Differential Assembly: Testing and Inspection
Initial Inspection

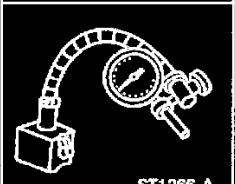
Special Tool(s)

 ST1622-A	Anglemaster II Driveline Inclinometer 164-R2402 or equivalent
 ST2044-A	Runout Gauge, Drive Pinion 205-323 (T92T-4851-D)

(Continued)

Special Tool(s) (Part 1)

Special Tool(s)

 ST2045-A	Gauge, Drive Pinion Flange (Pin) 1350 U-joint size 205-326 (T92T-4851-G)
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent

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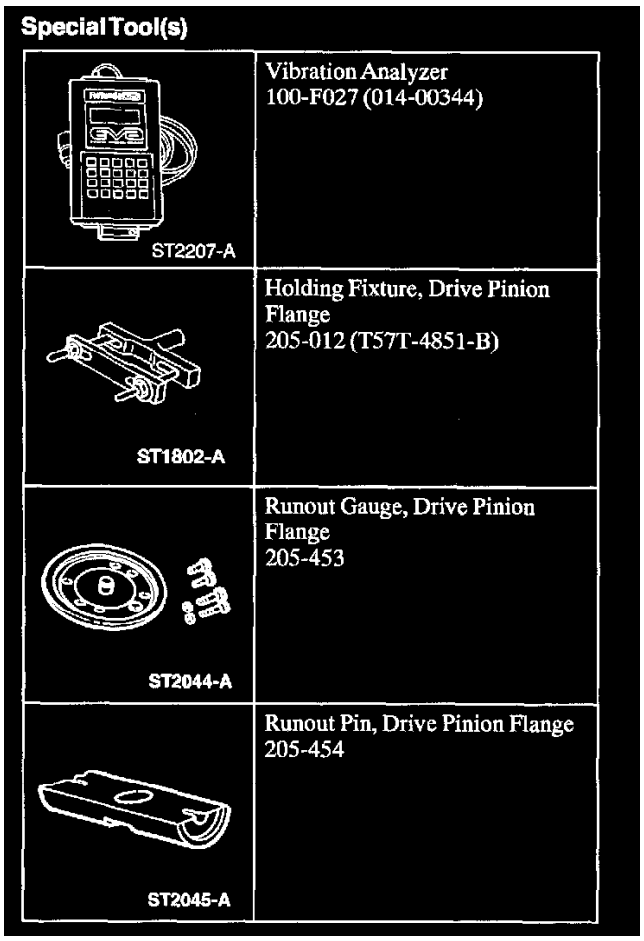
Special Tool(s) (Part 2)



Special Tool(s) (Part 3)

Driveline System

Inspection and Verification

Certain axle and driveline symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the axle before disassembling, adjusting or repairing the axle.

Certain driveshaft vibration symptoms are common to the Front Accessory Drive **(FEAD)**, the engine, transmission or tires. Be sure the cause is the driveshaft before repairing or installing a new driveshaft.

Certain symptoms may be caused by Traction-Lok(R) differentials. Check the vehicle certification label and axle identification tag to determine the type of differential.

Noise Acceptability

NOTE: A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions such as a newly paved blacktop road. Slight noise is not detrimental to the operation of the axle and is considered normal.

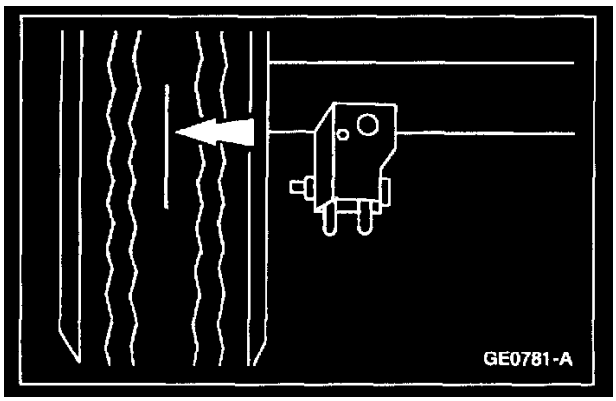
With the Ford Traction-Lok(R) differential, slight chatter noise on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the locking differential function.

