5) The difference between Steps (3) and (4) is thickness of shims required to set the pinion,

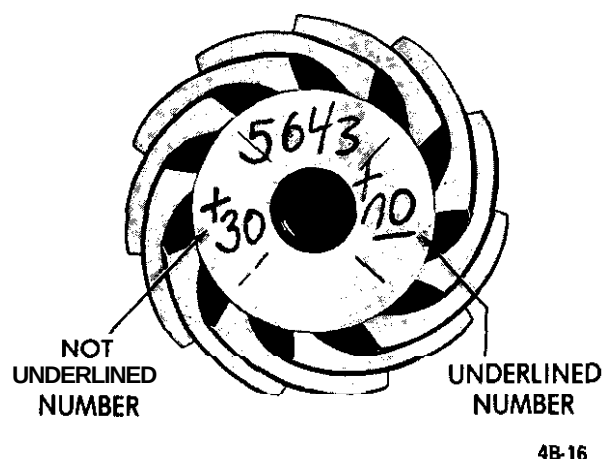


Figure 4B-16 • Pinion Gear Reference Number

NOTE: The digit "1", when written in German, resembles the digit "7". However, the digit "7: when written in German, always has a horizontal line drawn through it ("7").

4B-17

An example of how the above procedure should be applied to calculate pinion depth using markings on pinion is as follows:

1. Height block dimension ± 1.4840 .
2. Control figure (plus 10) converted to $\pm .0039$.
3. Difference between steps 1 and 2 ± 1.4801 .
4. Nominal figure ± 1.4680 .
5. Shim thickness required $\pm .0121$.
6. Shim to closest thickness $\pm .012$.
4. Remove differential side bearing caps, gauging arbor, gauge plate and pinion bearings.
5. Remove the rear pinion bearing outer race using a brass drift.
6. Install pinion depth shims selected in Step (f) in the rear pinion bearing outer race bore and install the rear pinion bearing outer race using installer J-781 18 and driver handle J-8092. See Figure 4B-18.

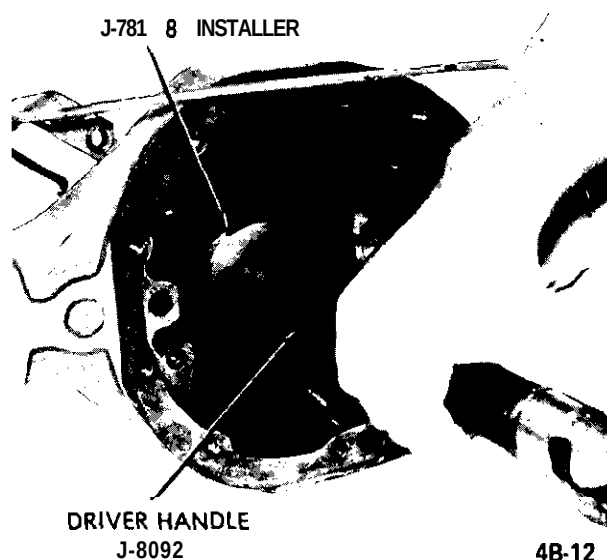


Figure 4B-18 Installing Rear Pinion Bearing Outer Race

I. Install rear pinion bearing onto the pinion using installer J-21022. See Figure 4B-19.

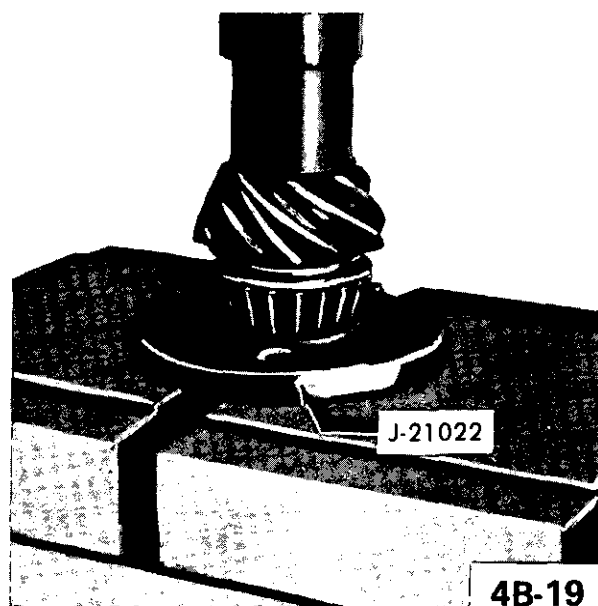
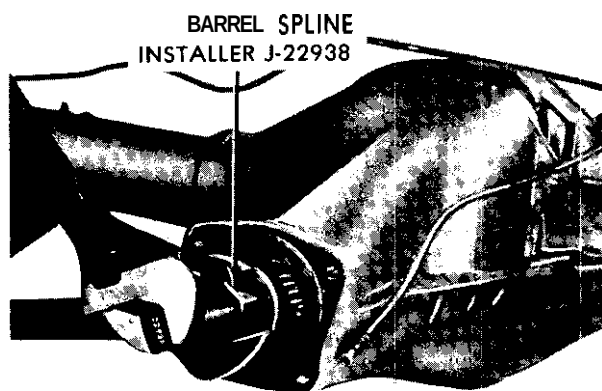


Figure 4B-19 Installing Rear Pinion Bearing

8. Lubricate pinion bearings and assemble the drive pinion, collapsible spacer, front pinion bearing, oil deflector plate and barrel spline sleeve in the differential carrier.

9. Thread barrel spline sleeve installer J-22938 onto the drive pinion and draw the spline sleeve onto the pinion until there are **sufficient** threads of the pinion

protruding to install the pinion preload nut. Do not use Installer J-22938 to adjust pinion preload. See Figure 4B-20.



