DRIVE AXLE

1994 Volvo 960

1994 DRIVE AXLES
Volvo Differentials & Axle Shafts

960

DESCRIPTION & OPERATION

All 960 station wagon models use type 1041 rear axle assembly. All 960 4-door models use type 1045 multi-link axle assembly.

An automatic differential lock system is available on 1041 and 1045 axle assemblies. See Fig. 1. The differential locking mechanism is controlled by a centrifugal governor. After it has engaged and automatically locked the differential, driving force is transferred to wheel with the most traction.

The device operates automatically when one of the drive wheels is spinning and vehicle speed is less than 25 MPH. Under normal conditions, the unit functions as a conventional differential, even at low speeds.

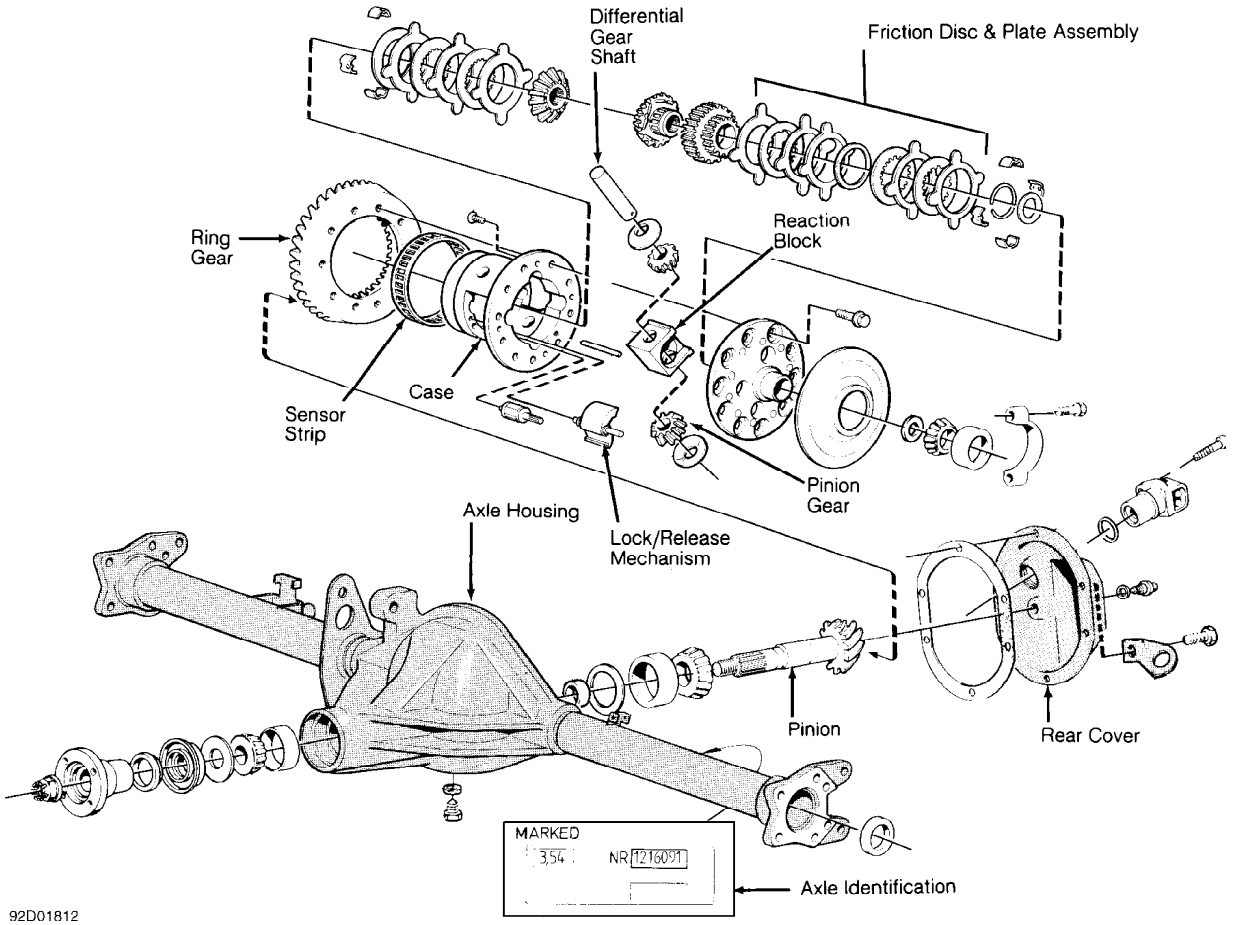


Fig. 1: Automatic Differential Lock ID (Type 1041 Axle Shown)
Courtesy of Volvo Cars of North America

AXLE IDENTIFICATION

AXLE IDENTIFICATION TABLE

Application	Axle Type
960	(1) 1041 & 1045

(1) - Information on 1041 conventional axle and 1045 multi-link axle is not available from manufacturer. However, differential information on these axles equipped with automatic differential lock is available. See DIFFERENTIAL ASSEMBLY under OVERHAUL.

AXLE RATIO

Several different ratios are used. Plate attached to left or right rear side of final drive housing gives axle ratio, part number, and serial number. Divide number of ring gear teeth by number of drive pinion gear teeth to determine axle ratio.

LUBRICATION

CAPACITY & FLUID TYPE

DIFFERENTIAL CAPACITY & FLUID TYPE TABLE (1)

Application	Quantity
1041	1.7 Qts. (1.6L)
1045	1.5 Qts. (1.4L)

(1) - Fluid type SAE 80-90W/API GL-5

TROUBLE SHOOTING

Refer to TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

REMOVAL & INSTALLATION

NOTE: Removal and installation information for 1041 and 1045 axle is not available from manufacturer. However, differential information on these axles (equipped with automatic differential lock) is available. See DIFFERENTIAL ASSEMBLY under OVERHAUL.

AXLE SHAFT & BEARING

NOTE: Although axle shaft bearing end play is not adjustable, it should be checked prior to disassembly.

Removal

1) Remove rear wheels and collision guards (if equipped). Disconnect brake line and bracket from axle housing. Remove caliper and support. Wire caliper out of way, being careful not to damage brake line. Ensure parking brake is fully released.

2) Remove brake rotor set screws. Take off rotors, tapping with soft mallet (if necessary). Remove parking brake shoes, unhooking retaining springs. Disconnect parking brake cables by driving out lock

pin at lever.

3) Remove bolts for bearing retainer through holes in axle flange. Remove axle shaft using puller. Pry inner seal from housing. Press bearing and snap ring off axle shaft. Remove oil seal.

Installation

1) Pack NEW bearing and NEW seal lip groove with high temperature wheel bearing grease. Place bearing retainer and oil seal on axle shaft. Press NEW bearing and NEW snap ring onto axle shaft. Narrow side of taper fits into axle housing.

2) Clean axle housing and drive in NEW inner seal. Install axle shaft and tighten bearing retainer bolts. Install parking brake shoes and reconnect cables. Install rotors.

3) Check parking brake adjustment. Install brake calipers, pads, and collision guards (if equipped). Reconnect brake line and bracket to axle housing. Install wheels.

PINION FLANGE & OIL SEAL

Removal

Disconnect drive shaft at pinion flange. Remove pinion flange nut. Remove flange using puller. Remove old oil seal and dust shield.

Installation

Drive new seal into housing after packing seal spring and lips with grease. Unless packed, seal spring could jump out of position. Press flange onto drive pinion. Install flange washer and nut and tighten to specification. See TORQUE SPECIFICATIONS. Reconnect drive shaft to drive pinion flange.

AXLE ASSEMBLY

NOTE: On models equipped with Limited Slip Differential (LSD), rotational friction of LSD must be checked with axle assembly in vehicle.

Checking Procedure

1) Raise one rear wheel and block opposite side. Place transmission in Neutral. Release parking brake. Remove raised wheel. Attach torque wrench to axle flange.

2) Rotate axle flange and measure friction torque of LSD using torque wrench. If rotational friction is less than minimum specification, friction discs and plates in LSD must be replaced. See AXLE & DIFFERENTIAL ASSEMBLY SPECIFICATIONS table.

Removal

1) Raise vehicle and remove wheels. Remove intermediate exhaust pipe. Loosen trailing arm retaining bolts so arms can pivot at front ends. Remove stabilizer bar and track (panhard) rod. Remove collision guards (if equipped).

2) Disconnect ventilation hose from axle housing. Disconnect brake line brackets from axle housing. Remove calipers and wire out of way. Be careful not to damage brake lines. Release parking brake. Remove rotors. Remove parking brake shoes and disconnect cables from levers.

3) Disconnect drive shaft from pinion flange. Disconnect parking brake cables from axle housing. Only remove plastic tube if axle housing is being replaced. Disconnect reaction rods at axle housing. Support axle assembly with transmission jack.

4) Compress springs and disconnect shock absorbers at upper mounts. Remove spring compressors. Remove bolts holding axle housing to trailing arms. Lower and remove axle assembly.

Installation

1) Move axle assembly under vehicle on transmission jack and raise into position. Connect trailing arms with stabilizer bar brackets to axle housing, leaving bolts finger tight. Compress springs and connect shock absorbers to upper mounts. Release springs.

2) Remove transmission jack. Connect reaction rods to axle housing, leaving bolts finger tight. Attach parking brake cables to axle housing. Attach drive shaft to pinion flange. Connect parking brake cables to levers and install parking brake shoes.

3) Install rotors and check parking brake adjustment. Install calipers and attach brake line brackets to axle housing. Attach ventilation hose to axle housing. Install collision guards (if equipped). Connect track (Panhard) rod and stabilizer bar to axle housing and trailing arms, leaving bolts finger tight.

4) Install wheels and tighten lug nuts. Lower and rock vehicle to settle suspension. With full weight of vehicle on suspension, tighten bolts on trailing arms, reaction rods, track (Panhard) rod, and stabilizer bar to specifications. See TORQUE SPECIFICATIONS.