Universal Joint (U-Joint) Inspection

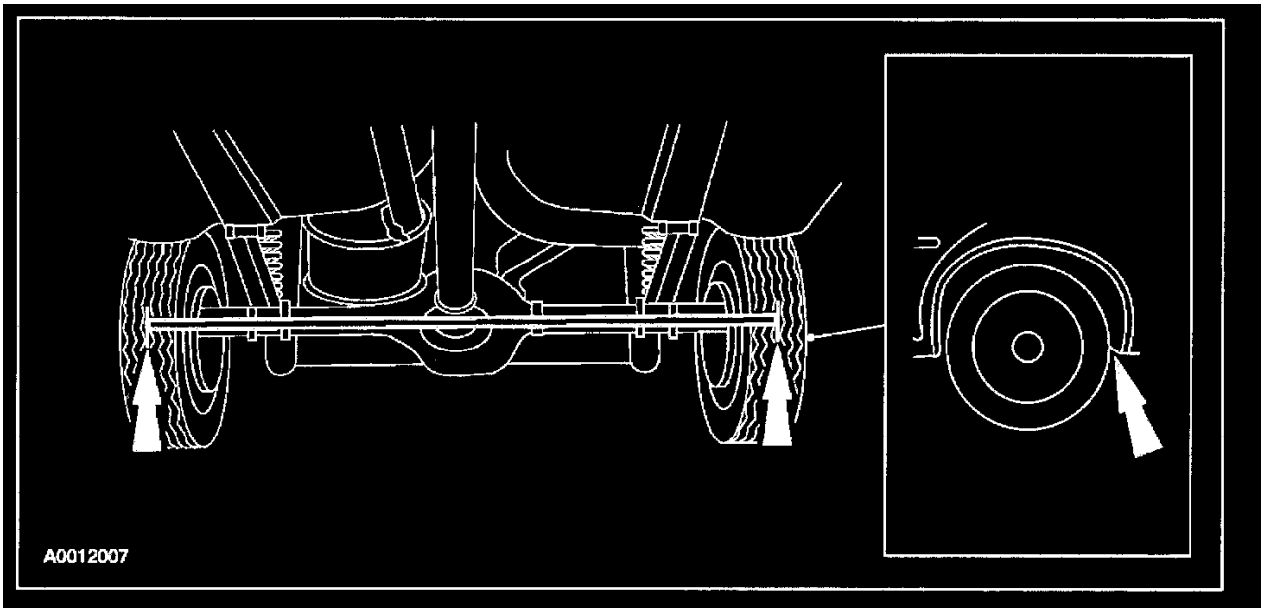
Place the vehicle on a frame hoist and rotate the driveshaft by hand. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating.