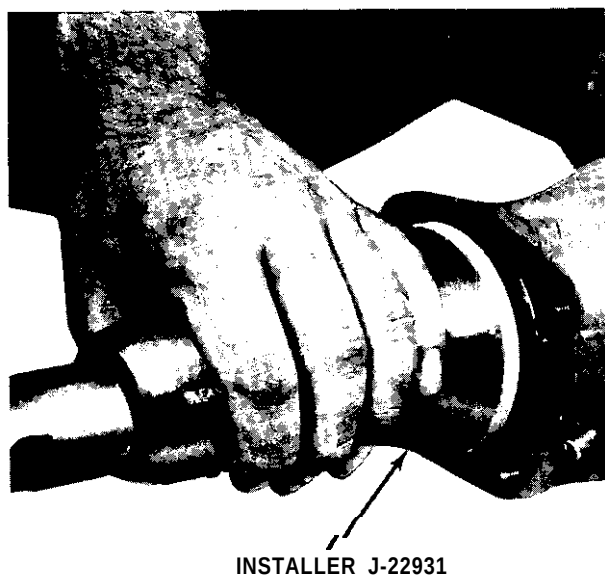
4B-20

Figure 4B-20 Installing Barrel Spline Sleeve

When the drive pinion end play is eliminated, the preload specification is being approached. If this specification is exceeded, replace the collapsible spacer.

10. Remove installer J-22938 and install washer and pinion preload nut. Using Special Tool J-22932, hold barrel spline and tighten preload nut until a preload of 6-13 lb.in. (9 lb.in. desired) with new bearings or 5-8 lb.in. (6 lb.in. desired) with used bearings is required to rotate the drive pinion.

11. Use J-2293 1 to install a new pinion oil seal that has been soaked in differential lubricant. See Figure 4B-21.

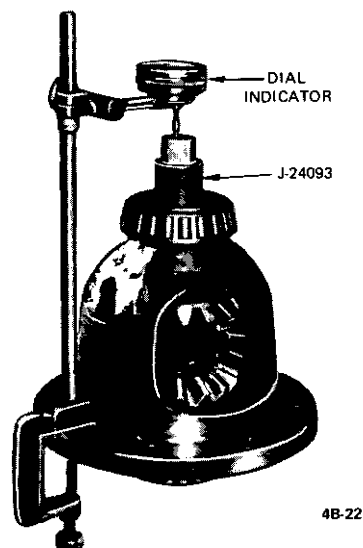


4B-21

Figure 4B-21 Installing Pinion Oil Seal

Assembly and Installation of Differential Case. Opel 1900 and Manta

1. Install side gears without thrust washers or shims.
2. Lubricate and install pinion gears and thrust washers between the side gears 180 degrees apart and rotate the gears as an assembly until the pinion gear bores are aligned with the pinion shaft bores in the case.
3. Install pinion shaft.
4. Install Special Tool J-24093 and, with the use of a dial indicator, check end play clearance between side gear and case as follows:
 - a. Zero dial indicator on end of Tool J-24093. See Figure 4B-22.



4B-22

Figure 4B-22 Zeroing Dial Indicator

- b. Using both hands, raise side gear until it bottoms against case and record dial indicator reading. See Figure 4B-23.
 - c. Measure the thickness of the concave thrust washer by using a 0" to 1" micrometer and subtract this dimension from the dial indicator reading as obtained in step b. Record dimension. See Figure 4B-24.
 - d. After obtaining a dimension by subtracting concave thrust washer thickness from dial indicator reading, subtract an additional .002 to obtain the correct shim thickness to be installed.

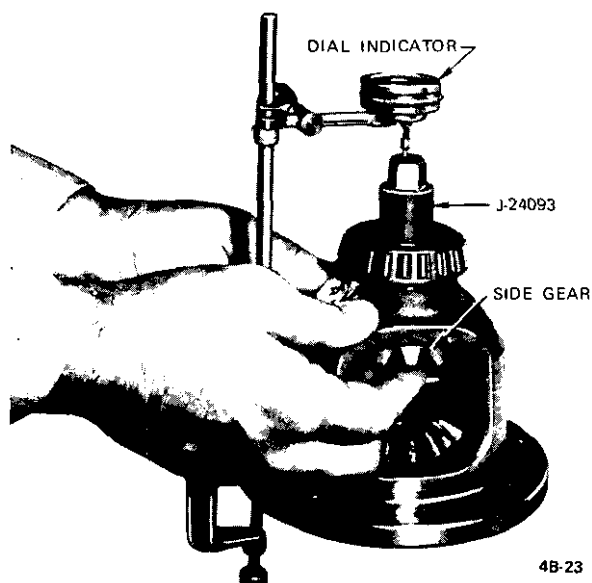


Figure 4B-23 Raising Side Gear Against Case

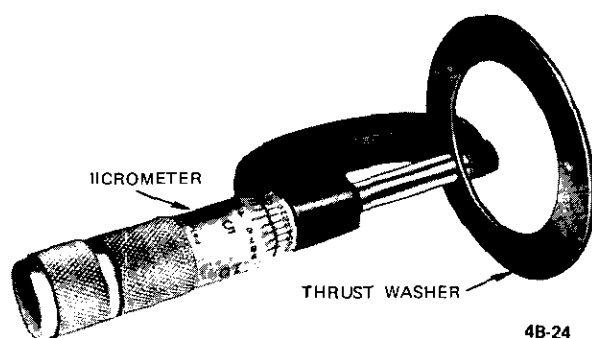


Figure 4B-24 Measuring Concave Washer Thickness

EXAMPLE:

1. Dial indicator reading $\pm .095$.
2. Subtract concave thrust washer thickness $\pm .050$.
3. Total $\pm .045$.
4. Subtract an additional $.002 \pm .002$.
5. Shim thickness to be used $\pm .043$.

5. Turn case over and repeat the above procedure to check other side gear to differential case clearance.

6. Before installing, shims must be measured to insure that the proper thickness is being used. Install shims of correct thickness to obtain desired clearance and reassemble and install pinion shaft lock pin. Install thrust washers with concave side towards differential case.