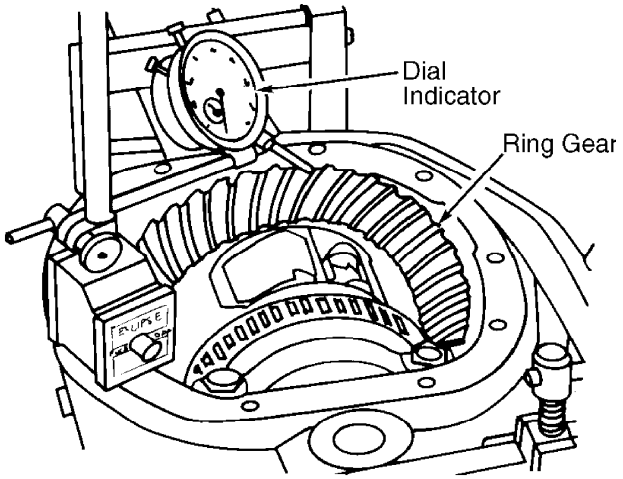
OVERHAUL

DIFFERENTIAL ASSEMBLY

NOTE: Differential assembly overhaul information applies to 1041 and 1045 differentials with differential lock. Information for 1041 and 1045 conventional differentials is not available from manufacturer.

Disassembly (1041 & 1045)

1) On 1041 type axle, support axle in Fixture (2522) and Floor Stand (2520). Remove rear cover. Using a dial indicator, check ring gear backlash and record reading. See Fig. 2. Remove drive shaft pressure plates and drive shafts. Use Differential Housing Spreader (2394 and 2601) to expand rear end so differential assembly can be removed. DO NOT tighten expander screw more than 2 1/2 turns. Note position of differential bearing races for reassembly reference.



92F01813

Fig. 2: Checking Ring Gear Backlash

2) On 1045 type axle, remove counterweight and side moldings for final drive lower bushings. Place final drive unit in Fixture (5370) and Floor Stand (2520). Remove rear cover. Use a large

screwdriver and pry off drive shafts. Using a dial indicator, check backlash and record reading. To remove differential from final drive, remove locking washers on adjusting nuts. Using Wrench (5371), remove adjusting nuts. Note position of bearing races and adjusting nuts for reassembly reference.

3) On all axles, use Puller (2483) and remove differential bearings and locking plate. See Fig. 3. Note position of bearings for reassembly reference. On 1041 type axle, note which side spacers were installed for reassembly reference. On all axles, install differential in a vise, using Holder (5425). Remove ring gear from differential.

NOTE: If either side of differential housing is damaged, replace differential lock.

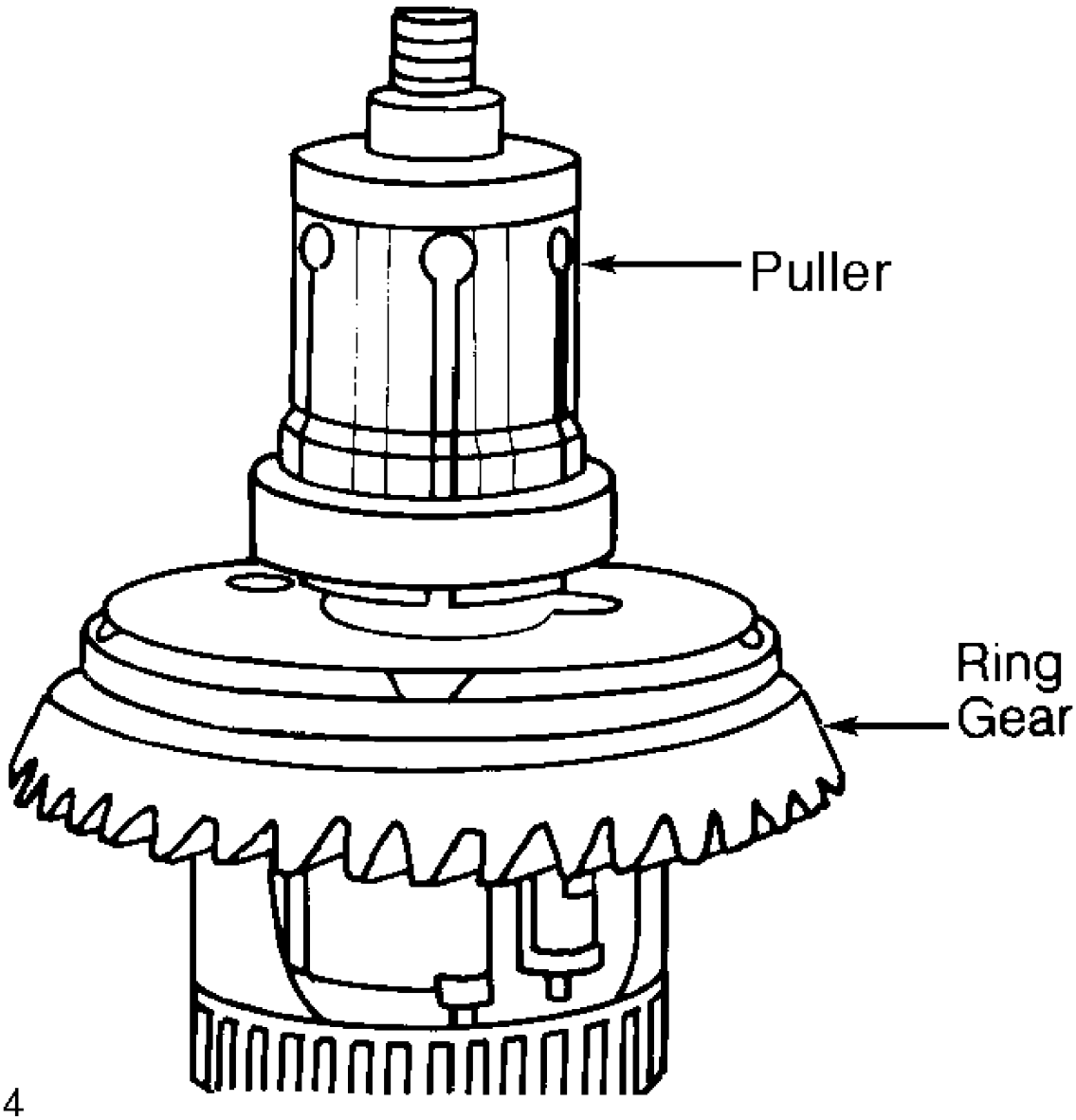


Fig. 3: Removing Differential Bearings & Locking Plate Using Puller (2483)

4) Loosen 3 flange screws on differential housing. See Fig. 4. Gently tap screw heads to separate differential housing from

end plate. Turn housing over and remove 3 screws. Lift off housing end plate. Leave shim for side gear in housing end plate.

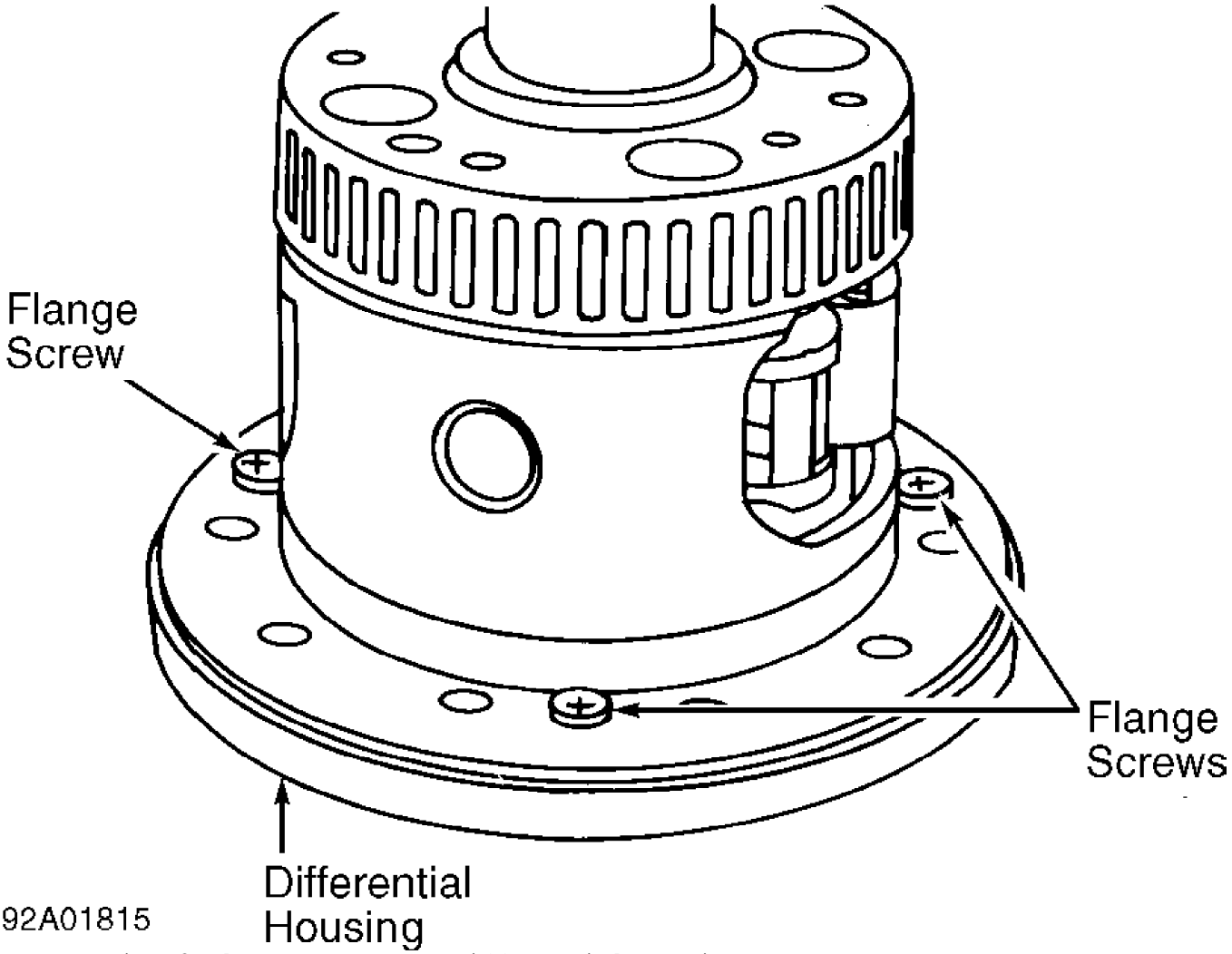


Fig. 4: Loosening 3 Flange Screws On Differential Housing

5) Lift out side gear on ring gear side with clutch assembly, guide lugs and shim (if not already removed with housing end plate). Lift out lock/release mechanism. See Fig. 5.