Inspection For Bent Rear Axle Housing

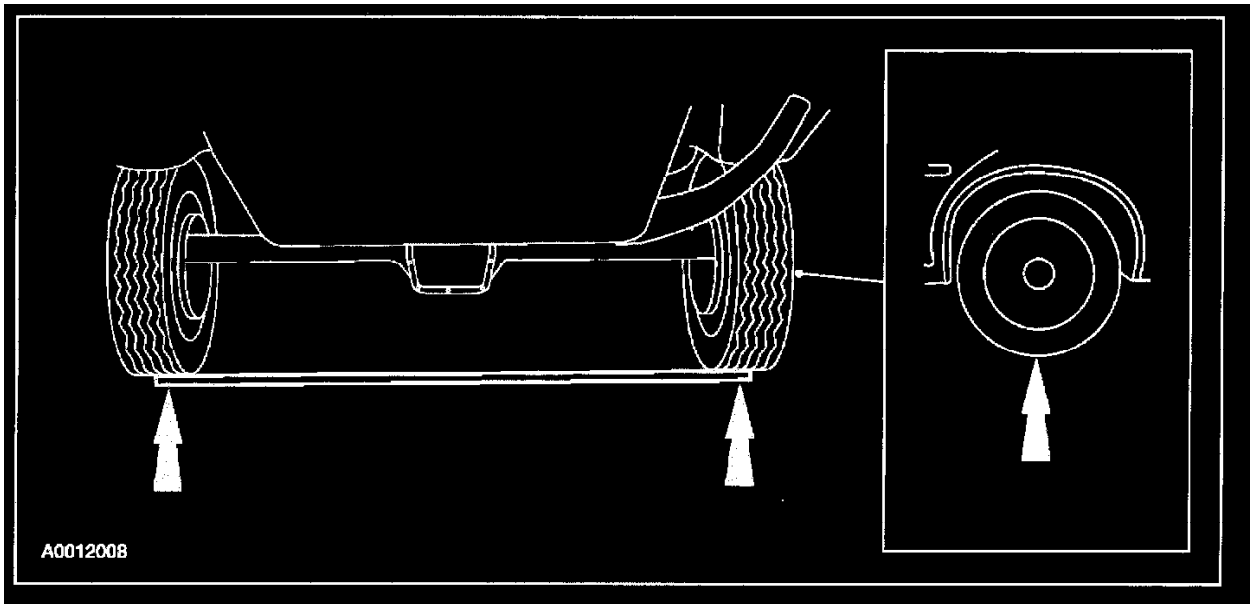
1. Raise and support the vehicle. Allow the rear axle to be freely suspended.



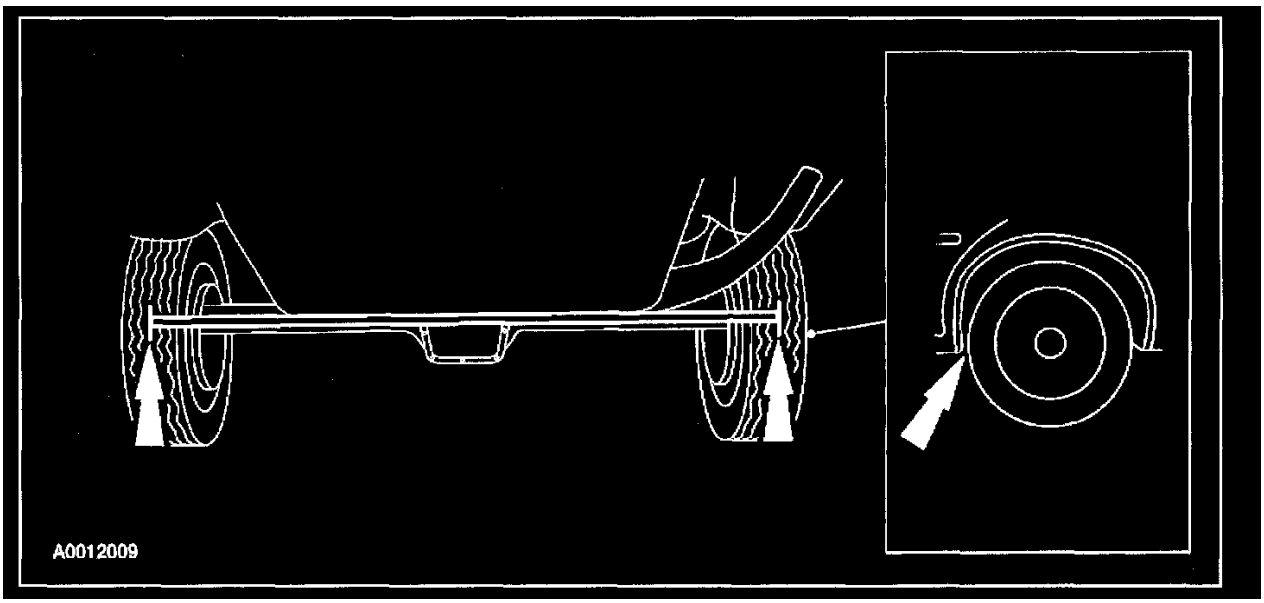
2. Use white chalk or paint to mark a vertical line on the center of each rear tire.



3. Adjust both wheels so that the markings face the front of the vehicle. With a tape measure, measure the distance between the marks and record this reading (front reading).