7. Using Special Tool J-24093, along with a foot-pound torque wrench, check torque to turn gears using the following procedure:

a. Install axle shaft into a vise and position differential case onto axle shaft. See Figure 4B-25.

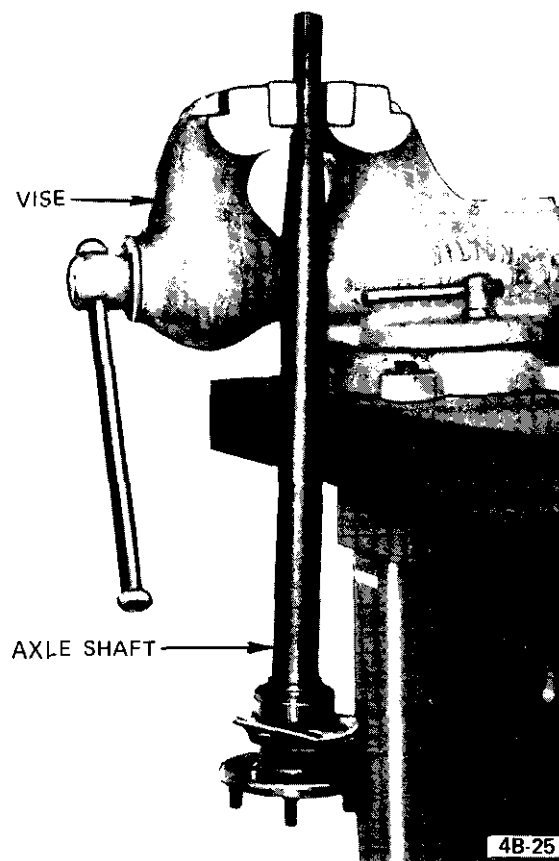


Figure 4B-25 Axle Shaft Installed in Vise

b. Insert Special Tool J-24093 into opposite side gear, attach a torque wrench, and check torque to rotate gear. See Figure 4B-26. Permissible torque to turn gears is $14 \frac{1}{2}$ to $17 \frac{1}{2}$ footpounds.

c. It is necessary to **check** rotating torque of both side gears.

8. If torque is not correct, it will be necessary to reshim differential gears. Add first at one side one shim of the next higher or lower thickness. If this is not enough, reshim both sides completely.

9. Install ring gear on case making certain their mat-

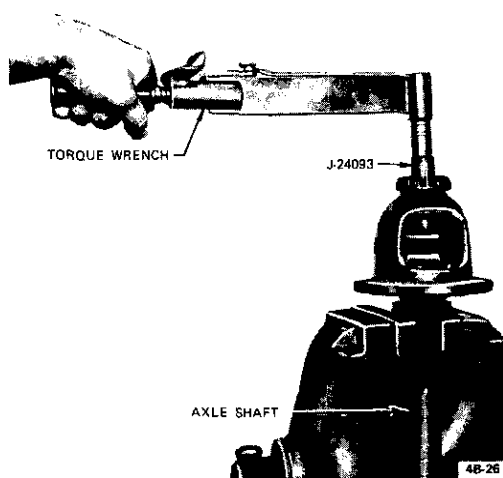


Figure 4B-26 Checking Torque to Rotate Gear

in; surfaces are free of burrs or foreign material. Tighten bolts to 47 lb.ft.

10. Check lateral runout of installed ring gear. Maximum permissible runout is .003". If runout is greater than specified, make certain that dirt or burrs are not holding the ring gear in a cocked position on the case and that the bolts are evenly torqued.

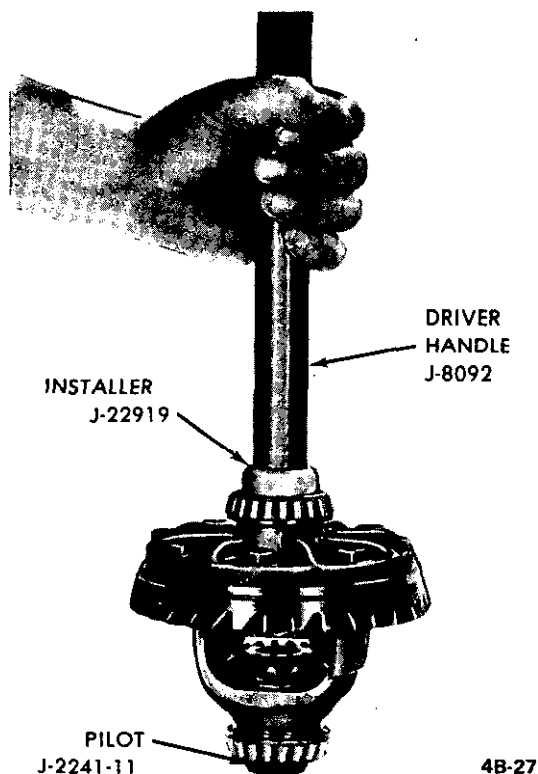


Figure 4B-27 Installing Differential Side Bearings

11. Install side bearings using installer J-22919 and drive handle J-8092. Support opposite side of case on pilot J-2241-11 to prevent bearing damage. See Figure 4B-27.

12. Determine differential side bearing preload and backlash as follows:

a. Position differential case assembly less side bearing shims into the side bearing bores of the carrier. See Figure 4B-28.



