Chapter 13
Drive Axle and Differential Diagnosis and Service

Learning Objectives (1 of 2)

1.1 Prepare to take the ASE certification test for content area “E” (Rear-Wheel-Drive Axle Diagnosis and Repair).
1.2 Perform the maintenance needed to keep a drive axle operating properly.
1.3 Describe the steps involved in drive axle service.
1.4 Discuss drive axle lubrication.
1.5 Discuss drive axle diagnosis.

Learning Objectives (2 of 2)

1.6 Discuss the procedures for in-the-shop inspections.
1.7 Explain the on-vehicle service operations.
1.8 Explain the procedure for differential carrier service and differential assembly service.
1.9 Explain pinion depth shim selection and drive pinion bearing preload adjustment.
1.10 Explain the steps to adjust backlash and carrier bearing preload.
Drive Axle Service (1 of 2)

- The cause of improper drive axle operation is determined using several diagnostic steps.
  - Verify customer complaint
  - Identify the vehicle, drive axle, and gear ratio
  - Check vehicle history and TSBs
  - Hoist the vehicle and remove wheels
  - Disassembly and inspection

Drive Axle Service (2 of 2)

- Test for proper backlash and operation of limited slip unit
- Replace components as needed
- Test drive vehicle

- Some drive axle problems can be repaired on-vehicle.
- Gear tooth count
- Counting revolutions

Figure 13–2 The service parts identification sticker includes the codes for major components parts and includes the drive axle ratio and other information needed by the parts department to get the correct parts
Drive Axle Lubrication

- Drive axles must have clean gear oil at the proper level and of the proper type.
- Viscosity of gear oil
- API gear oil grade
- Checking drive axle gear oil level

Figure 13–4 In most axles the gear oil level is at the bottom of the filler opening. When the axle operates, the ring gear will produce a dynamic oil flow to lubricate all the parts.

Drive Axle Diagnosis (1 of 2)

- Road test
- Noise diagnosis
  - Gear noise
  - Bearing noise
  - Clunk
  - Chuckle
  - Chatter on corners
Drive Axle Diagnosis (2 of 2)

• Major internal drive axle problems usually require that the assembly be removed from the vehicle.
• Drive axle disassembly and reassembly procedures vary between makes and models.

A summary chart showing the probable causes of various drive axle-related noise concerns.

<table>
<thead>
<tr>
<th>NOISE CAUSE</th>
<th>POSSIBLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chatter</td>
<td>Limited slip clutches incorrect backlash or pinion bearings, or runout issues</td>
</tr>
<tr>
<td>Clunk</td>
<td>Limited slip differntials incorrect backlash or pinion bearings, or runout issues</td>
</tr>
<tr>
<td>Growl</td>
<td>Incorrect driveline angles Tires</td>
</tr>
<tr>
<td>Howl</td>
<td>Incorrect driveline angles Tires</td>
</tr>
<tr>
<td>Noise becomes louder</td>
<td>Incorrect driveline angles Tires</td>
</tr>
<tr>
<td>Noise during cornering</td>
<td>Incorrect driveline angles Tires</td>
</tr>
<tr>
<td>Noise under all driving conditions</td>
<td>Incorrect driveline angles Tires</td>
</tr>
<tr>
<td>Noise while driving</td>
<td>Incorrect driveline angles Tires</td>
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</tbody>
</table>

In-The-Shop Inspections

• Checking for...
  – Internal backlash
  – Axle shaft endplay
  – Axle flange runout
  – Leaks
  – Limited slip differential
On-Vehicle Service Operations

- Items that can be serviced include...
  - Wheel stud replacement
  - Axle removal
  - C-Lock axle seal replacement
  - Retainer axle bearing and seal removal and replacement

- The differential pinion shaft must be removed to allow the C-lock and axle to be removed.
- A drive axle can be checked for excessive play in the differential by blocking one drive wheel and the driveshaft.
Brake drum over the bearing as a shatter shield. **CAUTION:** the bearing completely to contain the bearing if it explodes. The pressing procedure. Most axle bearing removal tools enclose avoid serious injuries from possible bearing explosion during should be observed when performing this procedure to and special adapters to remove and install. Extreme caution bearing is press fit on the axle and requires a hydraulic press housing with a slide hammer and adapter.

**FIGURE 13–16** The retainer nuts/bolts are removed before sliding the bearing-retained axle from the housing.

**Pinion Shaft Seal Replacement (1 of 2)**

- Disconnect the driveshaft from the companion flange, and support the driveshaft so it does not hang from the front U-joint.
- Measure the torque required to rotate the pinion shaft (pinion and carrier bearing preload) using an inch-pound torque wrench, and record this measurement.
- Place index marks on the end of the pinion shaft, pinion nut, and the companion flange so that the flange can be installed back on the same spline.

**Pinion Shaft Seal Replacement (2 of 2)**

- Remove the drive pinion nut, washer, and companion flange.
- Remove the pinion seal.
- Check the bearing pocket for damage and apply gear oil.
- Replace the companion flange and install a new pinion nut with a washer and tighten the nut until the parts align.
- Replace the driveshaft.
A leaky drive pinion seal is repaired by first measuring the axle preload. After removing the wheels and eliminating any brake drag, use an inch-pound torque wrench to measure the pinion bearing preload. It should be between 17 and 22 inch-pounds or slightly lower in most applications.