4. Rotate the rear wheels so the markings are directly underneath the vehicle. Measure the distance between the marks and record this reading (bottom reading).



5. Rotate the rear wheels so the markings face the rear of the vehicle. Measure and record the distance between the marks (rear reading).
6. Compare the front and the rear readings (Steps 3 and 5) to find the toe-in or toe-out condition.
   - Toe-in occurs when the front measurement is less than the rear measurement.
   - Toe-out occurs when the rear measurement is less than the front measurement.
7. To determine camber, find the average of the front and the rear measurements (Steps 3 and 5). Subtract the bottom reading (Step 4) from this number.
8. Positive (+) camber is when the bottom reading is less than the average of the front and rear readings. Negative (-) camber is when the bottom reading is greater than the average of the front and rear readings.
9. The results of the calculations in Steps 6 and 7 must conform to the following specifications:
   Toe-in: ..... **0.0-1/16 inch**.
   Toe-out: ..... **0.0 - 3/16 inch**.
   Camber: ..... **0.0 +/- 5/32 inch**.

   If the differential housing does not meet these specifications, install a new differential housing.

Analysis of Leakage

Clean up the leaking area enough to identify the exact source. An axle leak can be caused by the following:

- Axle lubricant level is too high.
- Worn or damaged axle shaft seals or differential seals.
- Differential housing is cracked.
- Flange yoke seal is worn or damaged.
- Pinion flange is scored or damaged.
- Axle cover is not sealed.
- Vent is plugged.

Repair the axle as necessary. Make sure the axle lubricant is at the correct level.

Axle Vent

NOTE: If a plugged vent cannot be cleared, install a new vent.

A plugged vent or vent hose will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent and the vent hose. Remove the hose from the vent nipple and clear the hose of any foreign material. While the hose is removed, pass a length of mechanics wire or a small diameter Allen wrench in and out of the vent to clean it. Connect the hose when done.

Flange Yoke Seal

Leaks at the axle drive pinion seal originate for the following reasons:

- Seal was installed incorrectly.
- Poor quality seal journal surface.

Any damage to the seal bore (dings, dents, gouges, or other imperfections) will distort the seal casing and allow leakage past the outer edge of the axle drive pinion seal.

The rubber lips can occasionally become hard and crack at the oil lip contact point. The contact point on the pinion flange may blacken. Marks, nicks, gouges, or rough surface texture on the seal journal of the pinion flange will also cause leaks.

Install a new pinion flange if any of these conditions exist.

When a seal leak occurs, install a new seal and check the vent and the vent hose to verify that they are clean and free of foreign material.

Wheel Hub Oil Seals

Wheel hub oil seals are susceptible to the same kinds of damage as axle drive pinion seals if installed incorrectly. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. Spindle journal surface must be free of nicks, gouges, and rough surface texture.

Analysis of Vibration

WARNING: A vehicle equipped with a Ford Traction-Lok(R) differential or a Tractech(R) Truetrac(R) differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Verify that both rear wheels are off the floor.

Few vibration conditions are caused by the front or rear axle. On a vibration concern, follow the diagnosis procedure at Vehicle / Testing and Inspection unless there is a good reason to suspect the axle.