Figure 4B-28 Installing Differential Case Assembly

b. Using two sets of feeler gauges, insert feeler stock of sufficient thickness between each bearing outer race and the carrier to remove all end play. Make certain the feeler stock is pushed to the bottom of the bearing bores. See Figure 4B-29.

c. Mount dial indicator J-8001 on carrier so indicator stem is at right angles to a tooth on the ring gear. See Figure 4B-29.

d. Adjust feeler gauge thickness from side to side until ring gear backlash is .004" to .008" (.005" is desired).

e. With zero end play and correct backlash established, remove feeler gauge packs, determine thickness of shims required and add .002" to each shim pack to provide side bearing preload.

f. Remove case assembly and both side bearings using J-22588 with adapter leg J-22939 and pilot J-2241-11.

g. Install shim packs with respective side bearing

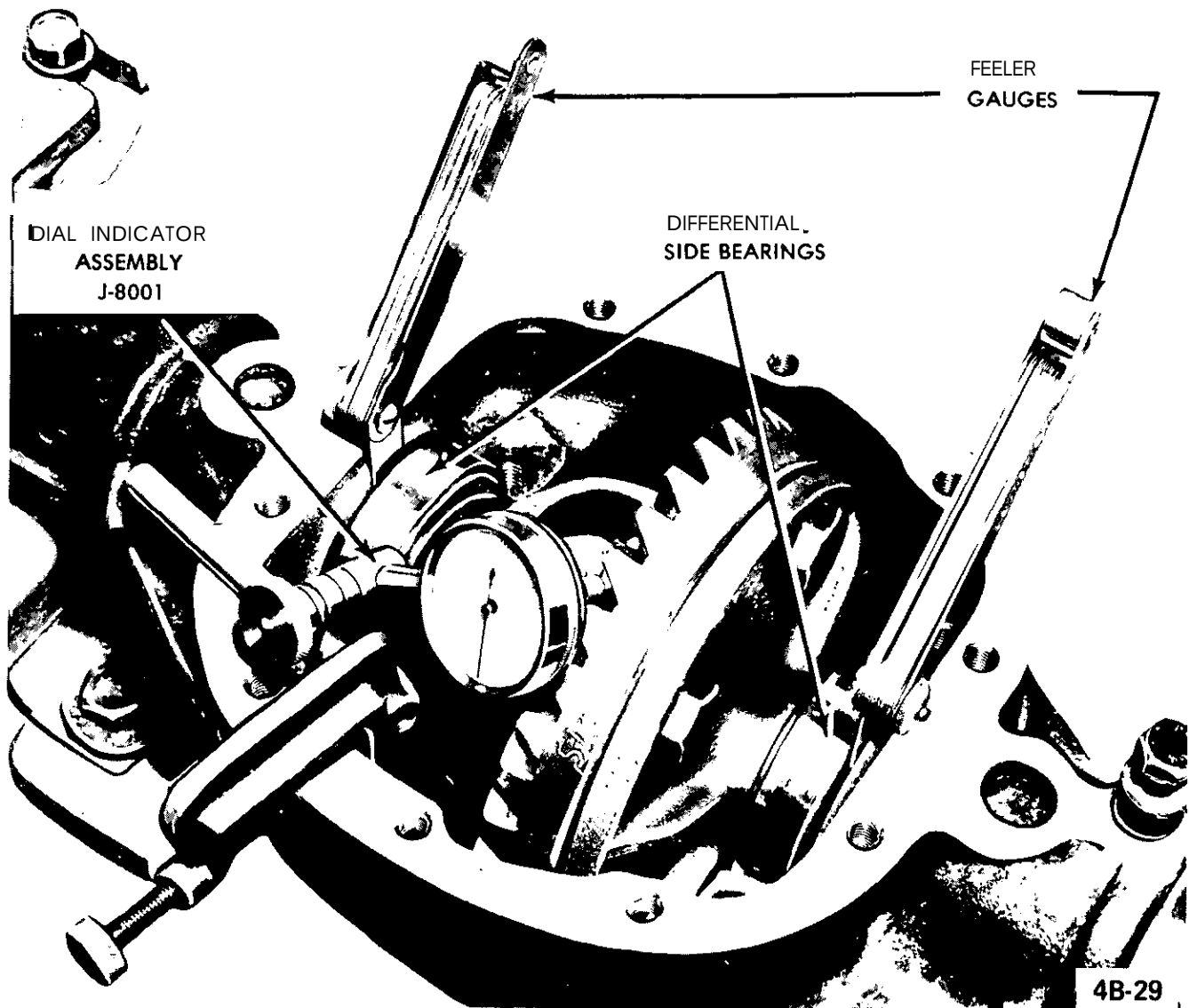


Figure 4B-29 Removing Differential Case and End Play

using installer J-22919, driver handle J-8092 and pilot J-2241-11.

13. Position case assembly and outer races in the carrier. Use a soft faced hammer to drive the case into the carrier until the side bearing outer races bottom in their bores.

14. Install side bearing caps in their original location and torque the bolts to 33 lb.ft.

15. Rotate case assembly several times to seat the bearings. Check backlash and preload using a torque wrench on a ring gear attaching bolt. See Figure 4B-68. Torque required to turn case should be 20 to 30 lb.in. for new bearings or 10 to 20 lb.in. for used bearings. If torque is not correct, it will be necessary to reshim the side bearings.

16. Install torque tube assembly.

17. Install axle shafts.

Assembly and Installation of Differential Case - GT

1. Lubricate the thrust washers, side and pinion gears and install the side gears with respective thrust washers in the differential case.

2. Install the pinion gears and thrust washers between the side gears 180 degrees apart and rotate the gears as an assembly until the pinion gear bores are aligned with pinion shaft bores in the case.

3. Install pinion shaft so that the lock pin hole in the shaft aligns with the lock pin hole in the case.

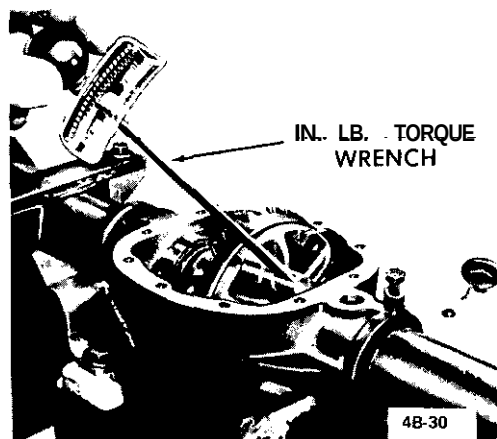


Figure 4B-30 Checking Side Bearing Preload

4. With the use of a feeler gauge, check clearance between differential side gears and case. See Figure 4B-31. Clearance should be .003" to .006". If clearance is not within these limits, remove side gears and install shims of correct thickness to obtain desired clearance, reassemble and install pinion shaft lock pin.



