GENERAL: This group contains information on the differential assembly and all mounting parts necessary for its installation.

SPECIFICS: As applicable

...Differential Carrier Assembly

...Differential Flanges

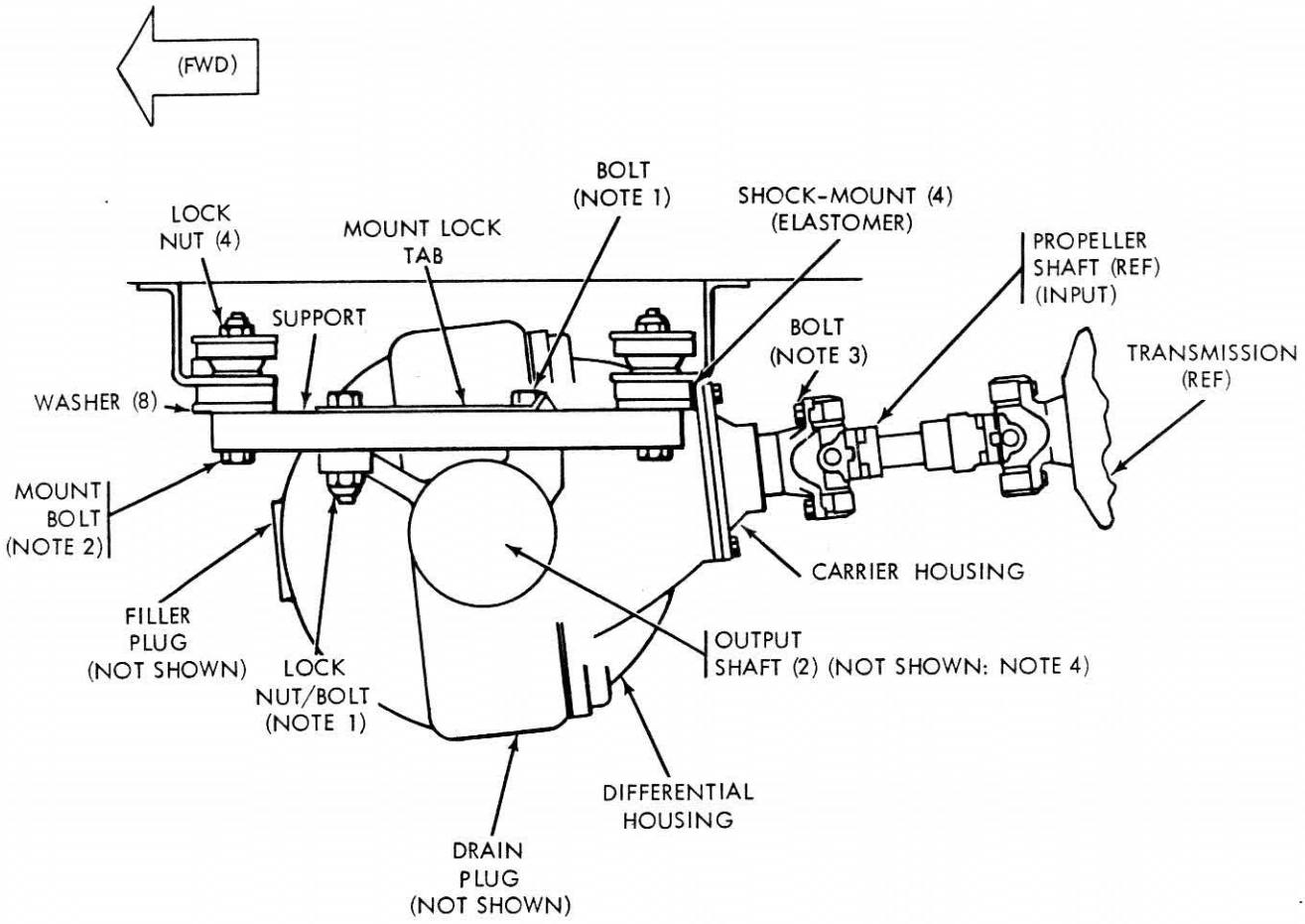
...Differential Gears, Shafts, etc.