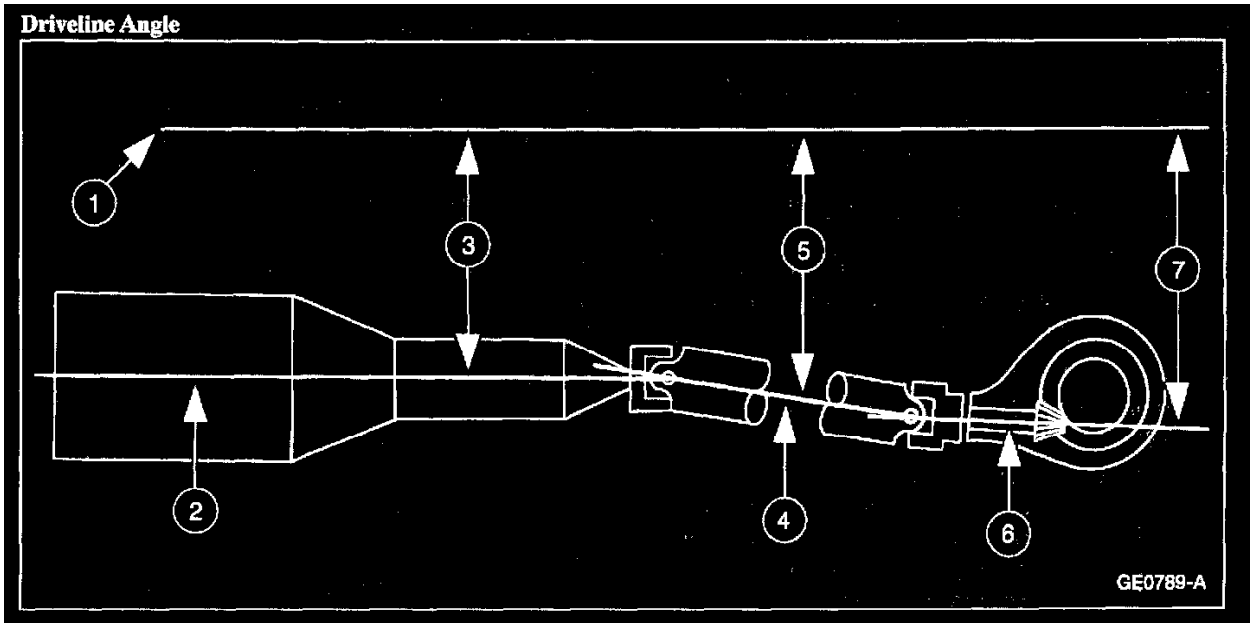
Tires

WARNING: Do not balance the wheels and tires while they are mounted on the vehicle. Possible tire disintegration/differential failure could result, causing personal injury/extensive component damage. Use an off-vehicle wheel and tire balancer only.

Most vibration in the rear end is caused by tires or driveline angle.

Vibration is a concern with modern, high-mileage tires if they are not "true" both radially and laterally. They are more susceptible to vibration around the limits of radial and lateral runout of the tire and wheel assembly. They also require more accurate balancing. Wheel and tire runout checks, truing and balancing are normally done before an axle inspection.

Driveline Angle



Driveline Angle (Part 1)

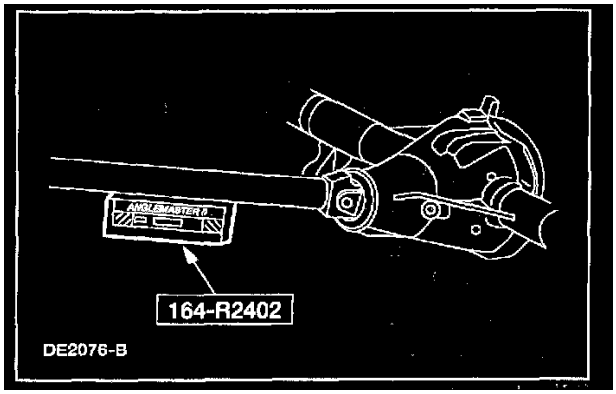
Item	Description
1	Bottom of the frame (0° reference)
2	Engine crankshaft centerline
3	Engine angle (to frame reference)
4	Driveshaft centerline
5	Driveshaft angle (to frame reference)
6	Rear axle pinion centerline
7	Axle pinion angle (to frame reference)

Driveline Angle (Part 2)

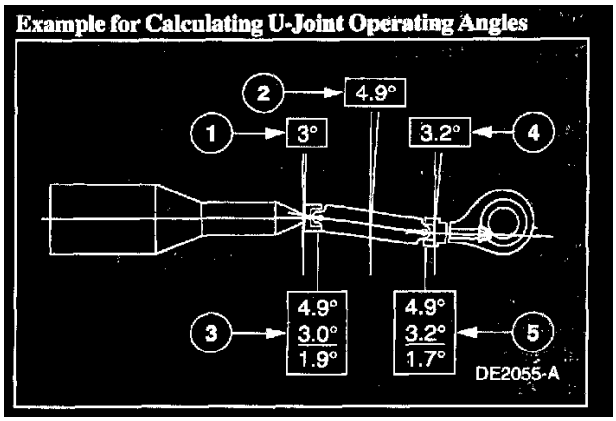
Driveline angularity is the angular relationship between the engine crankshaft, the driveshaft, and the rear axle pinion. Factors determining driveline angularity include ride height, rear spring, and engine mounts.