Figure 4B-31 Checking Side Gear to Case Clearance

5. Install ring gear on case, making certain their mating surfaces are free of burrs or foreign material. Tighten bolts to 47 lb.ft.

6. Check lateral runout of installed ring gear. Max-

imum permissible runout is .003". If runout is greater than specified, make certain that dirt or burrs are not holding the ring gear in a cocked position on the case and that the bolts are evenly torqued.

7. Install side bearings using Installer J-22919 and Drive Handle J-8092. Support opposite side of case on Pilot J-2241-1 to prevent bearing damage. See Figure 4B-32.

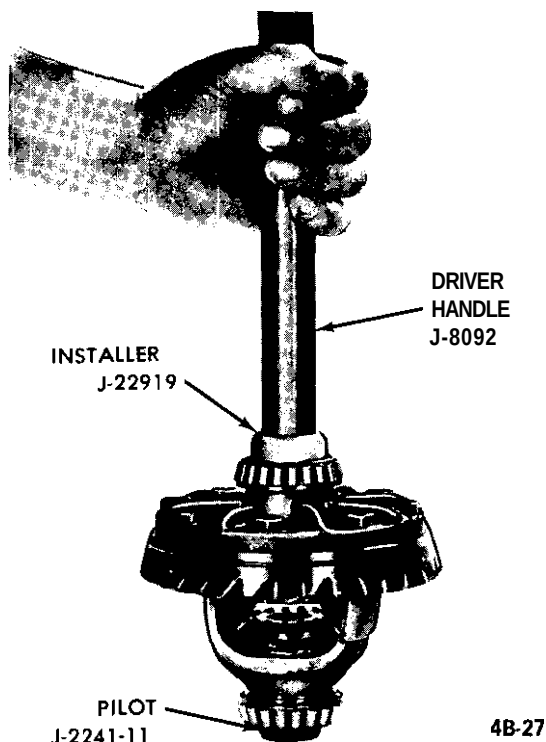


Figure 4B-32 Installing Differential Side Bearings



Figure 4B-33 Installing Differential Case Assembly

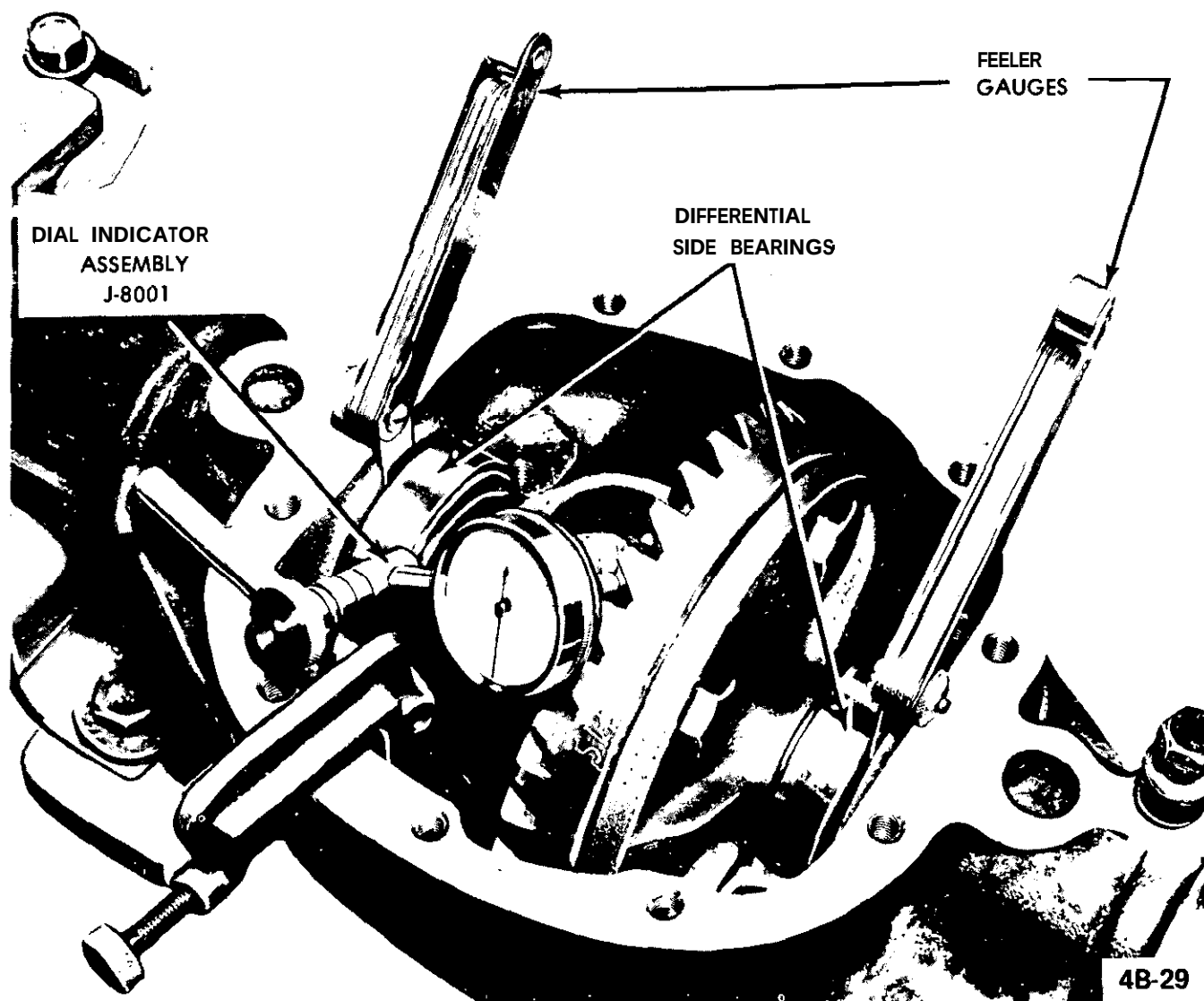


Figure 4B-34 Removing Differential Case and End Play

8. Determine differential side bearing preload and backlash as follows:

a. Position differential case assembly less side bearing shims into the side bearing bores of the carrier. See Figure 4B-33.