...Differential Housing

# GROUP 18

# DIFFERENTIAL

## TABLE OF CONTENTS




NOTE: 1. TORQUE 268 TO 295 FOOT-POUNDS
2. TORQUE 122 TO 133 FOOT-POUNDS
3. TORQUE 25 TO 30 FOOT-POUNDS
4. TORQUE YOKE-TO-U-JOINT ATTACHING BOLTS 70 TO 80 FOOT-POUNDS

**Figure 18-1. Differential Assembly**

# GROUP 18

# DIFFERENTIAL

## 18-1. DESCRIPTION

a. General (fig. 18-1). The coach differential assembly is a single-reduction drive unit incorporating a spiral bevel (hypoid) drive pinion and drive gear (4:63 ratio) arrangement that permits the rear wheels to turn at different speeds when cornering and divides the torque between each wheel drive shaft. The differential assembly functions to transmit the torque output of the aft-mounted V-8 engine through a 90-degree angle to rotate the axles in each dual-rear-wheel. The exploded view (fig. 18-2) illustrates the components of the differential assembly, including the input shaft (with pinion), case, flange half (with drive gear), spider (with four pinions), side gears and output shafts.

The bevel drive gear is integral with the differential-case flange half. Splined shafts fit into side gears that rotate on a plane with the bevel drive gear, interconnected by four spider pinions (gears). These spider pinions function as idlers, in that they are held on individual shafts of the spider and only contact the side gears. These spider pinions perform so that when the coach is going straight, the spider gears do not rotate on their own shafts, but turn both side gears with equal torque from the main drive gear. However, when the coach turns a corner, the inside output shaft is making fewer revolutions than the case flange and drive gear. Therefore, the drive gear forces the pinons (idler) to run along the side gear (the drive gear is turning faster), which in turn advances the opposite side gear the same amount. A breather plug, a magnetic-internal-wrenching type drain plug, an internal wrenching filler plug and an internal-wrenching inspection plug are incorporated in the differential.

The information provided in this Group covers the differential assembly. For service information on interconnecting equipment, such as axle and propeller shafts, refer to Group 17. For information on parts procurement, refer to Group 18 of the Parts Catalog.

b. Magnetic Drain Plug. An internal-wrenching-magnetic type drain plug, installed in the base of the differential, performs the function of trapping any small metallic particles that circulate in the differential lubricant (through the gears and bearings) which could cause rapid wear and premature failure. The magnet is strong enough to firmly hold the particles under service conditions. The plug magnetic elements (poles) have a minimum pickup capacity of two pounds of low-carbon steel particles. The magnetic plug also provides a convenient method of inspecting for excessive internal gear wear. If excessive particles are present on the plug magnetic elements, when removed during draining after the initial run-in period, the cause of wear should be analyzed and corrective measures taken.

## 18-2. TROUBLESHOOTING

Instructions for troubleshooting the differential are contained in table 18-1. Prior to troubleshooting, a preliminary visual inspection, to assist in locating the problem, should be made as outlined in paragraph 18-4b.

## 18-3. REMOVAL/INSTALLATION

a. General. Step-by-step instructions for replacement of the differential are provided in this section. Replacement parts should be procured from those listed in the 2900R Parts Catalog. Access to the differential assembly may require removal of components described in other Groups. For removal or installation instructions for such components, consult the Group number referenced in those steps where this occurs. Parts requiring replacement should be removed and/or installed with suitable puller or sleeve type press. Avoid use of drifts and hammers, as they may distort or damage component parts Burrs, caused by lock washers, on the face of stud holes of covers should be removed to assure easy reassembly. Remove nicks and burrs from machined surfaces with a small grinding stone or file.

b. Differential Removal (fig. 18-1). Before removing the differential from the coach, inspect for evidence of damage and/or parts failure. Drain lubricant; clean outside of housing and cover. To remove the differential, proceed as follows:

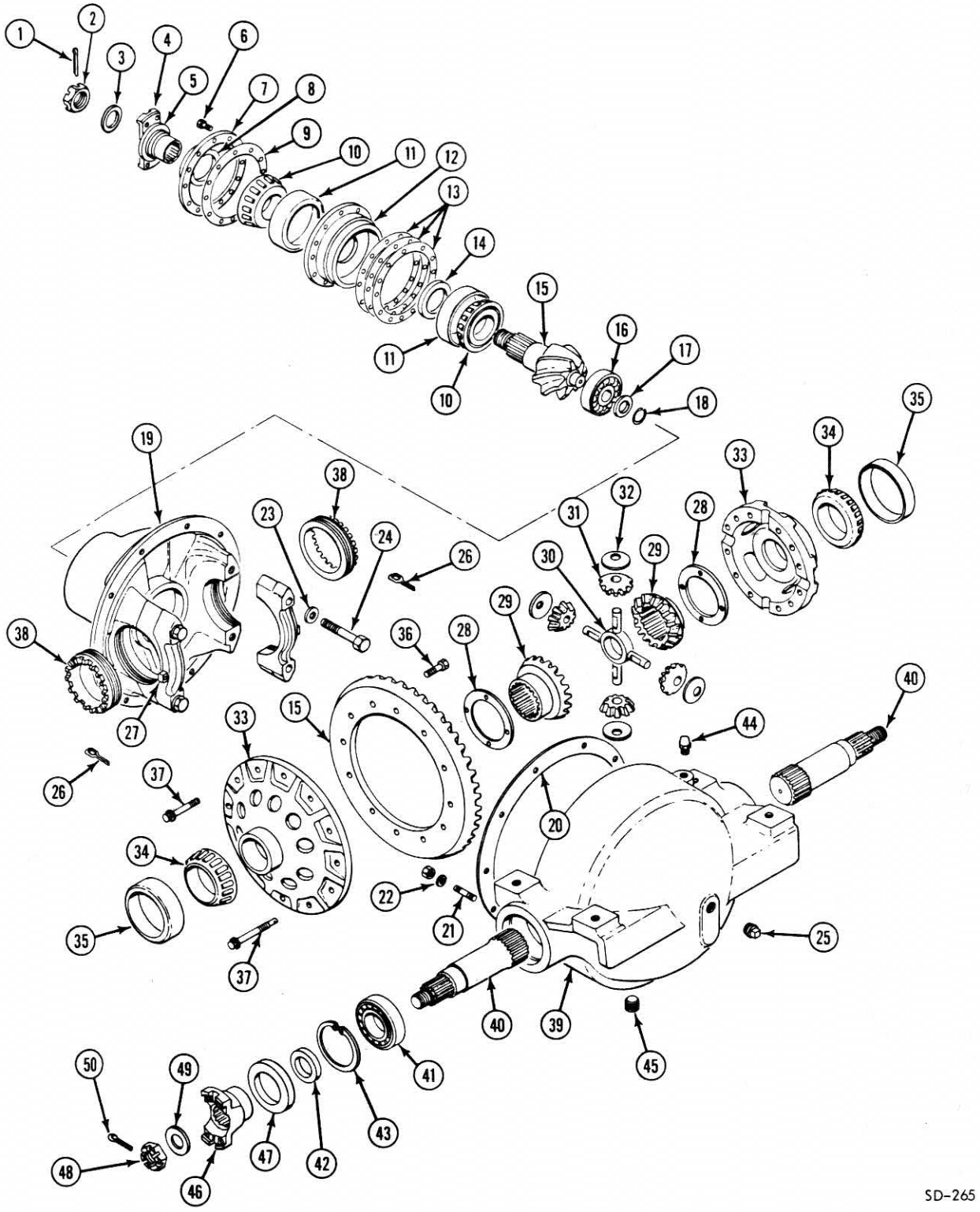



Figure 18-2. Differential – Exploded View

LEGEND

| | | | |
|---|---|---|---|
| 1 | PIN, Front yoke attaching nut | 26 | LOCK, Adjusting ring cotter |
| 2 | NUT, Input yoke attaching | 27 | DOWEL, Carrier locating |
| 3 | WASHER, Input yoke nut | 28 | WASHER, Side gear thrust |
| 4 | YOKE W/SLINGER ASSY, Differential input | 29 | GEAR, Side |
| 5 | SLINGER, Input yoke | 30 | SPIDER, Differential |
| 6 | SCREW, Drive pinion cover | 31 | GEAR, Diff spider pinion |
| 7 | COVER ASSY W/SEAL, Drive pinion | 32 | WASHER, Spider pinion gear thrust |
| 8 | OIL SEAL, Drive pinion cover | 33 | CASE ASSY, W/CAPSCREWS |
| 9 | GASKET, Drive pinion cover | 34 | CONE, Case bearing |
| 10 | CONE, Drive pinion cage bearing | 35 | CAP, Case bearing |
| 11 | CUP, Drive pinion cage bearing | 36 | RIVET, Differential case |
| 12 | CAGE & CUP ASSY, Drive pinion | 37 | CAPSCREW, Differential case |
| 13 | SHIM, Pinion cage to carrier | 38 | RING, Diff adjusting |
| 14 | SHIM, Pinion toward bearing | 39 | HOUSING ASSEMBLY, Differential |
| 15 | BEVEL GEAR AND PINION SET | 40 | SHAFT, Differential output |
| 16 | BEARING, Drive pinion pilot | 41 | BEARING, Differential output shaft |
| 17 | WASHER, Drive pinion bearing | 42 | SPACER, Differential shaft bearing |
| 18 | LOCKRING, Drive pinion bearing | 43 | RING, Differential shaft brg snap |
| 19 | CARRIER AND CAP ASSY, Less all gears | 44 | BREATHER, Diff housing |
| 20 | GASKET, Carrier to housing | 45 | PLUG, Housing drain hole |
| 21 | SCREW, Carrier to housing | 46 | YOKE, Diff to propeller shaft |
| 22 | WASHER, Carrier to housing screw | 47 | OIL SEAL, Diff to prop shaft yoke |
| 23 | WASHER, Carrier cap-screw | 48 | NUT, Yoke to diff |
| 24 | CAPSCREW, Carrier to cap | 49 | WASHER, Yoke to diff nut |
| 25 | PLUG, Carrier and housing grease filler | 50 | PIN, Yoke to diff nut cotter |