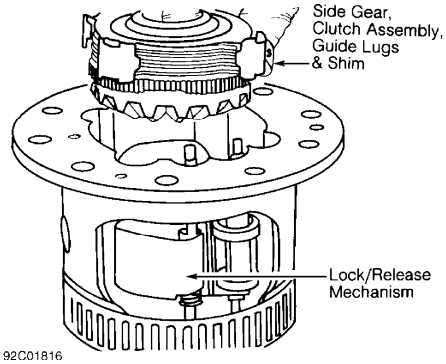
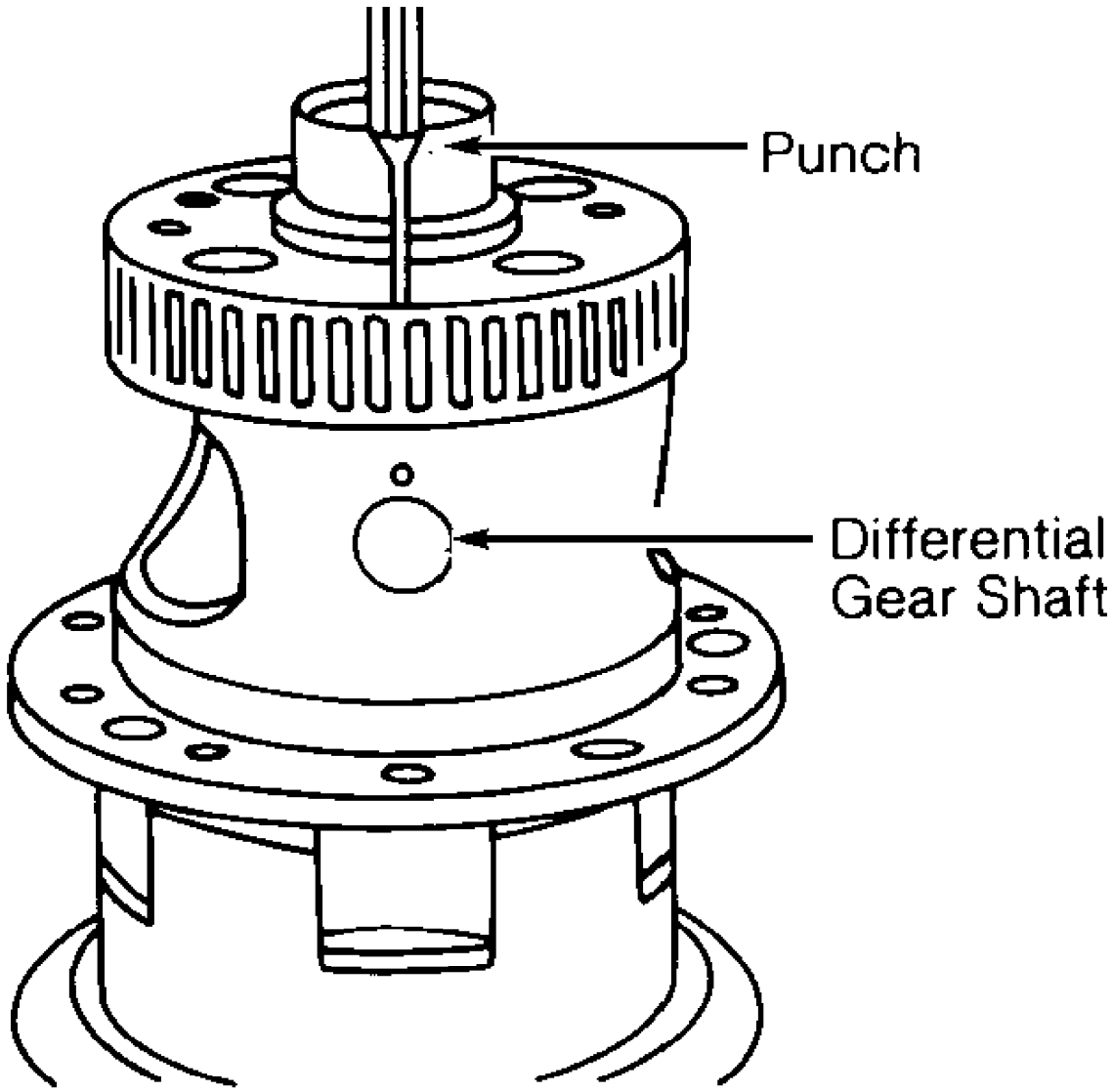


Fig. 5: Removing Side Gear, Clutch Assembly, Guide Lugs, Shim & Lock/Release Mechanism

6) Place differential housing on Support Plate (2861) so one opening is opposite locking pin hole. Use a punch and remove differential gear shaft locking pin. See Fig. 6. Knock differential gear shaft out from opposite side to locking pin hole. Remove reaction block, differential pinion gears and thrust washers.



92E01817

Fig. 6: Removing Differential Gear Shaft Locking Pin

NOTE: Mark differential pinion gears for reassembly reference.

7) Remove circlip on crown wheel side on clutch assembly. Remove clutch assembly and guide lugs. Remove cam wheel from side gear.

Cleaning & Inspection

1) Drive pinion and ring gear must be replaced as a set. If differential side or pinion gears show any damage, gears must be replaced as a complete set.

2) On models with LSD and differential lock, all friction discs should be replaced if any discs show excessive wear or heat damage.

Reassembly & Adjustments (1041 & 1045)

1) Install right side clutch assembly and side gear in differential housing. Using grease, position guide lugs on clutch assembly. Replace shim of same thickness as one removed.

2) Install differential pinion gears and thrust washers in original locations. Install reaction block. Using a brass drift, tap in differential gear shaft until aligned.

CAUTION: Differential gear shaft ends have different diameters.

3) Center reaction block between pinion gears. Install a large clamp in a vise. Clamp differential housing between reaction block and differential, using Drift (5912) between clamp and reaction block.

4) Place a magnetic stand with dial indicator on face of differential housing. Measure backlash of both pinion gears by placing tip in center of each gear. See Fig. 7. Press pinion gear against thrust washer during measurement. Correct backlash should be .0009-.005" (.025-.13 mm). If not to specification, shims are available in .25 mm, .38 mm and .64 mm sizes. After adjustment, recheck backlash.

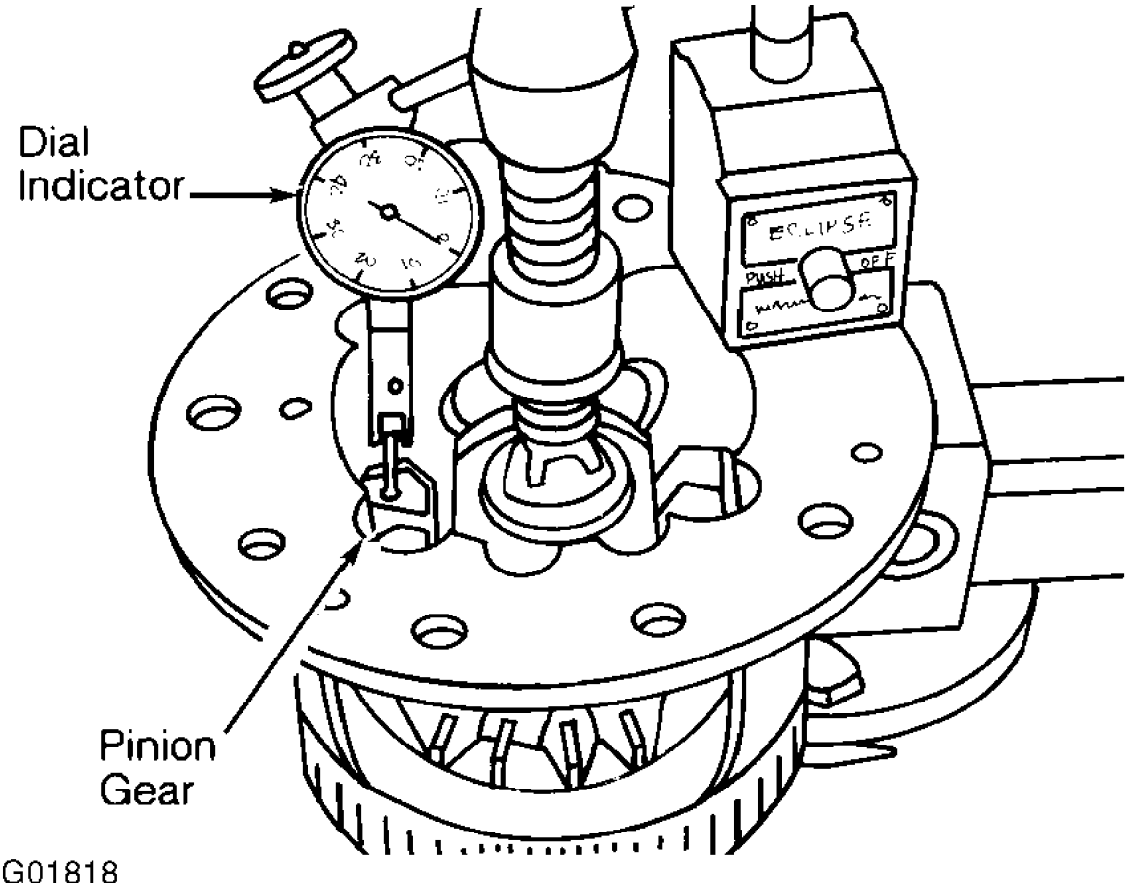


Fig. 7: Measuring Pinion Gear Backlash

5) Tap out differential gear shaft (from correct end). Remove reaction block, pinion gears and thrust washers, right gear assembly with clutch, and shim. Mark all parts for reassembly reference.