b. Using two (2) sets of feeler gauges, insert feeler stock of sufficient thickness between each bearing outer race and the carrier to remove all end play. Make certain the feeler stock is pushed to the bottom of the bearing bores. See Figure 4B-34.

c. Mount Dial INDICATOR J-8001 on carrier so indicator stem is at right angles to a tooth on the ring gear. See Figure 4B-34.

d. Adjust feeler gauge thickness from side to side until ring gear backlash is .004" to .008" (.005" is desired).

e. With zero end play and correct backlash established, remove feeler gauge packs, determine thickness of shims required and add .002" to each shim pack to provide side bearing preload.

f. Remove case assembly and both side bearings using J-22588 with Adapter Leg J-22939 and Pilot J-2241-11.

g. Install shim packs with respective side bearing using Installer J-22919, Driver Handle J-8092 and Pilot J-2241-1 1.

9. Position **case** assembly and outer races in the carrier. Use a soft-faced hammer to drive the case into the carrier until the side bearing outer races bottom in **their** bores.

10. Install side bearing caps in their original location and torque the bolts to 33 **lb.ft.**

11. Rotate case assembly several times to seat the bearings. Check backlash and preload using a torque wrench on a ring gear attaching bolt. See Figure 4B-35. Torque required to turn case should be 20 to 30 **lb.in.** for new bearings or 10 to 20 **lb.in.** for used bearings. If torque is not correct, it will be necessary to r&him the side bearings.

12. **Install** torque tube assembly.

13. Install axle shafts.

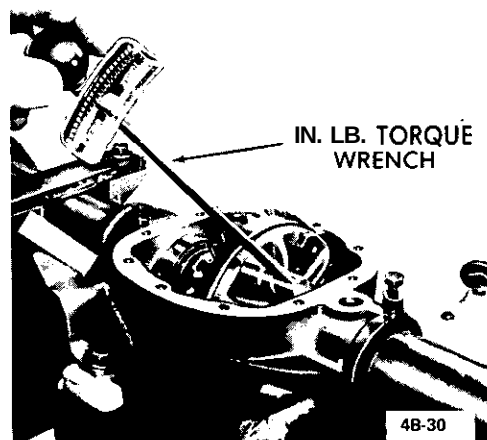


Figure 4B-35 Checking Side Bearing Preload

SPECIFICATIONS

DIFFERENTIAL SPECIFICATIONS

General Specifications

Rear Axle Type Semi-Floating Hypoid
 Rear Axle Oil Capacity 2 1/2 Pt.
 Ring and Pinion Gear Set Type Hypoid

Axle Ratios

Model	Engine	Transmission		Axle Ratio	
		4-Speed Manual	3-Speed Automatic	4-Speed	Automatic
51	Std.	Std.	Opt.	3.44	3.44
53	Std.	Std.	Opt.	3.44	3.44
54	Std.	Std.	Opt.	3.44	3.44
57	Std.	Std.	Opt.	3.44	3.44
57L	Std.	Std.	Opt.	3.44	3.44
57R	Std.	Std.	Opt.	3.67	3.44
77	Std.	Std.	Opt.	3.44	3.44

Adjusting end Fitting Specifications

Pinion Bearing Preload With New Bearings 7-13 **Lb.In.**
 Preload With Reused Bearings 5-8 **Lb.In.**
 Pinion Depth Setting .002" to -.001" from pinion marking using following selective shims:

Thickness In.	Number of Notches in Circumference Flattened on One Side
.0097	
.0098	0
.0108	1
.0118	2
.0128	3
.0138	4
.0148	5

Clearance Between Differential Side Gears and Case Max. .000" on the Opel 1900 and Manta and .006" on the GT using the following selective shims:

Thickness In.	Number of Notches in Circumference
1900	
.039	0
.041	1
.043	1
.045	3
.047	2
.049	5
.051	3
.053	7
.055	8
GT	
.0394	0
.0433	1
.0473	2
.0512	3