Figure 18-2. Differential – Exploded View (Continued)

Table 18-1. Troubleshooting the Differential

| Malfunction (symptoms) | Probable causes | Corrective action (remedies) |
|---|---|---|
| Noisy differential | Insufficient lubricant | Check for leaks and correct as necessary; refill with correct amount of lubricant |
| | Transmission out-of-alignment | Inspect transmission alignment; correct as necessary; refer to Group 15 |
| | Sprung output shaft | Replace |
| | Bearing defective | Replace |

Table 18-1. Troubleshooting the Differential (Continued)

| Malfunction (symptoms) | Probable causes | Corrective action (remedies) |
|---|---|---|
| Loss of lubricant | Lubricant level too high | Drain excess lubricant by removing drain plug and allowing lubricant to drain down to lower edge of filler plug hole<br>**Caution**<br>Too much lubricant in differential will cause pressure to build up and blow lubricant past seals and breather plug air vent. |
| | Worn output shaft oil seal | Replace with new seal; refer to paragraphs 18-3f and 18-3g |
| | Cracked housing | Replace |
| | Worn drive-pinion shaft cover oil seal | Replace with new seal; refer to paragraphs 18-3d and 18-3e |
| | Clogged breather-plug air vent | Remove obstructions |
| | Loose housing bolts or housing cover screws | Tighten bolts; refer to paragraph 18-5b. Fill to correct level with proper lubricant; refer to paragraph 18-5c (2) |
| Differential overheating | Lubricant level too low | Replenish |
| | Incorrect grade of lubricant | Drain and refill differential with correct amount of proper lubricant; refer to paragraph 18-5c (3) |
| | Excessively worn gears | Replace differential; refer to paragraphs 18-3b and 18-3c |

(1) With transmission at neutral (N), front wheels blocked, and parking brake on, raise coach aft end at least 14 inches and support it on jack stands.