6) Install pinion gears on correct side. Install thrust washers and reaction block. Using a brass drift, tap in differential gear shaft until aligned.

CAUTION: Differential gear shaft ends have different diameters.

7) Using NEW shim with same thickness as old one, position left (ring gear) side gear against pinion gears in differential housing. Use grease to hold in place. Install differential housing end plate and 3 flange bolts. Tighten 3 bolts to 72-88 INCH lbs. (8-10 N. m).

8) Reinstall differential housing in a clamp, using Drift (5912) against reaction block. Place Drift (5065) between Drift (5912) and clamp. Center reaction block and tighten clamp.

9) Attach Retainer (5971) in a ring gear bolt hole. Position magnetic stand on retainer. Measure pinion gear backlash. See Fig. 8. Correct backlash should be .009-.016" (.25-.43 mm). If adjustment is necessary, shims are available in .56 mm, .81 mm, 1.01 mm, and 1.20 mm thicknesses. Recheck backlash after adjustment is complete.

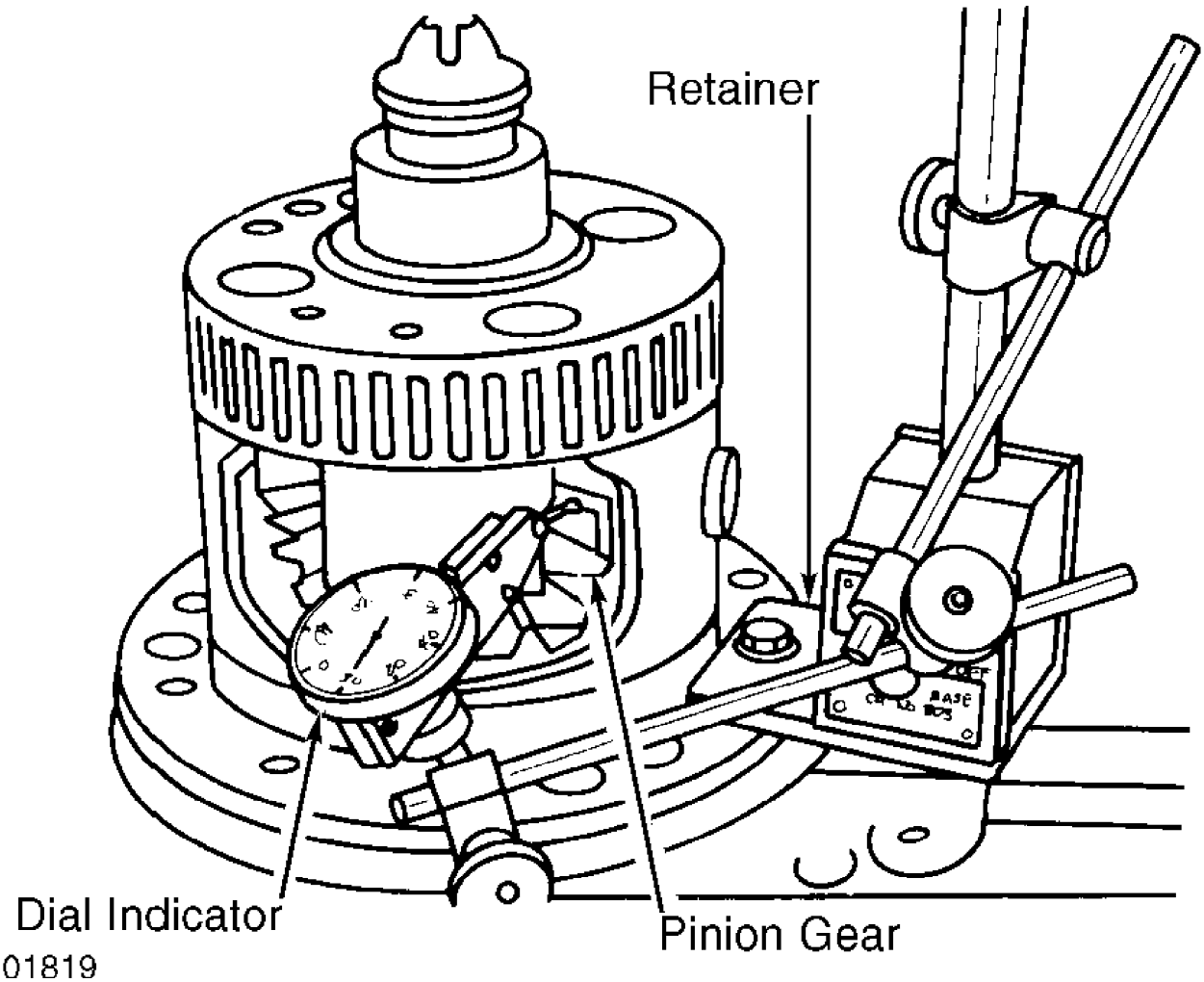


Fig. 8: Measuring Pinion Gear Backlash

10) Remove magnetic stand, retainer, 3 end plate bolts, end plate, side gear on ring gear side, shim, differential gear shaft, pinion gears, thrust washers and reaction block.

11) Install right (differential housing) side gear and clutch assembly using correct shim in differential housing. Install left (ring gear) side gear with correct shim in differential housing end plate. Bolt gear and housing assemblies together with 2 M12 bolts, 2 large washers (modified to an oval shape), and nuts. See Fig. 9.

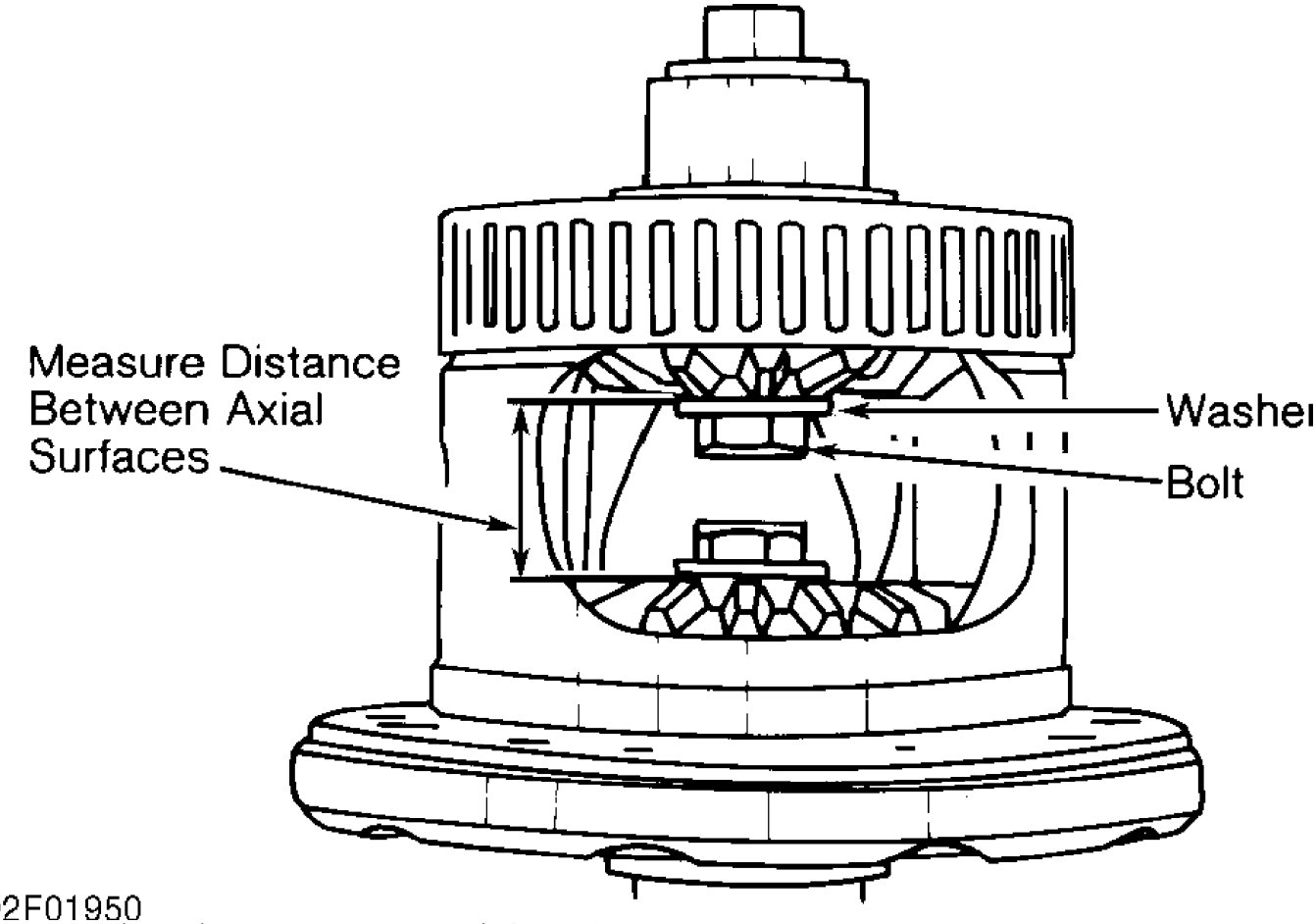


Fig. 9: Measuring Distance Between Axial Surfaces

12) Assemble 2 halves of differential housing and tighten 3 screws to 72-88 INCH lbs. (8-10 N.m). Measure and record distance between side gear axial surfaces. See Fig. 9.