Calculate the driveline operating angles as follows.

1. Preliminary setup procedures.
    1. Inspect the U-joints for correct operation.
    2. Park the vehicle on a level surface such as a drive-on hoist, or back onto a front end alignment rack.
    3. Verify the curb position ride height is within specifications with the vehicle unloaded, and all of the tires inflated to their normal operating pressures.
    4. Rotate the transmission output yoke until vertical. This will simplify taking measurements.
    5. Calibrate the special tool by placing tool on clean, flat level section of the frame rail and press the ALT-ZERO button.



2. Using the special tool, measure the slope of the components. Record the measurements and the direction of the component's slope.



Example For Calculating U-Joing Operating Angles (Part 1)

Item	Description
1	Output yoke slope
2	Driveshaft slope
3	The driveshaft slope minus the output yoke slope equals the transmission/driveshaft operating angle
4	Pinion flange slope
5	The driveshaft slope minus the pinion flange slope equals the driveshaft/axle operating angle

Example For Calculating U-Joing Operating Angles (Part 2)

3. Calculate the difference in the slope of the components to determine the U-joint operating angle.

- When two connected components slope in the same direction, subtract the smaller number from the largest to find the U-joint operating angle. When two connected components slope in the opposite direction, add the measurements to find the U-joint operating angle.
- The U-joint operating angle is the angle formed by two yokes connected by a cross and bearing kit. Ideally, the operating angles on each end of

the driveshaft must:
- be **equal or within one degree** of each other.
- have a **three degree maximum** operating angle.
- have **at least one-half of one degree** continuous operating angle.

If the tires and driveline angle are not the cause, carry out the NVH tests to determine whether the concern is caused by a condition in the axle.

Drive Pinion Stem and Pinion Flange

Check the pinion flange runout when all other checks have failed to show the cause of vibration.

Coupling Shaft/Center Bearing Alignment

Vehicle noise and vibration can be caused by a dislodged or failed driveshaft center bearing support rubber insulator, a contaminated driveshaft center bearing support or excessive compression of the rubber insulator.

Bearing Shimming

Drive-away shudder is the predominant symptom associated with driveline angles condition on vehicles with two-piece driveshafts. Drive-away shudder can usually be corrected by shimming down the driveshaft center bearing bracket.

If the drive-away shudder cannot be corrected by shimming down the driveshaft center bearing bracket, check the driveline angles as described.

Axle Noise

NOTE: Before disassembling the axle to diagnose and correct gear noise, eliminate the tires, exhaust, trim items, roof racks, axle shafts and wheel bearings as possible causes.

The noises described as follows usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are the type of noise heard during the road test.

Gear Howl and Whine

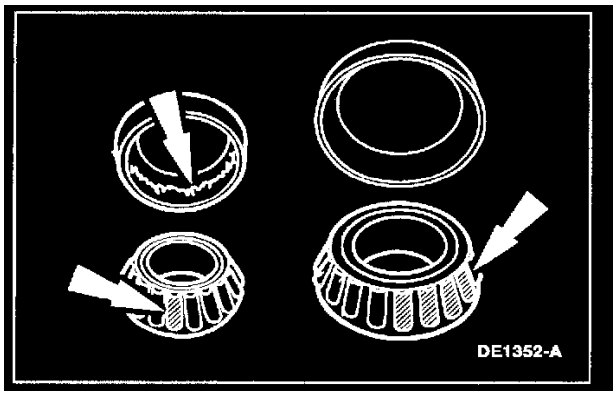
Howling or whining of the differential ring gear and pinion is due to an incorrect gear pattern, gear damage or incorrect bearing preload.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by worn/damaged pinion bearings, which are operating at driveshaft speed. Bearing noise occurs at all driving speeds. This distinguishes it from gear whine which usually comes and goes as speed changes.