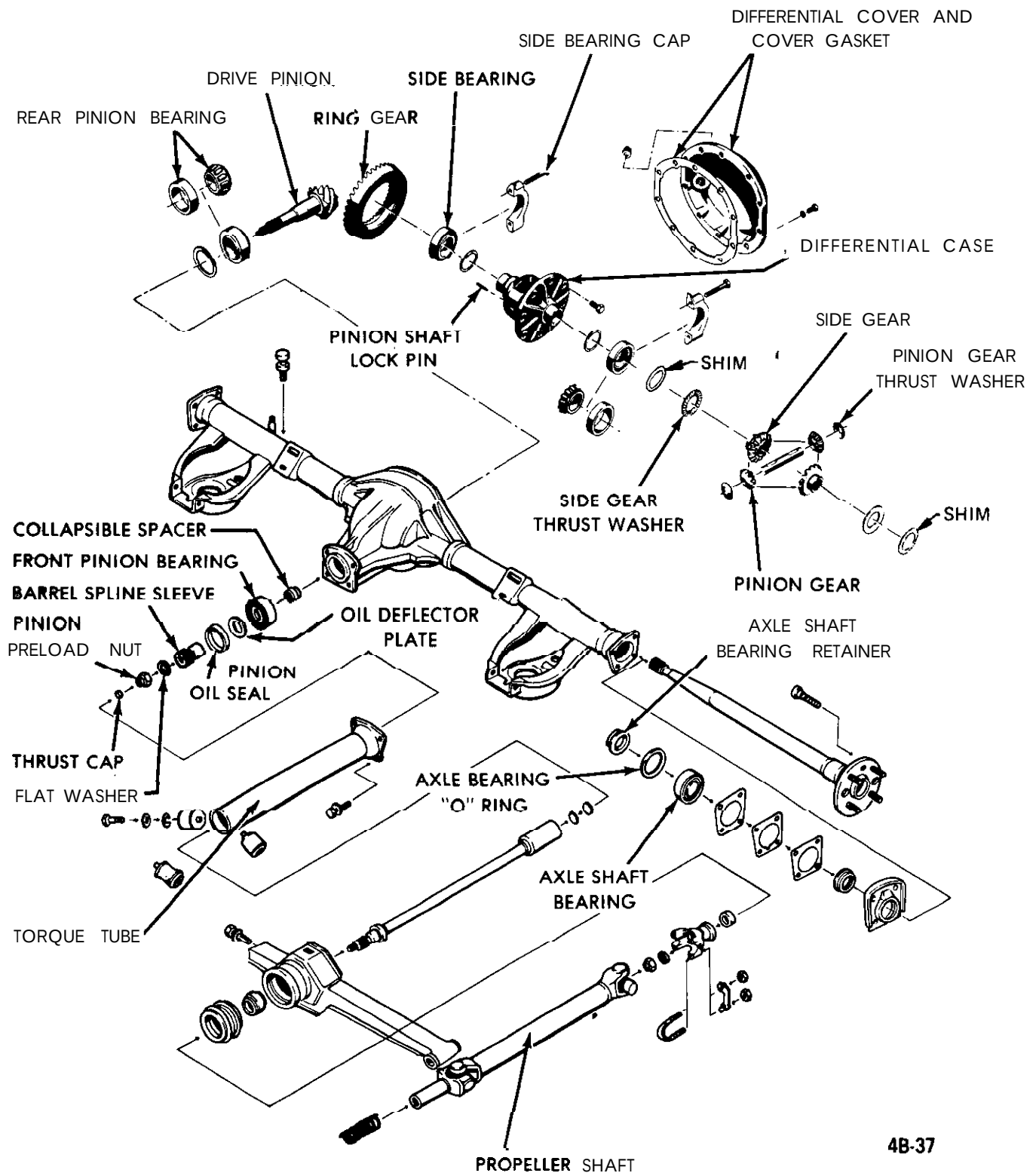
Max. Permissible Axle Shaft Bearing Seat Radial Runout002"
 Max. Permissible Rear Axle Shaft Flange Lateral Runout . . .004" at Largest Flange Dia.
 Max. Permissible Lateral Ring Gear R&out ".003"
 Ring Gear and Drive Pinion Backlash004"-.008"
 Differential Side Bearing Preload New, Bearings - 20-30 **Lb.In.**; Used Bearings - 10-20 **Lb.In.**, using following selective shims:

Thickness In.	Number of Notches in Circumference
.0059	0
.0069	1
.0079	2
.0089	3
.0098	4
.0108	5
.0197	8
.0433	7

Torque Specifications

Use a reliable torque wrench. Specifications are for clean and lightly-oiled threads.

Part	Location	Torque Lb.Ft.	
		1.9	
Nut and Bolt	Propshaft to Drive Pinion Shaft Extension Flange	11	
Nut	Flange to Drive Shaft Extension	87	
Bolt	Ring Gear to Case	47	
Bolt	Side Bearing Cap to Carrier	33	
Bolt	Differential Housing Cover	22	
Nut	Track Rod Attaching (GT)	40	
Nut and Bolt	Stabilizer Rod to Rear Axle Shackle	25	
Bolt	Stabilizer Rod to Body	15	
Nut	Track Rod to Rear Axle (Opal 1900 & Manta)	76	
Nut	Track Rod to Side Member (Opel 1900 & Manta)	22	
10 MM Bolt Nut			36
8 MM Bolt Nut			15
6 MM Bolt Nut			5