13) Using a micrometer, measure and note reaction block width. Backlash between side gear and reaction block should be .004-.009" (.10-.24 mm). If backlash is not to specification, reaction blocks are available in widths from 32 mm to 32.7 mm, in increments of .1 mm.

14) After measurement, remove end plate from differential housing. Remove retaining bolts, washers and nuts from side gear. Ensure side gear with clutch assembly, guide lugs and shim are still correctly installed in differential housing.

15) Install pinion gears, thrust washers, reaction block (flat side toward differential large opening) and differential gear shaft. Align shaft locking pin hole with differential housing hole by placing a 4.5 mm drill bit in differential shaft locking pin hole. Carefully tap in shaft after removing drill bit. Ensure holes are exactly opposite each other.

16) Install NEW lock pin from differential housing face. Tap in pin until it is .020" (.5 mm) below differential housing face.

Install latching pawl, centrifugal governor and weights. See Fig. 10. Ensure latching pawl spring is on correct side of centrifugal governor shaft.

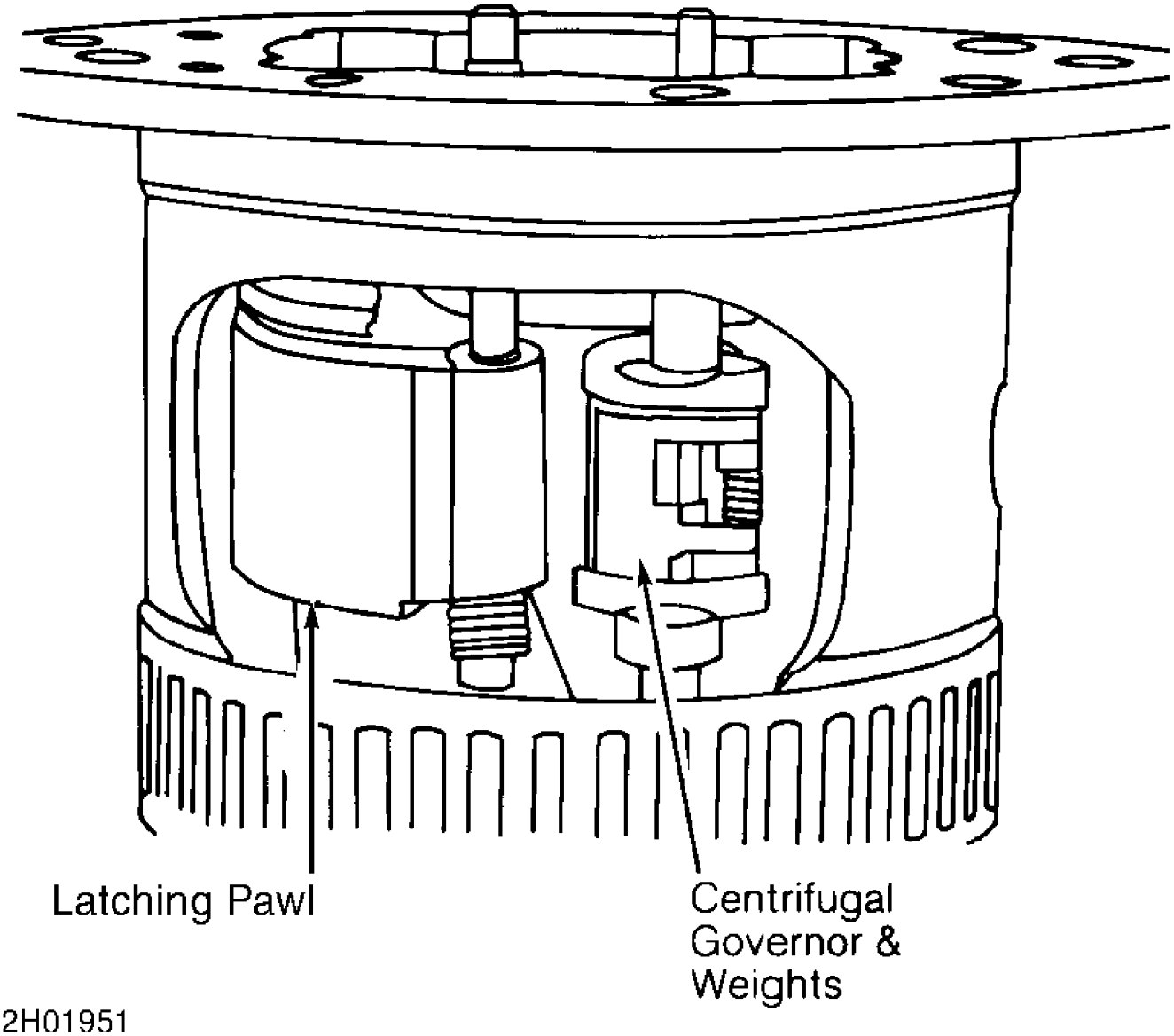


Fig. 10: Installing Latching Pawl, Centrifugal Governor & Weights

17) Install toothed cam wheel and clutch assembly on left (ring gear) side gear. Position guide lugs with grease. Place left (ring gear) side gear with clutch assembly and guide lugs into differential housing. Position shim with grease on end of side gear.

18) Ensure contact faces of differential housing and end plate are thoroughly free of grease. Assemble differential housing end plate. Tighten 3 screws to 72-88 INCH lbs. (8-10 N.m).

19) Using cutting pliers, cut off sensor strip. See Fig. 11. Lubricate new strip and surface of differential housing. Carefully tap on strip until it sits level on housing. Place differential housing with new strip on Support Plate (2861) and press sensor strip onto housing until it touches support plate surface.

CAUTION: Ensure contact faces of differential housing and end plate are thoroughly free of grease.

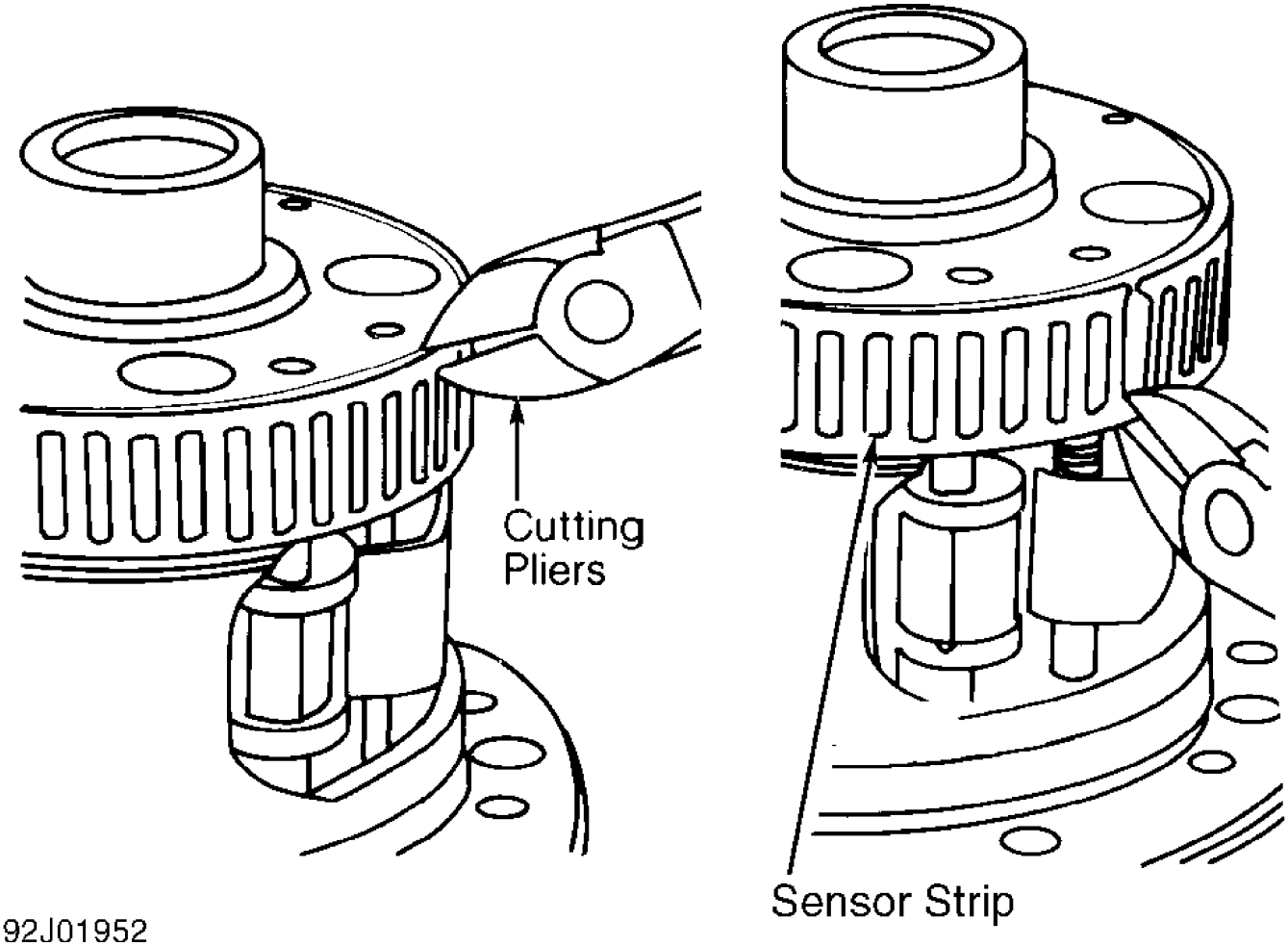


Fig. 11: Removing Sensor Strip

20) Using NEW bolts, install ring gear. Starting with 2 bolts in smaller holes in differential housing, tighten bolts diagonally to 26 ft. lbs. (35 N.m), then angle tighten an additional 60 degrees.

21) On 1041, if differential lock is replaced, new bearings installed or backlash is greater than specification, go to INSTALLATION & ADJUSTMENT (1041). If differential lock is not replaced, new bearings not installed or backlash is within specification, go to next step.