1. Mark the pinion flange, pinion nut, and the pinion shaft before removing the pinion nut.
2. Remove the drive pinion nut, washer, and companion flange. SEE FIGURE 13–23.
3. Remove the pinion seal. SEE FIGURE 13–24.
4. Check the bearing pocket for damage. Then, apply a thin film of gear oil to the lip of the seal and the sealing surface of the flange. SEE FIGURE 13–25.
5. Replace the companion flange and install a new pinion nut with a washer and tighten the nut until the parts align as per the marks that were made in step 3. Check that the bearing preload is slightly greater than that recorded in step 2. The pinion nut should be very tight.
6. Remove the driveshaft.

Differential Carrier Service (1 of 2)

- Differential carrier service…
  - An inspection of the gears and bearings before teardown
  - A check for ring gear runout
  - Removal and replacement of the differential and ring gear
  - Removal and replacement of the pinion gear
  - Inspection and repair of the differential

Differential Carrier Service (2 of 2)

- Assembly adjustments for pinion depth, pinion bearing preload, backlash, and carrier bearing preload.
- Removal carrier removal
- Integral carrier removal
- Inspection and cleaning
changing direction, low to reverse, or reverse to low.

The amount of lash is shown by the dial indicator to 0.009 inch (0 to 23 mm).

NOTE:

Other differentials do not use thrust washers, so the only way to reduce the clearance is to replace the worn differential gears and their thrust washers.

The amount of backlash in the differential gear set is engaged.

The pinion gears and thrust washers and the axle side gears can cause a clunk as the lash is taken up when either the manual transmission clutch or automatic transmission pressure is released.

The pinion shaft lock pin must be removed and the pinion gears are held in place by the companion pinion gears.

The pinion gears and thrust washers and the axle side gears should be smooth and have a polished sheen. Common damage includes chipped or nicked teeth.

Common damage to the ring gear includes ring gear wear, which appears as a rough, scored tooth surface, and ring gear runout, which is measured using a dial indicator.

When installing the ring gear, heating the gear is required to seat it properly onto the case.

When installing side gears, the shims have threaded holes and are furnished with new bolts. Many manufacturers recommend installing the bolts to the correct torque and in an alternating pattern, back and forth across the gear. Replacement ring gears have threaded holes and are furnished with new bolts.

When removing the ring gear, take care not to damage the carrier of the ring gear. When removing the ring gear, there is evidence of damage to the ring gear. Runout is usually measured at 90° to the gear surface.

To check ring gear runout, perform the following steps:

1. Mount a dial indicator with the stylus on the back of the ring gear at 90° to the gear surface.
2. Rotate the ring gear and observe the indicator needle.
3. Look for the "L" mark on the shims and bearing cups from each side.
4. As the carrier is removed from the housing, tag or mark the shims and bearing cups from each side.
5. Slide the pinion shaft out of the case and check it for excessive clearance in the differential gear set.
6. Inspect the gears, thrust washers, and case surfaces for obvious damage.
7. The pinion and side gears can be rolled to the case windows and removed; then the side gears can be lifted out of the case.

Ring gear wear appears as a rough, scored tooth surface. Common damage to the ring gear includes ring gear wear and ring gear runout.

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Differential Assembly service...

- Inspection
- Ring gear runout
- Ring gear replacement
- Pinion gear removal
- Pinion bearings
- Side bearings
- Differential case clearance checks

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Drive Pinion Shaft

- Drive pinion depth
- Determining pinion depth shim selection
  - + or − markings on the pinion gear
  - Gauge block and fixtures
  - Contact patterns
- Pinion bearings
- Drive pinion bearing preload adjustment
  - Collapsible spacer
  - Solid spacer

FIGURE 13–38 Using an inch-pound torque wrench to check the rotating torque of the drive pinion. This procedure is very important if the axle uses a collapsible spacer. The drive pinion nut should be gradually tightened and the rotating torque checked to prevent overtightening the nut. If the rotating torque is higher than specifications, the collapsible spacer will require replacement and the installation procedure must be repeated.

Carrier Assembly and Setup (1 of 2)

- Installing the ring gear
- Installing the case into the housing
- Gear marking compound
- Backlash and carrier side bearing preload adjustments are made as the ring gear and differential are installed into the carrier.
- Backlash is adjusted by moving the ring gear toward the pinion gear to reduce backlash and away from the pinion to increase backlash.
Carrier Assembly and Setup (2 of 2)

• Preload is increased by…
  – Moving one or both of the carrier bearing cups toward each other
  – And it is reduced by moving them away from each other
• Preload/backlash using shims

Figure 13–42 (a) Backlash is determined by mounting a dial indicator to the differential housing and placing the button of the gauge against a tooth of the ring gear.

Figure 13–42 (b) Backlash is the clearance between the drive pinion and the ring gear teeth
Limited Slip Differential Service

• Typical checks

• Procedure
  – Carefully remove the S-shaped preload spring by tapping it through the window.
  – Roll the differential pinions around the case windows, and remove them.
  – Remove the side gear and clutch packs as a group, and tag or mark them so that they can be reassembled on the same side of the differential.
  – Clean the parts.
  – Check clutch plates or cones.

Summary (1 of 2)

• Drive axles must have clean gear oil at the proper level and of the proper type.
• The cause of improper drive axle operation is determined using several diagnostic steps.
• Some drive axle problems can be repaired on-vehicle.

Summary (2 of 2)

• Major internal drive axle problems usually require that the assembly be removed from the vehicle.
• Drive axle disassembly and reassembly procedures vary between makes and models.