(2) Drain lubricant, then clean outside of housing and cover.

(3) Jack differential just enough to offset the weight of the assembly on the coach frame.

(4) Remove four bolts on input yoke from propeller drive shaft.

(5) Remove four bolts on output yoke on end of each differential-to-rear axle propeller shaft.

**Warning**

The differential weighs in excess of 300 pounds. When handling differential during removal/installation procedures, make sure it is securely supported in cradle-type blocking or in a large cup-type jack base that will prevent rolling or tilting. Do not attempt to manually balance the differential on a small-base jack as it could rotate out of position and cause injuries or damage.

(6) Remove bolt, nut, two washers, and shock-mount at each end of the two differential supports.

(7) Lower disconnected differential with jack until it clears frame of coach, then remove.

c. Differential Installation (fig. 18-1). To install a new or reconditioned differential, proceed as follows:

(1) With transmission at neutral (N), front wheels blocked, and parking brake on, raise coach aft end at least 14 inches and support it on jack stands so differential can clear the coach frame.

(2) Prepare differential for installation as follows:

(a) Place each support in mounting position on differential, with bolt holes in alignment.

(b) Place mount lock tab on each support, with bolt holes in alignment.

(c) At each of the two holes which pass completely through the mount lock tab, the support, and the boss on transmission housing, install bolt (threaded-end downward) and new metal-lock locknut.

(d) In each of the remaining two open mounting holes, install bolt.

(e) Torque the two nuts and the two bolts (without nuts ) 268 to 295 foot-pounds.

(f) Bend one corner of mount lock tabs upward to secure each mounting bolt in position (to avoid loosening by vibration).

**Warning**

The differential weighs in excess of 300 pounds. When handling differential during removal/installation procedures, make sure it is securely supported in cradle-type blocking or in a large cup-type jack base that will prevent rolling or tilting. Do not attempt to manually balance the differential on a small-base jack as it could rotate out of position and cause injuries or damage.

(3) With hydraulic jack, move differential under coach, then up and into alignment with four frame mounting holes.

(4) Install four bolts with threaded end up, washer, shock-mount, washer, and nut through each of the four support ends and frame mounting holes. Torque bolts 122 to 133 foot-pounds.

(5) Install input yoke to drive propeller shaft with four bolts.

(6) Torque input yoke bolts 25 to 30 foot-pounds.

(7) Install output yoke on rear propeller shafts with four bolts each.

(8) Torque output yoke bolts to 70 to 80 foot-pounds.

(9) Fill differential with lubricant; refer to paragraph 18-5c(3).

(10) Lower hydraulic jack slightly, then check differential supports; if properly secured, lower and remove jack.

(11) Remove coach from jack stands.

(12) Operate coach to check differential for correct functioning.

d. Drive Pinion Shaft Cover Seal Removal (fig. 18-2). To remove oil seal from drive pinion shaft input side of differential, proceed as follows:

(1) Drain lubricant from differential.

(2) Disconnect propeller shaft attaching bolts from differential input pinion shaft yoke.

(3) Remove input yoke-to-differential cotter pin, nut and washer.

**NOTE**

Nut has been torqued 500 to 600 foot-pounds and may require use of a 4-foot extension bar on wrench to loosen.

(4) Remove input yoke from splined shaft using a suitable puller.

(5) Pry oil seal from drive pinion cover using seal puller.

> ***Caution***
>
> Be careful that tool does not damage carrier housing.

e. Drive Pinion Shaft Cover Seal Installation (fig. 18-2). To install the differential oil seal, proceed as follows:

(1) Inspect housing bore and remove any burrs that could cause leaks around perimeter of seal.

(2) Apply lubricant to seal.

(3) Press oil seal in place in drive pinion shaft cover, using pinion seal driver.

(4) Inspect oil seal surface of input yoke for tool marks, nicks, marks or wear.

(5) Install input yoke onto shaft.

(6) Place input yoke washer and nut on shaft, and torque to 500 to 600 foot-pounds; install cotter pin.

(7) Connect propeller shaft flange with bolts.