22) On all axles, use Drift (4112) at both ends as supports and install locking plate and differential bearings. See Fig. 12. See appropriate INSTALLATION & ADJUSTMENT procedure.

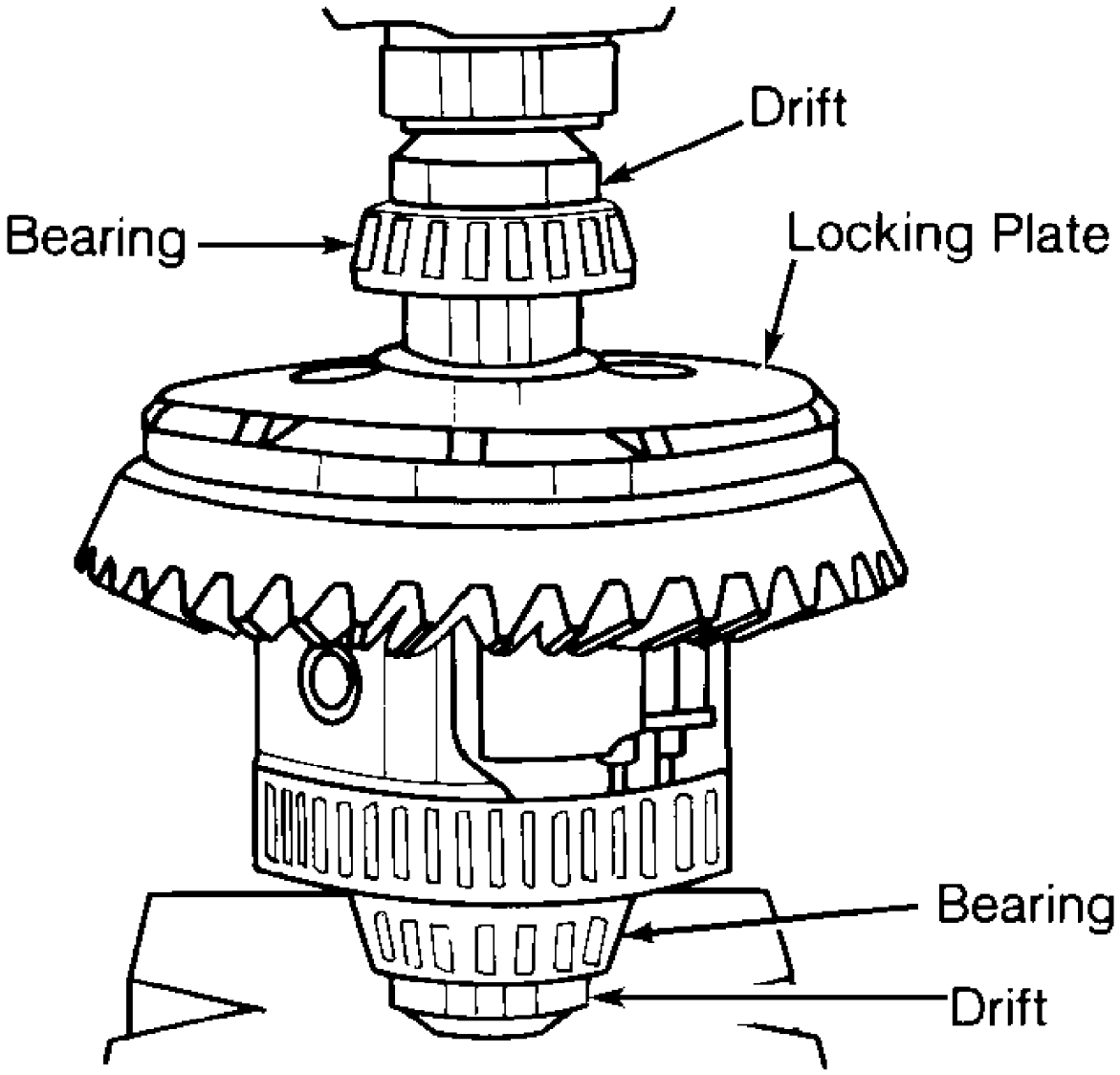


Fig. 12: Installing Locking Plate & Differential Bearings

Installation & Adjustment (1041)

1) Lubricate Adjusting Rings (2595) and contact faces. Place rings on bearings seats, with Black ring on ring gear side. Install differential housing in rear axle housing. Expand adjusting rings until differential housing is firmly positioned without any preload. See Fig. 13. There should be no play between rings, differential housing and rear axle housing.

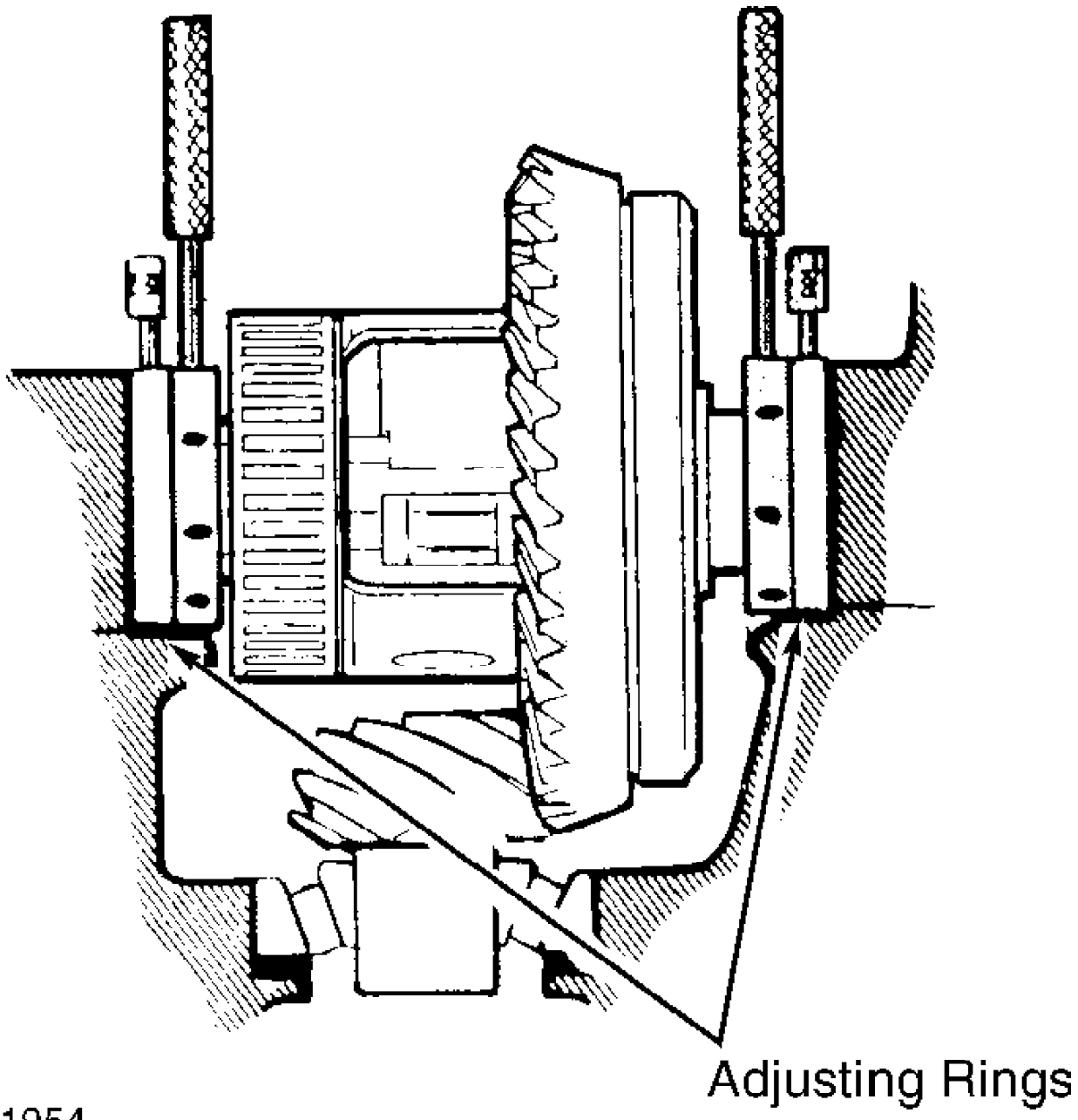


Fig. 13: Expanding Adjusting Rings

2) Position a dial indicator on rear axle housing. See Fig. 14. Rest measuring tip on one ring gear tooth approximately .12" (3 mm) from large end of tooth. Hold pinion and move ring gear back and forth. Acceptable backlash is .004-.006" (.10-.15 mm), but should be set as near as possible to .005" (.13 mm). Maximum variation between 3 measuring points should be no more than 0-.001" (0-.03 mm).