As noted, pinion bearings make a high-pitched, whistling noise, usually at all speeds. If, however, there is only one pinion bearing that is worn/damaged, the noise may vary in different driving phases. Do not install new pinion bearings unless bearings are scored or damaged or there is a specific pinion bearing noise. A worn/damaged bearing will normally be obvious at disassembly. Examine the large end of the rollers for wear. If the pinion bearings original blend radius has worn to a sharp edge, install a new pinion bearing.

NOTE: A low-pitched rumble normally associated with a worn/damaged wheel bearing can be caused by the exterior luggage rack or tires.



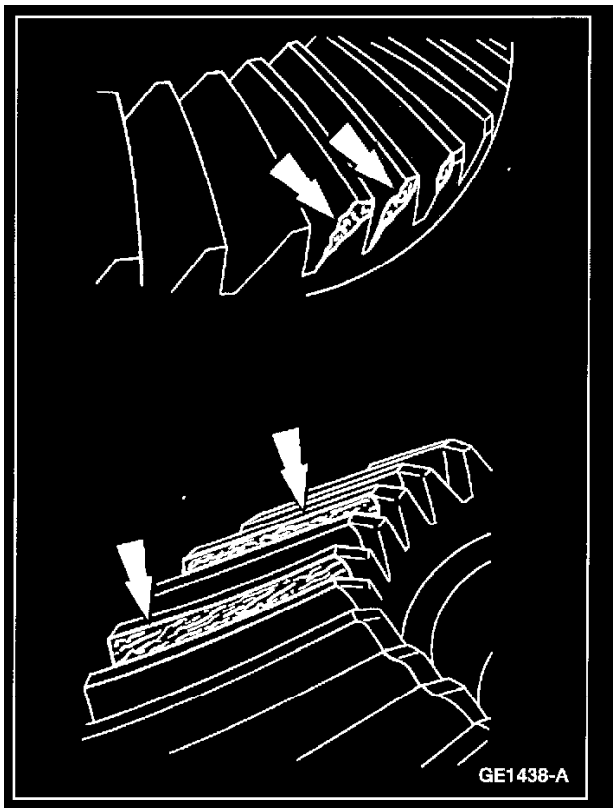
A wheel bearing noise can be mistaken for a pinion bearing noise. Check the wheel bearing for a spalled cup, and spalled/damaged rollers. Install a new wheel bearing and cup if any of these concerns are detected.

Chuckle

Chuckle that occurs on the coast driving phase is usually caused by excessive clearance between the differential gear hub and the differential case bore. Damage to a gear tooth on the coast side can cause a noise identical to a chuckle. A very small tooth nick or ridge on the edge of a tooth can cause the noise.

Clean the gear tooth nick or ridge with a small grinding wheel. If the damaged area is **larger than 3.2 mm (1/8 inch)**, install a new gearset.

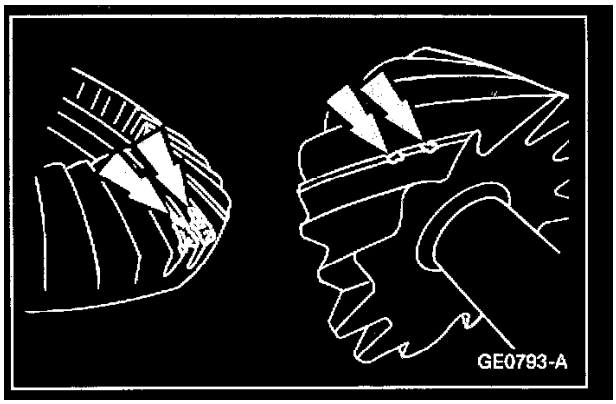
To check the differential ring gear and pinion, remove as much lubricant as possible from the gears with clean solvent. Wipe the gears dry or blow them dry with compressed air. Look for scored or damaged teeth. Also look for cracks or other damage.