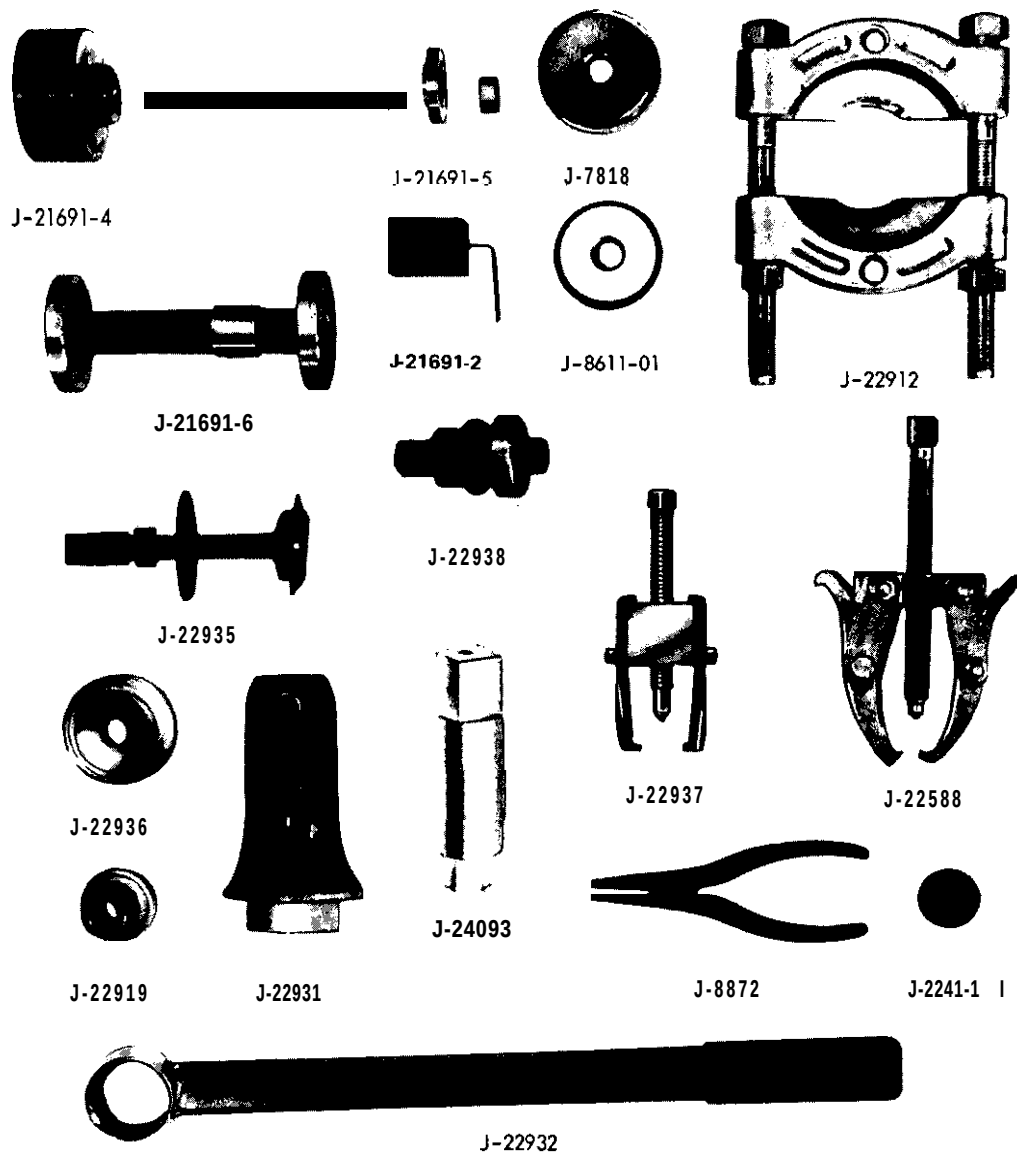


4B-37

Figure 4B-37 Exploded View Rear Axle Assembly

MM Inches	MM Inches	MM Inches	MM Inches	MM Inches	MM Inches
.01 .0004	.23 .0091	.44 .0173	.65 .0256	.87 .0343	9 .3543
.02 .0008	.24 .0095	.45 .0177	.66 .0260	.88 .0347	10 .3937
.03 .0012	.25 .0098	.46 .0181	.67 .0264	.89 .0350	11 .4331
.04 .0016	.26 .0102	.47 .0185	.68 .0268	.90 .0354	
.05 .0020	.27 .0106	.48 .0186	.69 .0272	.91 .0358	12 .4724
.06 .0024	.28 .0110	.49 .0193	.70 .0276		13 .5118
.07 .0028	.29 .0114	.50 .0197	.71 .0280	.92 .0362	14 .5512
.08 .0032	.30 .0118	.51 .0201		.72 .0284	.93 .0366
.09 .0035	.31 .0122 .32 .0126		.52 .0205	.73 .0287	.94 .0370
.10 .0039		.53 .0209	.74 .0291	.95 .0374	17 .6693
.11 .0043	.33 .0130	.54 .0213	.75 .0295	.96 .0378	18 .7087
			.76 .0299	.97 .0382	19 .7480
.12 .0047	.34 .0134	.55 .0217		.77 .0303	.98 .0386
.13 .0051	.35 .0138	.56 .0221	.78 .0307	.99 .0390	21 .8268
.14 .0055	.36 .0142	.57 .0224	.79 .0311	1.00 .0394	
.15 .0059	.37 .0146	.58 .0228	.80 .0315	1 .0394	22 .8661
.16 .0063	.38 .0150	.59 .0232	.81 .0320		2 .0787
.17 .0067	.39 .0154	.60 .0236		.82 .0323	3 .1181
.18 .0071	.40 .0158	.61 .0240	.83 .0327	4 .1575	25 .9843
.19 .0075			.84 .0331	5 .1969	26 1.0236
.20 .0079	.41 .0161	.62 .0244	.85 .0335	6 .2362	27 1.0630
.21 .0083			.42 .0165	.63 .0246	.86 .0339
	.22 .0087	.43 .0169	.64 .0252	8 .3150	29 1.1417
* (one MM = .0394"; one inch = 25.4 MM)					30 1.1811
					4B-38

Figure 4B-38 Conversion Table - Millimeter to Inch Equivalent



J-21691-2	ADJUSTABLE HEIGHT BLOCK	J-22937	BARREL SPLINE SLEEVE REMOVER
J-21691-4	GAUGE PLATE	J-22588	SIDE BEARING REMOVER
J-21691-5	PILOT WASHER	J-22936	AXLE SHAFT BEARING AND SEAL INSTALLER
J-21691-6	GAUGING ARBOR	J-22919	SIDE BEARING INSTALLER
J-7818	REAR PINION BEARING OUTER RACE INSTALLER	J-22931	PINION OIL SEAL INSTALLER
J-8611-01	FRONT PINION BEARING OUTER RACE INSTALLER	J-21022	PINION BEARING INSTALLER (NOT ILLUSTRATED)
J-22912	PINION BEARING REMOVER	J-8872	AXLE SHAFT RETAINER RING REMOVER AND INSTALLER
J-22938	BARREL SPLINE SLEEVE INSTALLER	J-2241-11	SIDE BEARING HUB PILOT
J-22935	AXLE SHAFT BEARING AND SEAL REMOVER	J-22932	BARREL SPLINE SLEEVE HOLDER
J-24093	DIFFERENTIAL SIDE GEAR LASH ADJUSTER		

Figure 4B-39 Differential Special Tools