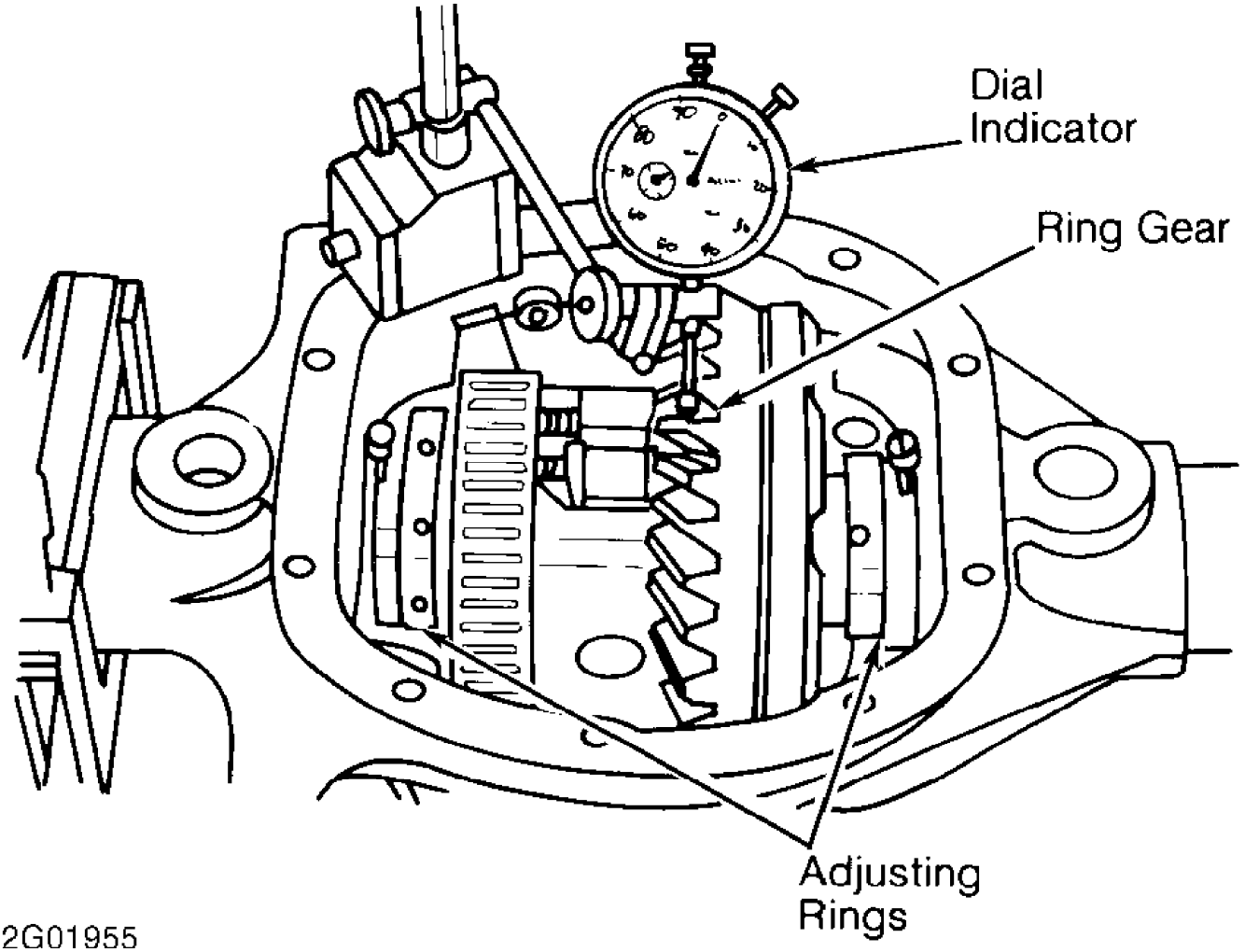


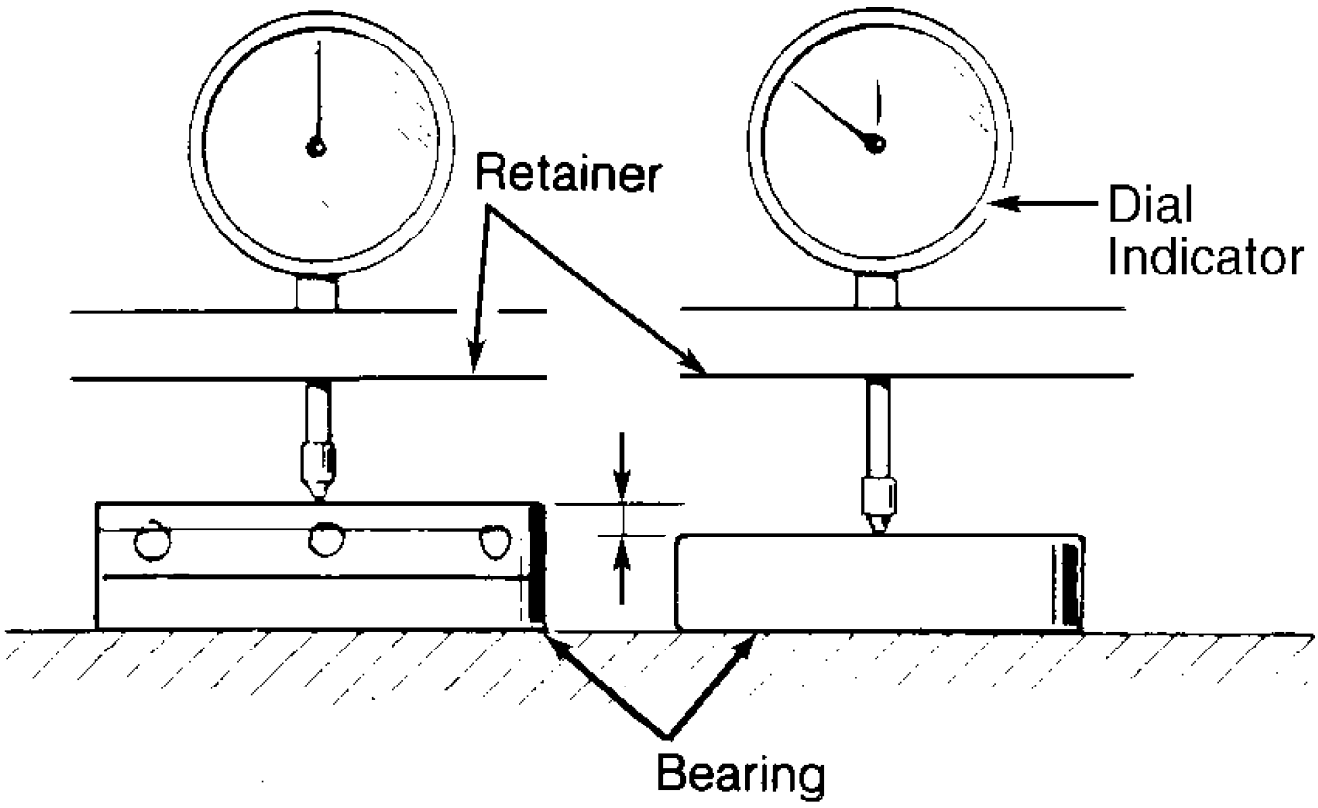
Fig. 14: Measuring Ring Gear Backlash

3) To adjust backlash, turn both adjusting rings in same direction. After correct backlash is obtained, lock adjusting rings in position and lift out differential housing assembly and adjusting rings.

CAUTION: Note on which side differential housing shims and bearings are to be installed, or backlash will be incorrect.

4) On ring gear side, place bearing with outer side up in Measuring Fixture (2600) and install plate, spring and nut (flat side down). Turn plate and bearing assembly back and forth so rollers position correctly.

5) Position adjusting ring on measuring fixture. Install Retainer (2284) and dial indicator. Place tip of indicator against ring and set to zero. Move tip to bearing and note reading. See Fig. 15.



92I01956

Fig. 15: Determining Shim Thickness

6) Using a micrometer, locate a shim that measures the same as reading just taken, plus an additional .003" (.07 mm). This is done to retain preload on differential housing bearing. Put shim aside with bearing just measured. Repeat procedure for other side.

7) Using a press, install differential housing bearing. Use Drift (4112) to support bottom bearing during pressing procedure. While pressing, ensure lock plate is not jammed between bearing and carrier.

8) Install Differential Housing Spreader (2394 and 2601) on rear axle housing. Expand tool until play is removed, then tighten an additional 2 1/2 turns. Place differential housing and bearing in rear axle housing. Remove expander and retainer.

9) Install bearing caps in original locations. Tighten bolts to 26 ft. lbs. (35 N.m), then angle tighten an additional 60 degrees.

10) Recheck ring gear backlash. Backlash should be .004-.006" (.10-.15 mm). Measure backlash at 3 points, .12" (3 mm) from outer edge of ring gear.

11) Check differential rotational torque by installing one drive shaft, Drift (2725) and a flat washer on one wheel nut, and a wheel nut with cone facing outward. Use a wrench with an extension to prevent drive pinion from turning. Turn drive shaft with a torque wrench. Rotational torque must not exceed 26 ft. lbs. (35 N.m). If not to specification, check differential bearing preload.

12) Install remaining drive shaft. Tighten drive shaft pressure plates to 30-42 ft. lbs. (40-56 N.m). Using NEW gasket, replace rear cover. Tighten rear cover bolts to 18 ft. lbs. (24 N.m).

Installation & Adjustment (1045)

1) Install complete differential in rear axle housing.

Install oiled adjusting nuts with NEW lubricated "O" rings and seals. Install Washer (5871) with one adjuster nut. Install magnetic stand with dial indicator. Place measuring tip of dial indicator on opposite side of housing. See Fig. 16.