(8) Fill differential; refer to paragraph 18-5c(3).

f. Differential Output Shaft Seal Removal (fig. 18-2). To remove either output shaft oil seal from the differential, proceed as follows:

(1) Drain lubricant from differential; refer to paragraph 18-5c(3).

(2) Disconnect propeller shaft attaching bolts from output yoke.

(3) Remove output yoke cotter pin, nut and washer.

(4) Using a bearing puller, remove output yoke from splined shaft.

(5) Pry oil seal from side of differential housing.

> ***Caution***
>
> Be careful tool does not damage carrier housing.

g. Differential Output Shaft Seal Installation (fig. 18-2). To install either output shaft oil seal into differential, proceed as follows:

(1) Inspect oil seal bore in differential housing and remove any burrs that could cause leaks around perimeter of seal.

(2) Apply oil lubricant to seal.

(3) Press oil seal in place using a pinion oil-seal driver.

(4) Inspect oil seal surface of output yoke for tool marks, nicks, marks or wear.

(5) Install output yoke onto splined shaft.

(6) Install output yoke washer and nut on shaft, and torque 500 to 600 foot-pounds; install cotter pin.

(7) Connect axle shaft to output yoke with bolts.

(8) Fill differential; refer to paragraph 18-5c(3).

## 18-4. INSPECTION/CLEANING

a. General. This section contains procedures for inspection and cleaning of the differential. Cleaning also includes removal of foreign matter from interconnected components.

b. Inspection. The inspection procedure is a visual inspection for indications of component wear or stress.

(1) Inspect bearings and associated components and replace if worn, pitted, scored or damaged.

(2) Inspect shafts for signs of torsional fractures or other indications of possible failure.

(3) Inspect housing for cracks, loose studs, nicks and burrs on machined surfaces.

(4) Tighten all the nuts to the specified torques (use standard torques, Group 0, unless otherwise indicated). Threads should be clean to obtain correct torque.

(5) Replace all worn or round cornered hex nuts.

c. Cleaning. Cleaning the components directly connected to the differential periodically, at least every time the unit is lubricated, can reduce the number of wear failures. Remove any accumulation of dirt, grit or gum adhering to the differential housing. Clean areas thoroughly with solvent and blow dry with compressed air. Parts having ground and polished surfaces such as gears, bearings, shafts and collars, should be cleaned in a suitable solvent. Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless absorbent paper towling or wiping rags, free of abrasive material. Parts to be immediately reassembled that have been cleaned, dried, and inspected should be coated with a light oil to prevent corrosion. If these cleaned parts are to be stored for any length of time, they should be treated with a good rust inhibitor and wrapped in a special wax coated paper or other material designed to prevent corrosion.

## 18-5. GENERAL INFORMATION

a. General. This section contains general information related to data contained in the previous paragraphs.

b. Torque Requirements. Torque requirements for mounting hardware used in the differential are given in table 18-2.

Table 18-2. Torque Requirements

| Part secured | Attaching part(s) | Torque (foot-pounds) |
|---|---|---|
| Differential case to frame | Bolts | 122 to 133 |
| Input yoke to propeller shaft | Bolts | 25 to 30 |
| Output yokes to propeller shaft | Bolts | 70 to 80 |
| Shock absorber to lower bracket | Bolt | 212 to 234 |
| Input yoke to bevel-gear-and-pinion | Nut | 500 to 600 |

c. Lubrication. Lubrication of the differential is divided into three catagories, as follows:

(1) Lubricant Replacement After Initial Run-In. After an initial run-in, the differential lubricant should be replaced. This should be accomplished at a convenient time before 3,000 miles are accumulated. Completely drain original lubricant while the differential assembly is warm. Refill with multipurpose gear lubricant SAE 140. Drain by removing the magnetic drain plug from the base of the differential, with the fill plug also removed to provide better venting. Inspect magnetic plug for excessive magnetic particles, then clean the magnetic elements. Reinstall magnetic drain plug, then fill differential with approximately 2 gallons of new SAE 140 multipurpose lubricant up to the filler plug base; install filler plug. Jack-up both rear wheels and operate vehicle in high ("H") gear at approximately 25 to 30 mph for at least 5 minutes, to assure satisfactory lubrication of all parts of the differential assembly. The parking and service brakes must be off, to allow both wheels to rotate at approximately the same speed.