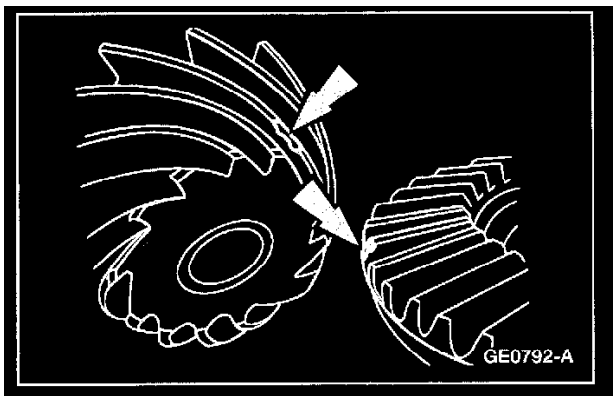
If either gear is scored or damaged badly, install a new differential ring gear and pinion.

If metal has broken loose, the differential housing must be cleaned to remove particles that will cause damage. At this time, any other damaged parts in the differential housing must also be discarded and new parts installed.

Knock



Knock, which can occur on all driving phases, has several causes including damaged teeth or gearset.



A gear tooth damaged on the drive side is a common cause of the knock. This can usually be corrected by grinding the damaged area.

Clunk

Clunk is a metallic noise heard when the automatic transmission is engaged in REVERSE or DRIVE. The noise may also occur when throttle is applied or released. It is caused by backlash somewhere in the driveline or loose suspension components; it is felt or heard in the axle. For additional information, refer to Total Backlash Check.

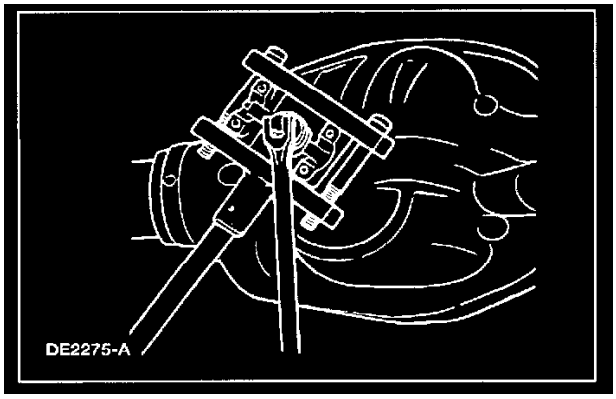
Additionally, clunk may be heard upon initial drive-away. This occurs as engine torque shifts vehicle weight, forcing changes in driveline angles, preventing the driveshaft slip-yoke from sliding on the output shaft. To correct this condition, lubricate the slip-yoke splines

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. This condition is usually caused by worn/damaged wheel bearing. The lower pitch is because the wheel bearing turns at only about one-third of the drive shaft speed. Wheel bearing noise also may be high-pitched, similar to gear noise, but will be evident in all four driving modes.

Total Backlash Check

1. Raise and support the vehicle.
2. Remove the driveshaft.
3. Install the special tool.



   - Clamp a rigid bar or pipe to the tool. Clamp the other end of the bar or pipe to the frame or a body member in order to prevent movement of the pinion flange.
4. Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will be used to measure total rear axle backlash.
5. Rotate the free wheel slowly, by hand, until the feeling of driving the rear axle is encountered. Place a mark on the side of the tire, **305 mm (12 inches)** from the center of the wheel, with a crayon or chalk.
6. While holding the crayon or chalk against the tire, rotate the wheel slowly in the opposite direction until the feeling of driving the rear axle is encountered again.
7. Measure the length of the crayon or chalk mark on the tire.
   - If the length of the mark is **25.4 mm (1 inch) or less**, the rear axle backlash is within allowable limits.
   - If the chalk mark is greater than **25.4 mm (1 inch)**, check for these conditions:
     - Elongation of the differential pinion shaft and holes in the differential case.
     - Missing differential pinion thrust washer or differential side gear thrust washer.
     - Galling of the differential pinion shaft and bore.
     - Excessive ring gear and pinion backlash. Follow the procedure for the type of rear axle to check backlash.