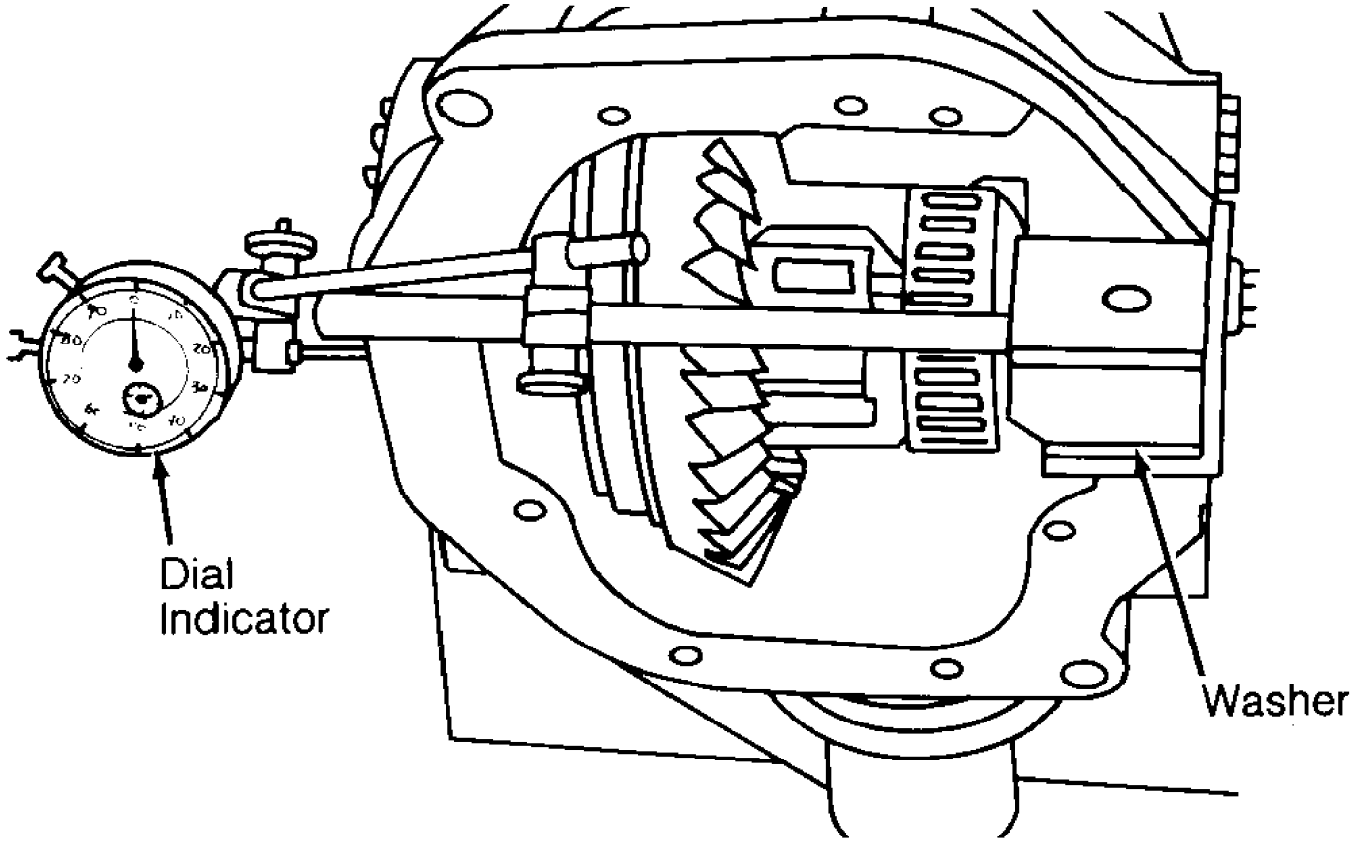


Fig. 16: Placing Measuring Tip Of Dial Indicator On Opposite Side Of Housing

2) Using Wrench (5371), tighten adjuster nuts on both sides. See Fig. 17. Turn adjuster nuts until a slight backlash can be felt on ring gear and dial indicator just begins to give a reading. Rotate differential housing several times to center roller bearings.

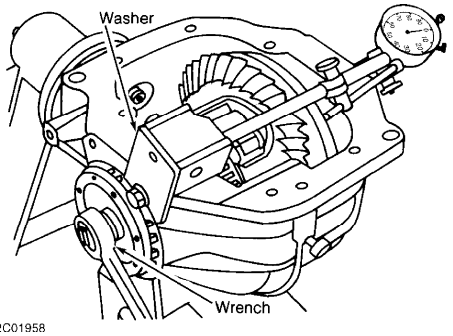


Fig. 17: Tightening Adjuster Nuts

3) Position a dial indicator on differential case. Place measuring tip on one ring gear tooth, about .12" (3 mm) from larger end of tooth. Hold pinion steady and move ring gear back and forth

against measuring tip. Acceptable backlash is .004-.006" (.10-.15 mm), but should be set as near as possible to .005" (.13 mm). Maximum variation between 3 measuring points should be no more than 0-.001" (0-.03 mm).

4) To adjust backlash, use Wrench (5371) and move nuts in or out as necessary. See Fig. 18. After adjustment, preload housing one notch on both sides. Rotate differential 5 turns and check backlash. Adjust if necessary. Adjustments can be made with preloaded bearings.

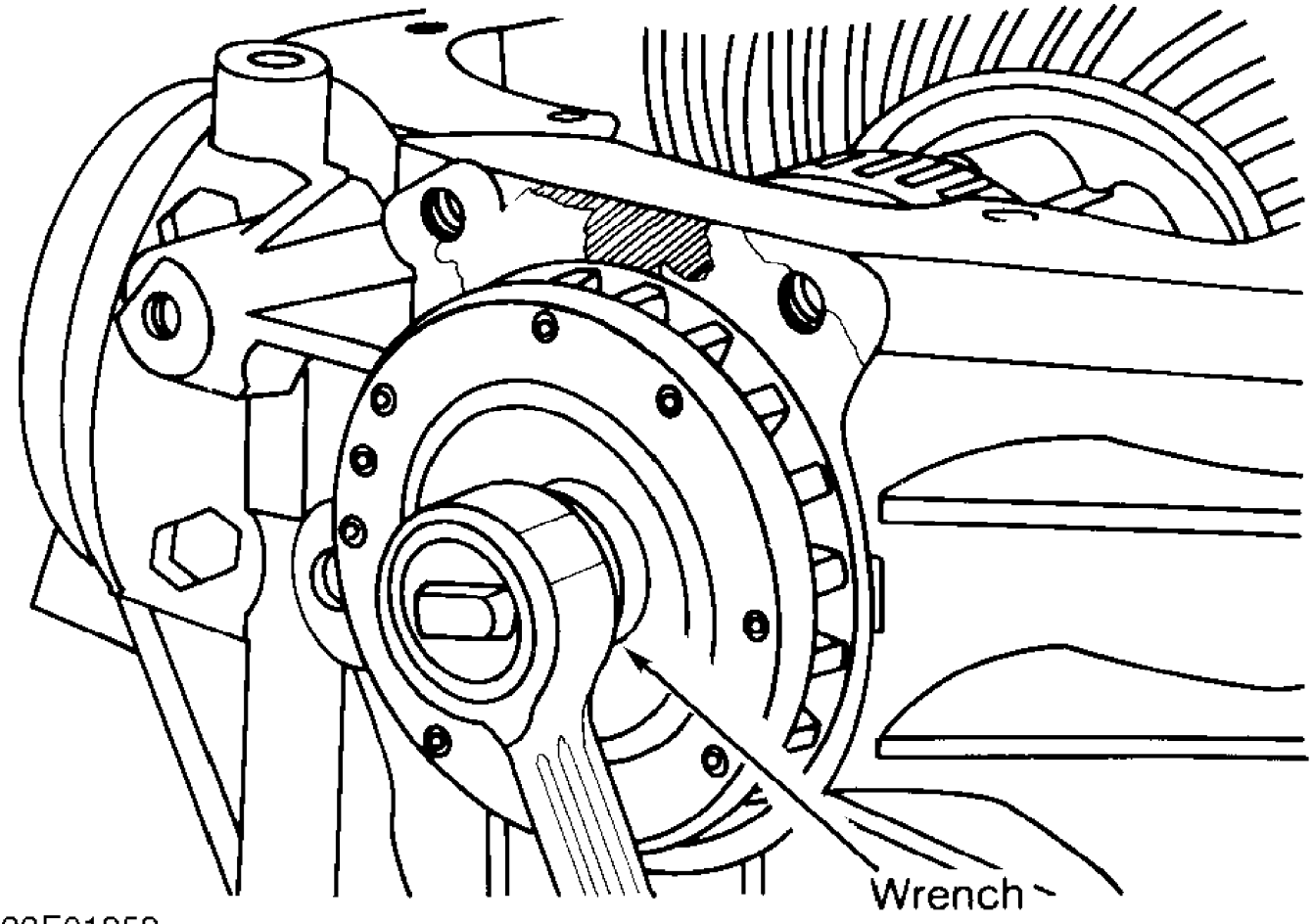


Fig. 18: Adjusting Backlash Using Wrench

5) Using liquid gasket sealer, install rear cover and tighten bolts to 18 ft. lbs. (24 N.m). To complete preload, tighten adjuster nuts one more notch on both sides.

NOTE: If old bearings were reused, tighten adjuster nuts 1/2 notch.

6) Lock adjuster nuts with lock washers and tighten to 30-41 ft. lbs. (40-56 N.m). Install drive shafts. On one drive shaft and one hole for drive shaft flange, install an M10 bolt approximately .75" (20 mm) long with a flat washer. Use a wrench with an extension to prevent drive pinion from turning.

7) Turn drive shaft with a torque wrench. Torque should not exceed 26 ft. lbs. (35 N.m). If not to specification, recheck differential bearing preload. Install side mountings for lower bushings. Tighten bolts to 30-41 ft. lbs. (40-56 N.m). Remove final drive from fixture and install counterweight. Tighten counterweight

bolts to 15-21 ft. lbs. (20-28 N.m).

AXLE & DIFFERENTIAL ASSEMBLY SPECIFICATIONS

DIFFERENTIAL ASSEMBLY SPECIFICATIONS TABLE - 1041 & 1045 (1)

Application	In. (mm)
Ring Gear Backlash	
Preferred	.005 (.13)
Range	.004-.006 (.10-.15)
Side Gear-To-Reaction Block Backlash	.004-.009 (.10-.24)
Pinion Gear Backlash	.0009-.005 (.025-.13)
	Ft. Lbs. (N.m)
Shaft Rotational Torque	26 (35)

(1) - Applies to traction lock differential only.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE - 1041 & 1045 (1)

Application	Ft. Lbs. (N.m)
Adjuster Nuts	30-41 (40-56)
Bearing Cap Bolts	(2) 26 (35)
Counterweight Bolt	15-21 (20-28)
Lower Bushing Side Mounting Bolt	30-41 (40-56)
Rear Cover Bolts	18 (24)
Ring Gear Bolts	(2) 26 (35)
	INCH Lbs. (N.m)
Differential Housing End Plate Flange Screws	72-88 (8-10)

(1) - Applies to traction lock differential only.
(2) - Angle tighten an additional 60 degrees.