> ***Caution***
>
> Do not attempt to operate coach with only one wheel jacked up, as this could result in overheating the differential spider with resulting galling or shearing of the spider pins.

(2) Periodic Lubricant Check and Replenishment. At least every 1,000 miles, the lubricant level should be checked. If lubricant is not level with bottom of filler-plug hole, add, as required, to raise to prescribed level.

> ***Caution***
>
> Do not overfill. Too much lubricant in the differential will cause pressure to build-up and blow lubricant past the seals or clog the breather vents.

(3) Periodic Replacement of Lubricant. Replace the differential lubricant at 32,000 miles intervals, when the yearly mileage exceeds 60,000 miles. When yearly mileage is under 60,000 miles, change lubricant twice yearly, in the spring and fall. The lubricant serves more than one purpose: it not only lubricates, but it transports chemically-reactive additives, washes away minute wear particles, serves as a corrosion inhibiter, and also acts as a heat-transfer medium. Draining and refilling with a fresh supply assists in eliminating both magnetic and non-magnetic wear particles which are not trapped by the magnetic plug. Exposure to heat and heavy usage may also alter the desirable performance properties, which are assured again through a lubricant change.

**NOTE**

When the differential is working, it generates wear particles at a fairly steady rate. These wear particles are very fine but hard. The magnetic drain plug functions to trap these metal particles. If these hard particles are allowed to circulate in the lubricant, the bearings will wear at a faster rate than they would if the hard wear particles were removed as they are generated. The magnetic drain plug magnets will lose effectiveness as the collected material bridges the gap between the two magnetic poles. Change plugs before this occurs. It may be necessary to change plugs one or more times between complete lubrication changes. The removed plugs can be cleaned and reused.

d. Differential Road Test. This test requires one man to drive the coach while a mechanic evaluates coach noises. To make a road test of the differential under various operating conditions proceed as follows:

**NOTE**

When low noises are noticed, the differential is often suspected of malfunction; however, similar noises can originate from sources such as tires, road surfaces, wheel bearings, engine, transmission or muffler. A thorough check should be performed to localize troubles before replacing or disassembling the differential. Differential gears should be accepted as being acceptably quiet, unless a trained service representative detects an abnormal noise.

(1) Select a level hard-surfaced road to test for tire noise.

(2) Drive coach far enough to thoroughly warm lubricant in differential.

(3) Note engine speed at which noise occurs; then park coach. With transmission in neutral, run the engine to the speed at which the noise was most pronounced. This should indicate which noises orginated in the engine, and which ones are likely from the differential, drive train, and wheels.

(4) Perform road test in each of four driving conditions:

(a) Acceleration or heavy pull (uphill in second gear). An increase in noise indicates problems in drive train or differential.

(b) Under normal driving conditions while maintaining a constant speed, slighly press brake pedal. A decrease in noise indicates possible problems in wheel bearings.

(c) Keep the coach slowing gradually, with engine still pulling slightly. A lower noise level indicates loose-fitting drive-train shafts (propeller shafts).

(d) Coast under 30 mph with throttle in full up (not depressed) in high gear. If noise decreases, problem is likely in differential or rear axle.

e. Rear-End Noise Analysis. After it has been determined that noise originates in the differential unit, analyze as follows:

(1) Gear Noise. Gear Noise (sometimes referred to as 'whine') is audible from 20 to 65 mph and is usually divided into two groups:

(a) Gear Noise During Power Pull. If the noise is deep in pitch and increases as coach speed increases, the gear teeth could be scored. This condition may be caused by loss of lubricant, use of incorrect lubricant, or improper gear mesh.

(b) Gear Noise While Coasting Under 30 mph. If noise is deep and irregular, scored teeth could again be the problem, however, this scoring usually results from excessive play on the pinion bearing or an incorrect adjustment.

**NOTE**

Other differential operating ranges where gear noise becomes more prominent are 30 to 40 mph; and 50 to 60 mph.

(2) Mechanical Impacts (Short Duration Knocks). Excessive noise (klunk) caused by gear impact during acceleration and deceleration can be caused by a worn differential pinion shaft, excessive clearance between output shaft and side gear splines, worn pinion, worn side gear teeth, and excessive drive pinion and drive gear backlash. When differential unit is being evaluated for excessive backlash, be sure to eliminate other problems associated with backlash, such as: engine tune-up (engine must be properly tuned); worn universal joints or flanges loose on shaft; or excessive play in transmission gears.

(3) Drive-Line Squeals and Squeaks. Squeals and squeaks are audible only at low speeds, and seldom over 20 mph. A continuous squeal is from the input pinion shaft oil seal.

**NOTE**

Seal squeaks frequently correct themselves; a constantly squealing seal should be replaced.

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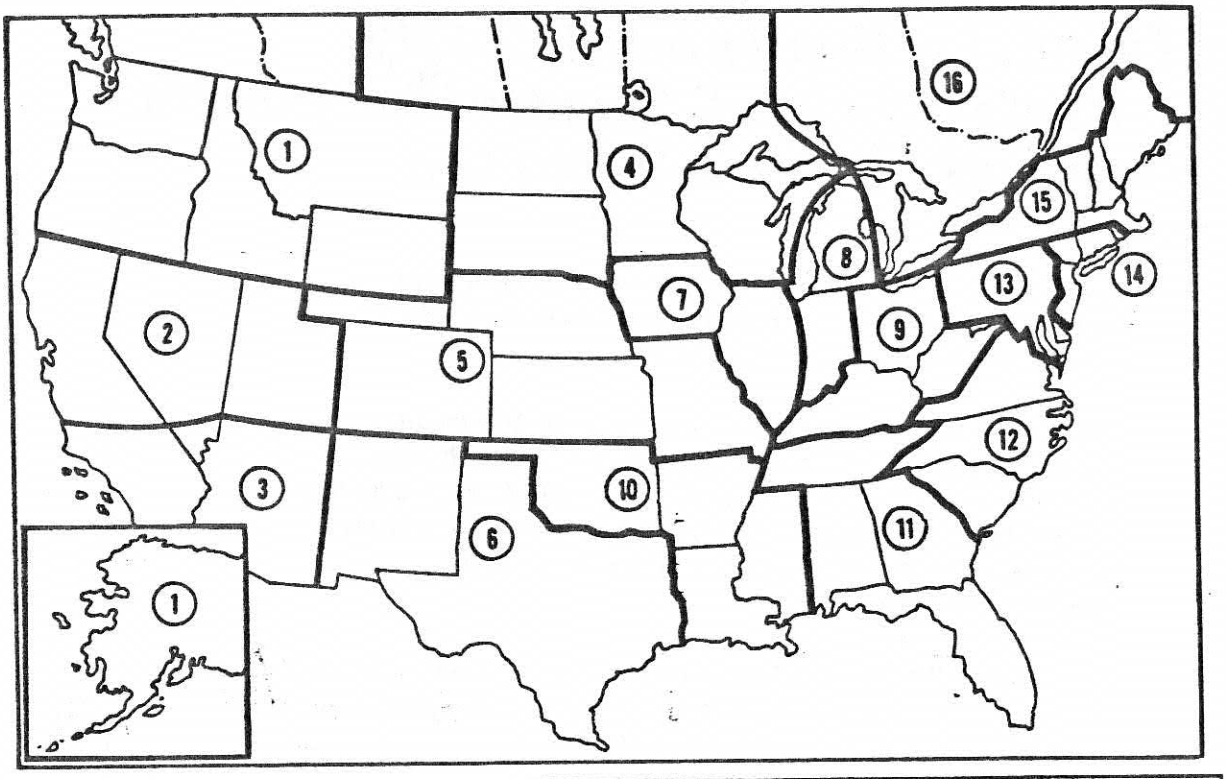


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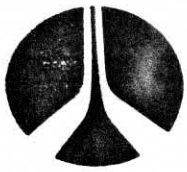

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